

Schultz, T. Paul

Working Paper

Testing the Neoclassical Model of Family Labor Supply and Fertility

Center Discussion Paper, No. 601

Provided in Cooperation with:

Yale University, Economic Growth Center (EGC)

Suggested Citation: Schultz, T. Paul (1990) : Testing the Neoclassical Model of Family Labor Supply and Fertility, Center Discussion Paper, No. 601, Yale University, Economic Growth Center, New Haven, CT

This Version is available at:

<https://hdl.handle.net/10419/160523>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

ECONOMIC GROWTH CENTER
YALE UNIVERSITY
Box 1987, Yale Station
New Haven, Connecticut 06520

CENTER DISCUSSION PAPER NO. 601

TESTING THE NEOCLASSICAL MODEL OF
FAMILY LABOR SUPPLY AND FERTILITY

T. Paul Schultz
Yale University

May 1990

Notes: The research underlying this paper is partly sponsored by the Women in Development Division, Population and Human Resources Department, The World Bank.

Center Discussion Papers are preliminary materials circulated to stimulate discussion and critical comments.

An earlier version of this paper was presented at a conference sponsored by The Rockefeller Foundation at the Economic Growth Center, Yale University, on "Bargaining Models of the Family" in April 1989, and is forthcoming in the Journal of Human Resources.

TESTING THE NEOCLASSICAL MODEL OF
FAMILY LABOR SUPPLY AND FERTILITY

Abstract

The McElroy-Horney Nash-bargaining model of family demand behavior relaxed the restriction that nonearned income of husband and wife has the identical effect on family labor supply and commodity demands. This restriction of the neoclassical model of family behavior is tested for the determination of husband and wife labor supply and fertility based on the 1981 Socioeconomic Survey of Thailand. The neoclassical restriction is rejected for female labor supply and fertility. Another unexplored limitation of family demand studies, due to the sample self selection of intact marriages, is empirically treated through alternative estimation strategies. In this case, a more sharply focused theory of marital behavior is needed to identify family demand models.

TESTING THE NEOCLASSICAL MODEL OF FAMILY LABOR SUPPLY AND FERTILITY *

I. Introduction

For several decades, the neoclassical model of individual consumer choice has guided empirical analysis of behavior within the family. In one form or another, the family is central in virtually all societies, coordinating not only consumption and production, but equally important, reproduction and child-rearing. This neoclassical framework helps to explain the increase in female labor supply to the market and the decrease in fertility in terms of the increase in women's market wage opportunities or the opportunity cost of women's time in nonmarket production (Layard and Mincer, 1985). Conversely, at least in poorer agricultural societies where unskilled child labor remains a valuable family resource, the neoclassical framework provides an interpretation for why child wage rates and adult male wage rates are both positively associated with fertility and negatively related to the time women allocate to market production (Rosenzweig and Evenson, 1977). To forecast how wages for men, women and children affect fertility and the allocation of a population's time to taxable forms of market production requires a model that encompasses production and consumption behavior of family members. This neoclassical model of family labor supply and fertility has thus become a common tool for evaluating many public finance issues involving welfare policies and labor markets.

But because the functions performed by the family are varied and in flux in many industrially advanced and low-income countries, the neoclassical framework that is often formulated in terms of the nuclear conjugal family may not always prove suitable. Cross-cultural comparisons of family behavior, including fertility, investment in children and time allocation, span many functions of

* A draft of this paper was presented at meetings of the Population Association of America in Baltimore, MD, on March 30, 1989 and at workshops at Yale, Brown and VPI. The research underlying this paper has been partly supported by the Women in Development Division, Population and Human Resource Division of The World Bank. I appreciate in particular the comments of J. Berhman, B. Herz, S. Khandkar, R. Moffitt, J. Strauss, D. Thomas, and the computational assistance of P. McGuire. Permission to study these Thai surveys was generously granted by Dr. Duangchai Poomchusri of the Thailand National Statistical Office.

the family that encompass different degrees of coordination along varied lines of kinship and responsibility. Flexible models of family decisionmaking are thus needed that can discriminate between alternative definitions of the family, some of which will be more extensive than the nuclear family or coresidential household. A variety of resource pooling arrangements may also coexist and they need not be coincident across different family functions, such as production, consumption, investments in child health, schooling and migration (e.g. Pollak, 1985; Lundberg, 1988; Rosenzweig and Stark, 1989; Schultz, 1989).

This paper reports empirical evidence drawn from a survey of Thailand. In distinction to the neoclassical model of the family that implies families act according to a common set of preferences and thus have no reason not to pool the resource of their individual members, the Thai evidence suggests that family members exercise a self-interest in family resource allocations. These findings are not, therefore consistent with the standard neoclassical model of integrated family utility maximization that has guided much recent research on family behavior. The Nash-bargained model of family decision-making (McElroy and Horney, 1981) is an alternative framework to guide research on family and individual behavior that can accommodate these empirical results. Although it embodies a specific bargaining rule associated with cooperative game-theoretic conventions, it can also be interpreted as a generalization of the neoclassical family demand model. It directs particular attention to the resources the individual would control, if the marriage had not formed in the past, or if it were to dissolve in the future. These "partible" resources are assumed to strengthen the partner's bargaining power by increasing her or his opportunity cost of being married and thus to shift outward their "threat point". The natural counterpart to partible family resources in the neoclassical demand model is nonearned income.^{1/}

The distribution of earned income in the family is a choice variable, and thus it is not legitimately treated as an exogenous determinant of household behavior or demands. Not only is the choice of labor supply a determinant of current market earnings of family members, but the shadow value of each member's time (or wage if a market worker) can also affect the composition of household demands for market goods and how they are combined to produce final consumption commodities in the neoclassical household production framework (Becker, 1965). For example, if more educated (or higher wage) women are observed to invest more in child health inputs and produce healthier children,

it cannot be concluded that more educated women have stronger preferences for healthy children than do less educated women. The more educated (higher wage) women could have a comparative advantage in producing child health, and only because they can produce child health at lower cost do they demand more health inputs and produce a higher level of child health.

The challenge to the neoclassical model of household demand arises if nonearned income of different family members is observed to affect differently the household's allocation of resources. If nonearned income (or ownership of the underlying physical asset) influences family demand behavior differently depending on who in the family controls the income (or owns the asset), then the preferences for that demand must differ across individuals and such families must not completely pool nonearned income. This test of the neoclassical model of the family is qualified by two further working assumptions: differential individual sources of nonearned income must be indistinguishable in terms of what they can purchase in the market and produce in the household, and these sources of nonearned income must be exogenous or not affected by other household choices.

This approach to testing the neoclassical model of the family should be more robust to misspecification of functional forms than is the alternative that tests the equality of symmetric income-compensated cross-price effects. In the case of the nuclear family, the practice has been to test for the equality of cross-compensated wage effects on the labor supplies of husband and wife (Heckman, 1971; Ashenfelter and Heckman, 1974; Kniesner, 1976; Killingsworth, 1983). The effect on husband's labor supply of an income compensated change in the wife's wage tends to be less negative than the effect on wife's labor supply of a compensated change in the husband's wage. The testing of such symmetry restrictions becomes more complicated, of course, if the income effects of husband- and wife-specific nonearned income differ.

This paper first reviews the standard individual and family models of economic and demographic behavior and the bargaining models derived from the two-person cooperative game theory of Nash (1951, 1953). It should be noted that this bargaining approach does not prescribe why one family member prefers a certain allocative outcome whereas another family member prefers another. It does allow, however, for individual preferences to differ and for it to influence observed family behavior. Some of the empirical behavioral regularities examined below can be interpreted, however, by appeal to intuition.

Many aspects of household economic and demographic behavior are currently studied to inform public policy and guide resource allocations. Forecasts of household behavior may be improved by conditioning that behavior on individually disaggregated household resources (as implied by the bargaining model) or by the inclusion of the economic resources of "relatives" in other households (that are omitted in regular household-based surveys). In this manner, the bargaining approach to family decision-making could be compared to the neoclassical framework over time as a forecasting model (e.g., Heckman and Walker, 1989).

II. Models of Marriage and Family Behavior

If both partners to a union derive some part of the net gains from marriage, in addition to the opportunity costs given up by each from foregoing alternative arrangements, the union has at least an economic basis for continuation (Becker, 1974). Market forces or personal endowments of family members might affect the division of family output between partners (Becker, 1981:42). The allocation of consumption among members in a family is, however, rarely studied, probably because it is hard to measure the consumption of particular family members. Moreover, neoclassical demand models of the family do not formally prescribe how distributional patterns accommodate these market forces and personal endowments.

The neoclassical model of the family assumes that the family behaves as if it were trying to allocate the time of its members and other endowments to satisfy a common set of "family" preferences (Becker, 1965, 1981). This process involves pooling resources and agreeing on the form of the family's preferences. The simplest way this might occur is if couples share the same preferences. More realistic is the assumption that a dominant family decision-maker allocates gains from marriage to reward the other spouse with more than she or he expects to receive as a single person or in an alternative union. Incentives are also needed to encourage the non-dominant members of the marriage to allocate their time along with other family resources to accomplish the production solution chosen by the dominant member (Becker, 1981). Although more plausible, the second set of assumptions still does not imply any testable predictions about intra-family allocations of resources.

If the family demand model is modified to accommodate the distinct preferences of family members, these conflicts of interest must be resolved by a specified bargaining mechanism. Because many game theoretic models of this form do not imply a unique equilibrium, they are rarely tested with empirical evidence (Harsanyi and Selten, 1987). However, the cooperative Nash-bargained framework, as stated by McElroy and Horney (1981), nests the neoclassical family demand system within it as a special case. Statistical tests can be implemented, therefore, to determine whether data on observable family behavior satisfy the added restrictions implied by the neoclassical model of the family (e.g. Jones, 1986; Carlin, 1990).

These tests are simple and intuitive. As stated in the introduction, they imply that exogenous nonearned income of the husband and wife may influence family consumption differently in a bargaining model, whereas within the neoclassical model of the family, these spouse-specific sources of nonearned income must exert the same effects on family allocative behavior. If this empirical test rejects the neoclassical family demand model, more complex tests of the demand system can be implemented (McElroy and Horney, 1981, 1988), but they may be sensitive to the choice of functional form as in the conventional models of demand (Deaton and Muellbauer, 1980).

Other models of bargaining may be developed which are less restrictive than the cooperative Nash-bargained solution. They may permit partners to know different amounts of information, choose among a wider range of Pareto allocations, and engage in strategic planning (Chiappori, 1988). However, the Nash-bargained allocative solution can also be reached through other, more complex negotiating procedures. For example, uncertainty and risk can be introduced by allowing partners to maximize their expected utility based on the subjective probability that their offer of a "distribution of marital gains" will be accepted, or alternatively, that they will receive their initial endowment as a single person. Under quite general conditions, a couple engaging in this sequential form of bargaining over offers of how to distribute marital gains will eventually arrive at the Nash-bargained solution, if one exists (Harsanyi and Selten, 1987). Even this simplest form of game-theoretic model of the family adds flexibility to the neoclassical framework by dealing more realistically with the distinct interests of family members and their potential retention of control over economic resources in marriage.

Consider for example the individual model of consumer choice and labor supply. The individual maximizes utility in a single period by purchase of X market goods and production at home of Z commodities,

$$U_i = U(X_i, Z_i), \quad (1)$$

subject to a full income budget constraint and technical opportunities to produce Z. Market prices, P, and individual wages, W_i , and nonearned income, V_i , then determine individual demand for X and Z. One form of Z could be called leisure, L_i , which is the mirror image of labor supply, H_i .

A linear approximation for the labor supply function for individuals can be written:

$$H_i = a_0 + a_1 W_i + a_2 P_i + a_3 V_i + e_i \quad (2)$$

where e is a random disturbance due to stochastic variation and also undoubtedly includes errors in measurement and functional form, and the a's are parameters to be estimated.

This approach is adapted to analyze labor supply behavior of wives (Mincer, 1962; Kosters, 1966; Smith, 1980) and then generalized to all family members (Heckman, 1971):

$$H_i = b_0 + b_1 W_i + b_2 W_j + b_3 P + b_4 \bar{V}_i + u_i \quad i, j = 1, 2 \quad (3)$$

where $i \neq j$ and only husband and wife couples are analyzed who both earn a wage (Ashenfelter and Heckman, 1974). Leisure of each working family member has been added as an argument to the unified family utility function, but family nonearned income is aggregated into $\bar{V} = V_i + V_j$. Although nonmarket time is more than leisure, since some of it may be used to produce Z for the benefit of other family members, it is common to assume that the hours of labor supplied to the labor force decreases with an increase in family nonearned income. Nonearned income is assumed to be unaffected by past or current time allocation choices or household demands in general. Nonmarket time is thus assumed to be a "normal good", just as leisure is expected to be. In sum, this neoclassical approach implies that nonearned income has the identical effect on household demands and labor supply regardless of the source of the nonearned income.

In contrast, in the Nash-bargained model (Manser and Brown, 1980; McElroy and Horney, 1981) it is assumed that partners cooperatively maximize W , a product of the differences each individual's utility from belonging to the family, U_i^f , and the individual's reservation utility sacrificed outside of the family or an alternative union, U_i^a :

$$W = [U_1^f(X, Z) - U_1^a(P, W_1, V_1)] * [U_j^f(X, Z) - U_j^a(P, W_j, V_j)]. \quad (4)$$

The utility in the alternative state represents a "threat point" that limits consumption allocations within marriage to those which benefit, and hence are acceptable to, both spouses. Increases in nonearned income of the husband or of the wife is expected to increase the "threat point" of that spouse and thereby increase that spouse's bargaining power. This could potentially change the distribution of consumption in the family.

Consequently, nonearned income is divided into those elements brought to the marriage or accumulated during the marriage through the individual's activities, the receipt of bequests or transfers, and by means of personal connections. A wife might reduce her market labor supply by a specific number of hours per week if she had inherited wealth or brought to her marriage a dowry that earned a given flow of nonearned income. Her labor supply response might be systematically different, plausibly less, if the same nonearned income accrued from her husband's inherited property.^{1/} Conversely, the payment of a bride price in many areas of SubSaharan Africa by the groom to the bride's parents may be associated with the bride increasing her supply of time to the labor force. The implicit assumption that a dowry is controlled by the bride after marriage or that a brideprice adds to her financial indebtedness may not accurately describe how these transfers at the time of marriage are viewed by the couple and their families, or how they cement the union or subjugate a partner.

However, nonearned income can come from many sources and its effect on labor supply or consumption patterns could differ. Unexpected bequests or gifts that increase the property of the individual should relax the budget constraint but not alter the prices facing the individual or be biased toward a particular pattern of consumption or behavior. Alternatively, property income can be accumulated by the savings of an individual out of past earnings. In this case, property income may be related to prior labor supply behavior. If

preferences for work and savings are persistent over time for individuals, current property income could become positively associated with labor supply behavior, because property income is endogenous or determined in part by the family.

Another source of nonearned income is private and public transfer. These transfers from outside the coresidential family may be viewed as consumption-smoothing, and may involve obligations to reciprocate in other time periods. Other items of nonearned income may appear to be more similar to a transfer than a return from property, such as insurance payments, scholarships, and grants. All of these sources of nonearned income may perform a variety of functions in a poor society where credit markets are imperfect, or transaction costs are substantial, or weather-induced variability in agricultural incomes are important. These varied forms of "transfer" nonearned income could respond to shocks in labor supply, caused by unemployment, illness, disability or even unwanted pregnancy and thus also be endogenous to family consumption behavior.

Between the two types of nonearned income, "property" income is more likely to be exogenous for younger persons, and if endogenous, to be positively correlated with labor supply. "Transfers", on the other hand, may be increased by depressed labor supply or unemployment, bad health, or family support problems. If transfer and property nonearned income exerted the same effects on family time allocation and consumption behavior, the case would be strengthened for treating them as an aggregate. If the behavioral effects of transfer and property nonearned income are identical, regardless of whether they are received by male and female members of the family, the pooling of family resources assumed in the neoclassical model of family decision-making would be confirmed.

III. Data and Empirical Model Specification

The analysis is based on the Socio Economic Survey of Thailand for 1980/81, a national stratified probability sample of households. The survey collects information on household expenditures, labor force activities, and income sources, and is used by the National Statistics Office to adjust periodically the weights for price indices. Income is reported by type for all adults, with about 20 percent of males and 16 percent of females over age 14 reporting some nonearned income in the last month (see Table A-1). The survey provides a sample of 8816 women and 7986 men between the ages of 25 and 54.

These age restrictions are designed to exclude most persons not working because they are investing in schooling or are retired.

The estimation strategy involves several steps. Alternative specifications are reported to assess the sensitivity of the findings. First, estimates of market wage rates are estimated for men and women, correcting for the selective sample of wage earners (Heckman, 1979). Second, the response of labor supply behavior to wife and husband transfer and property nonearned income is estimated, to test the equality restriction on the impacts of spouse-specific nonearned income implied by the neoclassical model of family labor supply (Horney and McElroy, 1988). Third, fertility is analyzed to test another dimension of the neoclassical model of the family. Finally, marriage is introduced as a further sample selection criterion and added as another interrelated decision process that might respond to sex-specific amounts of nonearned income. The inclusion of husband nonearned income and wage rate opportunities in the female labor supply and fertility equations requires that either the presence of the husband and their endowments are taken as exogenous, as is common in the empirical literature, or these husband endowment variables are treated as jointly determined and endogenous. Adopting the latter specification, the sample is restricted to those women with husbands, and a further Heckman-type sample selection correction regressor is added to the family labor supply and fertility models.

IV. Labor Supply Tests of Family Decisionmaking

Hourly wage rate functions are estimated for men and women separately, correcting for the selective sample of wage earners. Although an unusually large fraction of women in Thailand participates in the labor force (83 percent of those age 25 to 54), the fraction of women in wage employment is much lower, 28 percent. Virtually all men in these age groups are in the labor force (98 percent), whereas 57 percent work for wages (Table A-4). The probit sample selection equation for the wage employment status includes all of the variables in the semi-logarithmic wage function: years of schooling at three levels, a quadratic in postschooling experience, and four regional strata variables that may capture regional differences in the cost of living, or interregional costs of migration, or disequilibrium rents. The wage earner status probit equation also includes the husband- and wife-specific property and transfer nonearned income and the number of hectares of irrigated or dry farm land owned by the

family. These latter identifying variables are assumed to raise the shadow value of a person's time in nonmarket and self-employment activities and thereby reduce the probability that that person will be a wage earner.^{2/} The wage equations and the wage status probit equations are jointly estimated by maximum likelihood methods for women and men and are shown in Table A-2 and Table A-3 in Columns 2 and 3.

In Tables 1 and 2 labor supply equations are reported for women and men in what has become called a generalized Tobit model (Heckman, 1976). The probit equation for participation in the labor force last week, and the linear equation for hours worked per week among participants are estimated jointly by maximum likelihood methods. In columns (1) and (2) no correction is attempted for the selective nature of the sample of women with husbands present in Table 1, or men with wives present in Table 2. A likelihood ratio test is first performed to assess if coefficients on the transfer and property nonearned income are equal, though possibly different for nonearned income owned by husbands and wives. The null hypothesis of equality cannot be rejected at the 5 percent level of confidence, with the Chi-squared statistics for women's labor supply being 2.04, with 4 degrees of freedom, and the analogous test statistic for men's labor supply of 1.60. However, the null hypothesis of equality on the coefficients on the male and female nonearned income can be rejected at the 1 percent level of confidence for women's labor supply, where the Chi-squared statistic is 7.17, with 2 degrees of freedom. For men's labor supply, the Chi-square statistic remains insignificant at 1.66. The neoclassical model of family labor supply is thus rejected for women. The significant difference found between the spouse-specific nonearned income effects on women's labor supply behavior is interpreted as due to a shift in the "threat point" within the bargaining model of family decisionmaking (McElroy and Horney, 1981).

Furthermore, the pattern of coefficients is intuitively suggestive. The individual's own nonearned income has a larger effect reducing his or her labor supply than an equal amount of nonearned income controlled by one's spouse. This pattern is clearest in the case of Thai women, where the own nonearned income effect on participation is six times as large as that of their spouse's nonearned income. The preponderant sign of all of the labor supply effects of transfer and property nonearned income is negative, as anticipated.

Future research is planned to disaggregate family nonearned income by its ownership in order to explain the allocation of labor supply by family members among alternative types of jobs, such as wage employment, self employment, and family unpaid work. In many parts of the world women engage in separate jobs from their husbands. This may occur to increase women's control over family resources and thereby influence to a greater extent family consumption patterns. This tendency is particularly notable in SubSaharan Africa and Southeast Asia, although even in these regions, women still work primarily as unpaid family workers. In parts of Africa, husband and wife often cooperate in the joint production of some crops, while other crops or parts of the production process -- such as marketing -- are entirely the responsibility of one person. The neoclassical model of the family leads to the expectation that the wife allocates her time between the joint crops and her own crops to equalize the value of her marginal product across all activities. The bargaining model, however, would suggest that she would work more than expected on the basis of the neoclassical model on her own fields. Jones (1986) confirmed these predictions of the bargaining model with survey data collected from North Cameroon. Allocative incentives within these Cameroon families, therefore, do not appear to allocate labor to maximize family income, but seek other objectives that involve the competing interests of family members.^{3/}

To evaluate the partial effects of husband and wife nonearned income on household time allocation and expenditure patterns, the wage rates of both partners should be held constant. It is often suggested that increases in women's productive endowments increase expenditures on children's nutrition, health, and education (e.g., Senauer, et. al., 1988). Unfortunately, the Thai Socio Economic Survey does not describe sufficiently nutrition, health and educational investments allocated to children, to test these implications of the bargaining approach. One interesting household "demand" that can be studied in the survey is fertility.

V. Fertility and Investment in Children

The pattern of consumer demands may be especially sensitive to variation in market wage rates available to men and women in cases where the good demanded requires a disproportionate amount of production time from either the husband or the wife. The care of children in many cultures occupies much of their mother's time and this describes Thailand as well. An increase in the

market earnings potential of women relative to men may increase what parents perceive as being the cost to bear and rear children. This perception is likely to decrease fertility among better educated women who are offered higher wages in the labor force, even though at the same time the woman's earning potential increases the family's income opportunities. Increases in wages of women relative to men are generally associated with a reduction in fertility and with a reallocation of women's time from nonmarket to market work. Alternatively, increases in the labor productivity and wage rates of men can enhance the attractions of a large family and often are associated with higher levels of fertility, at least in low income agricultural countries such as Thailand (Schultz, 1981; Levy, 1985).

The labor supply and fertility patterns derived from this conventional economic model of the family are based on the assumption that the nuclear family pools resources. Consequently, a married woman is assumed to rely in part on the earnings of her husband for the purchase of market goods consumed by her children and herself. Where wives engage in economic activities oriented toward market exchange as well as family consumption, such as in rural SubSaharan Africa, Thailand and Malaysia, it is not clear whether the human and physical wealth of a husband are pooled with those of a wife to support all members of their nuclear family.

Table 3 reports ordinary least squares estimates of the number of living children under age 5 residing with their mother age 15 to 49 in Thailand, as recorded in the 1981 Socioeconomic Survey. Fertility has been declining at about 2% per year since the 1960's in Thailand. This measure of surviving fertility and the basis for this specification of the fertility equation are discussed more fully elsewhere (Schultz, 1988). As already noted, the bargaining model of family decision-making does not inform us as to why the preferences of husband and wife might be different for children. However, the neoclassical model of the family implies that the distribution of ownership of nonearned income should be irrelevant to its impact on fertility. As seen from column (1) of Table 3 only nonearned income of the woman, and primarily transfer income, is associated with her recent fertility. Nonearned income owned by the woman is significantly related to higher fertility, and this effect is not evident for male nonearned income. Based on the joint F test of equality of the coefficients on nonearned income of the woman and man, the null hypothesis consistent with the neoclassical model of family demand is rejected at a confidence level of 1 percent.^{4/}

Sociological studies of contemporary Thailand also suggest that if women had more wealth, they would want to have more children (Chamratrithirong, 1984). The common survey response is that women would desire more children, were it not for the rising cost of rearing and educating them. Mothers remain primarily responsible for childcare in Thai society, but they also appear to reap more of the economic benefits from their children in the form of old age support than do fathers (e.g. Knodel, et al, 1987). These observations are consistent with the positive effect of women's nonearned income on the demand for children shown in Table 3, even though the effects of women's market wage opportunities (and indirectly their education) is nonetheless to reduce their fertility.

VI. Marriage and Sample Selection Bias

One way that people express their demands for consumption patterns is in the form of families they create. Both the neoclassical (Becker, 1974, 1981; Frieden, 1974) and the bargaining (Manser and Brown, 1980; McElroy, 1988) approach to family decisionmaking suggest that the productivity and endowments of men and women may influence the timing and frequency of marriage. Cross-sectional patterns and some time series evidence in industrially advanced countries suggest that if male and female productivity increase at the same rate, women's participation in the labor market increases, the onset of marriage is delayed, and lifetime fertility decreases (Layard and Mincer, 1985). This cluster of developments are thought to be related to the reduced net gains from specialization by husband and wife in market and nonmarket production, respectively, within lifetime marriages (Becker, 1981). Although it has not been subsequently replicated in other U.S. social experiments, women who were given independent financial support (i.e, nonearned income) for their children in the Seattle negative income tax experiment opted with increased frequency to separate from their husbands (U.S. Department of Health and Human Services, 1983). In those societies where women's earnings approach more nearly those of men, there are fewer women married at each age, and there may be more female-headed households. This latter development may be partially attributed to the greater life expectancy of women than of men in the more industrially-advanced countries, but it could also reflect the choices made by women (and men) of marriage and household arrangements.^{5/}

Data have also been analyzed to estimate the determinants of age-at-marriage among individual women in low income countries. More educated women marry later, even in cases where marriage is sufficiently delayed in the overall society to avoid overlapping with school attendance, as in East and Southeast Asia (Montgomery and Sulak, 1988; Anderson and Hill, 1980; King et al, 1986); Casterline and Reynes, 1990).

The family bargaining model may clarify the gains to marriage and the resulting prevalence of marriage in contemporary Thai society. Demographic and anthropological studies of Thailand document that marriage was until recently nearly universal. About 95 percent of men and women reported themselves as having been married (once) by age 35 (in the 1960 Census cited by Knodel et al, 1987; Table 5.1). An informal process of divorce has also been traditionally common with frequent remarriage. Seventy percent of the women and 81 percent of the men between the ages of 25 and 54 are living in the same household as their spouse in the 1981 Survey of Thailand. To explain who is in this sense "currently married", the specialization model of Becker as well as the bargaining model would predict a decrease in marital gains with an increase in women's predicted market wage opportunities, holding men's expected wage opportunities equal. These predictions as to the sign of wage effects are ambiguous if education is also treated as a marriage determinant, because of the strong correlation between wages and schooling (Tables A-2 and A-3). At the individual level, however, the "expected" spouse's characteristics are not observed, and thus it is not possible to hold constant for the characteristics of potential spouses in the entire population.

Table 4 therefore reports the probit equation for the likelihood of being married, conditional on the individual's own characteristics, including quadratic terms in instrumented wage rates and nonearned income. It is notable that both nonearned income from property and transfer sources contribute to increased marriage among men and decreased marriage among women. The size of the coefficients on property and transfer income is many times larger in absolute value in the case of women than of men. However, the coefficients on property and transfer sources of nonearned income are of roughly similar magnitude. The statistical restriction of equality of coefficients can be accepted at the 5 percent confidence level, using the likelihood ratio test. In sum, marriage in Thailand is not a "normal" good for Thai women: marriage is less attractive to the wealthier Thai women than remaining single, other things being equal.

If nonearned income is an important determinant of marriage in Thailand, just as are wage opportunities, schooling, and urbanization, how can the sample of married couples be assumed a representative sample for the purposes of estimating family labor supply and fertility relationships? If it is not, can the selection bias correction terms (i.e., inverse of the Mill's ratio in Heckman's (1976, 1979) terms) be incorporated into the family labor supply and fertility relationships? These estimates are reported in the second half of Tables 1, 2, and 3. The previously reported specification in these tables assumed that the presence of a spouse is an exogenous event and can be approximately held constant by the introduction of a dummy variable for a husband (or wife). The second specification allows for the covariation between the error in the marital status equation and the labor supply and fertility equations. A variety of methods might be proposed to deal with this potential simultaneity bias. The estimation strategy followed here is to analyze the censored sample of married couples and include in these family "demand" equations a sample selection bias correcting term derived from the probit equation for marital status and participation, parallel to those as reported in Table 4. The labor supply equations are estimated jointly by maximum likelihood methods in col. 3-4 and 5-6 in Tables 1 and 2, as is the fertility equation in col. 2, Table 3 and col. 1 in Table 4. Consequently, the standard errors and reported asymptotic t ratios are consistent and appropriate for hypothesis testing.

A comparison of the estimates based on these two model specifications confirms that the differential effects of male and female nonearned income are not changed. Indeed the same coefficient restriction tests reported earlier continue to reject the neoclassical model for female labor supply and fertility, but do not reject the restriction for male labor supply. However, certain other response coefficients are more sensitive to the assumptions about the determinants of marital status. (Compare Col. 2 and 6 in Tables 1 and 2.) The impact of the woman's wage opportunities on her fertility changes sign when the estimation is restricted to the sample of married women and corrected for this selective sampling. The own-wage effect of the married women on fertility is positive (Table 3, col. 2), because her market wage opportunities also influence marital status through the sample selection rule (Table 4). The exclusion restriction that identifies these marriage sample selection corrections assumes that the quadratic (nonlinear) effects of own wages and

nonearned income influence marital status but do not influence fertility (or labor supply). Until a stronger theoretical basis for the marriage selection rule is provided, all estimates of models of family labor supply and fertility must be viewed with some skepticism.

In the 1981 survey of Thailand there is no information on the individual's migration, occupational, or marital history. There is little information, therefore, that might have a particular bearing on marital status compared with other current conditions that could affect last week's labor supply or fertility during the last five years. Ultimately disentangling the effect of marital status on fertility and female labor supply will require a more fully articulated model of life cycle behavior of women and men in Thailand and a richer source of data to implement that model.

In this single cross-sectional survey support has been found, nonetheless, for the hypothesis that the ownership of nonearned income in the Thai family has a distinct association with that family's labor supply and reproductive behavior. The differences in the effect of husband- and wife-owned sources of nonearned income on these forms of behavior did not prove particularly sensitive to the two specifications considered for dealing with the marriage decision rule. However, other important response coefficients do appear to be more sensitive to the statistical methods employed to hold constant for the likelihood that a husband resides in a woman's household. There is much room here for further research.

VII. Conclusions

This paper has rejected one of the restrictions implied by the neoclassical model of family demand behavior, that for female labor supply. However, the evidence does not actually accept the "bargaining" model. If nonearned income is assumed to be a proxy for bargaining power of the person who owns or controls that income, then the empirical results obtained here for the Thai population in 1981 imply that women with more "bargaining power" prefer to increase their own consumption of leisure or time in nonmarket activities. Correspondingly, these same women prefer to have more children, though this conclusion is more qualified, because the finding is due predominantly to the positive partial correlation between transfer income to the woman and her recent fertility, and the correlation is not statistically

significant with respect to her property nonearned income. Consequently, the connection between transfer income and fertility may reflect the reverse causation to that hypothesized here, where women with more children to support are more likely to receive transfers from their family and other groups in society. In the case of men, their nonearned income is also associated with their preference for more leisure or time out of the labor force. But in the case of men's joint decisions of participation and hours worked, the impact of their wife's nonearned income exerts a weaker effect. The difference between the effects of the spouse's nonearned income on male labor supply is not statistically significant.

A limitation of previous tests of the family demand model that focus on the equality of compensated cross-wage effects (Cain and Watts, 1973; Heckman, 1971; Kalachek and Raines, 1970; Ashenfelter and Heckman, 1974; Olsen, 1977; Killingsworth, 1983) is that the estimates are for samples of married couples or couples both of whom are working in the labor force. The resulting selectivity of the sample of married couples may bias estimates, and this potential source of parameter bias should be eliminated to test the family demand model (Heckman, 1979). In the final section of this paper, quadratic terms for the own wage and own nonearned income are added to other individual characteristics to predict the probability of marriage, and this probit model is used to add a regressor in the family demand system (i.e., the inverse of the Mills ratio). This alternative censored specification to the conventional family demand model does not change the previously summarized conclusion -- fertility and female labor supply behavior reject the neoclassical restriction that nonearned income is pooled and partners exhibit the same behavioral preferences.

However, the spouse cross-wage effects do, in some cases, change substantially in magnitude when the marriage sample selection is included in the specification of the family demand model. A better model is needed to forecast marriage that will provide a theoretical basis for the exclusion restrictions needed to correct for the source of sample selection bias in models of family demands. In other words, variables are needed for partners that have an impact on their likelihood of being currently married but are deemed theoretically irrelevant in directly affecting family labor supply and fertility.

Whether this family demand model is viewed as neoclassically pooled or individualistically bargained, the basis for identifying the family demand model must start with a better theory of marriage. These Thai survey data suggest that such an adjustment for the bias of being included in the selective sample of intact marriages can change appreciably population parameter estimates and thereby modify economic inferences about the behavioral responses of individuals and families.

TESTING THE NEOCLASSICAL MODEL OF FAMILY LABOR SUPPLY AND FERTILITY

REFERENCES

- Anderson, K.H and M.A. Hill (1980), "Determinants of Age at Marriage in Malaysia and Japan," Economic Growth Center Discussion Paper, New Haven, CT: Yale University.
- Ashenfelter, O. and J.J. Heckman (1974), "The Estimation of Income and Substitution Effects in a Model of Family Labor Supply", Econometrica, 42:1 (January), 73-76.
- Becker, G.S. (1965), "A Theory of the Allocation of Time", Economic Journal, Vol. 75:299 (December), 493-519.
- ____ (1974), "A Theory of Marriage" in Economics of the Family, (ed.) T.W. Schultz, Chicago: University of Chicago Press.
- ____ (1981), A Treatise on the Family, Cambridge, MA: Harvard University Press.
- Cain, G. and H. Watts (1973) (eds.), Income Maintenance and Labor Supply, New York: Academic Press.
- Carlin, P.S. (1990), "IntraFamily Bargaining and Time Allocation," forthcoming in Research in Population Economics (eds.), T.P. Schultz, Vol. 7, Greenwich, CT: JAI Press.
- Casterline, J.B. and J. F. Reynes (1990), "Women's Schooling and Marriage in Low Income Countries", presented at American Association for the Advancement of Science, New Orleans (February).
- Chamrathirithong, A. (ed.) (1984), Perspectives on the Thai Marriage: A Review of Demographic Evidence, Mahidol University, Institute for Population and Social Research, Salaya, Thailand.
- Chiappori, D.A. (1988), "Nash-Bargained Household Decisions," International Economic Review, 29:4 (September) 791-796.
- DaVanzo, J. (1972), Determinants of Family Formation in Chile, 1960, Santa Monica, CA: The Rand Corporation (August).
- Deaton, A. and J. Muellbauer (1980), Economics of Consumer Behavior, Cambridge University Press.
- Engel, E. (1895), "Die Lebenskosten Belgischer Arbeiter-Familien fruher and jetzt", International Statistical Institute Bulletin, Vol. 9, 1-74.
- Freiden, A. (1974), "The U. S. Marriage Market," in Economics of the Family, (ed.) T. W. Schultz, Chicago: University of Chicago Press.
- Harsanyi, J.C. (1977), Rational Behavior and Bargaining Equilibrium, Cambridge, MA: MIT Press.
- ____ and R. Selten (1987), A General Theory of Equilibrium Selection in Games, Cambridge, MA: MIT Press.
- Heckman, J.J. (1971), "Three Essays on the Supply of Labor and the Demand for Goods," unpublished Ph.D. dissertation, Princeton University (May).
- ____ (1974), "Shadow Prices, Market Wages and Labor Supply," Econometrica 42:679-694.
- ____ (1976), "A Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models", Annals of Economic and Social Measurement, 5/4, 475-502.
- ____ (1979), "Sample Bias as a Specification Error," Econometrica 47:1 (January) 153-162.
- Heckman, J.J. and J.R. Walker (1989), "Forecasting Aggregate Period Specific Birth Rates", Journal of American Statistical Association, 84:408 (December), 958-965.
- Horney, M.J. and M.B. McElroy (1988), "The Household Allocation Problem: Empirical Results from a Bargaining Model," in Research in Population Economics Vol. 6, (ed.) T.P. Schultz, Greenwich, CT: JAI Press.

- Jones, C.N. (1986), "Intra-Household Bargaining in Response to the Introduction of New Crops," in Understanding Africa's Rural Households and Farming Systems, (ed.) J.L. Moock, Boulder, CO: Westview Press.
- Kalachek, E.D. and F.Q. Raines (1970), "Labor Supply of Lower Income Workers" in Presidents' Commission on Income Maintenance Programs, Technical Studies, pp. 159-86, Washington, D.C.: Government Printing Office.
- Killingsworth, M. (1983), Labor Supply, Cambridge: Cambridge University Press.
- King, E.M., J.R. Peterson, S.M. Adioetomo, L.J. Domingo, and S.H. Syed (1986), Change in the Status of Women Across Generations in Asia, Santa Monica, CA: The Rand Corp (December).
- Kneisner, T.J. (1976), "An Indirect Test of Complementarity in a Family Labor Supply Model", Econometrica, 44:4 (July), 651-659.
- Knodel, J., A. Chamrathrithirong, and N. Debavalya (1987), Thailand's Reproductive Revolution. Madison, WI: University of Wisconsin Press.
- Kosters, M. (1966), Income and Substitution Effects in a Family Labor Supply Model, P-3339, Santa Monica, CA: The Rand Corporation.
- Layard, R. and J. Mincer (eds.) (1985). "Trends in Women's Work, Education, and Family Building," Journal of Labor Economics 3:1, pt. 2 (January).
- Levy, V. (1985), "Cropping Pattern, Mechanization, Child Labor and Fertility in a Farming Economy: Rural Egypt," Economic Development and Cultural Change 33(4) 777-792 (July).
- Lundberg, S. (1988), "Labor Supply of Husbands and Wives: A Simultaneous Equation Approach," Review of Economics and Statistics 70:2 (May) 224-235.
- McElroy, M.B. (1988), "The Empirical Content of Nash-Bargained Household Behavior," Economics Department Discussion Paper No. 88-08, Duke University (September).
- _____ and M.J. Horney (1981), "Nash Bargained Household Decisions," International Economic Review, 22:333-350, (June).
- Manser, M. and M. Brown (1979), "Bargaining Analysis of Household Decisions," in C.B. Lloyd, E.S. Andrews and C.L. Gilroy (eds.), Women in the Labor Force, New York: Columbia University Press.
- _____ and _____ (1980), "Marriage and Household Decisionmaking," International Economic Review, Vol. 21:1 (February) 31-44.
- Maurer, J., R. Ratajiczak and T.P. Schultz (1973), Marriage, Fertility and Labor Force Participation of Thai Women, Santa Monica, CA: The Rand Corp.
- Mincer, J. (1962), "Labor Force Participation of Married Women in Aspects of Labor Economics, Princeton, NJ: Princeton University Press.
- Montgomery, M. and D. Sulak (1988), "Female First Marriage in East and Southeast Asia", Journal of Development Economics, (forthcoming).
- Nash, J.F. (1950), "The Bargaining Problem", Econometrica, Vol. 18, 155-162.
- _____ (1953). "Two-Person Cooperative Games", Econometrica, Vol. 21, 128-140.
- Nerlove, M. and T.P. Schultz (1970). "Love and Life Between the Censuses", Santa Monica, CA: The Rand Corp.
- Olsen, R.J. (1977). "An Econometric Model of Family Labor Supply", unpublished Ph.D. dissertation, Chicago: University of Chicago Press.
- Pollak, R.A. (1985). "A Transactions Cost Approach to Families and Households," Journal of Economic Literature 23: 581-608.
- Rosenzweig, M.R. and R.E. Evenson (1977), "Fertility, Schooling and the Economic Contribution of Children in Rural India", Econometrica, 45:5 (July), 1065-1080.
- Rosenzweig, M.R. and O. Stark (1989). "Consumption Smoothing, Migration, and Marriage: Evidence from India," Journal of Political Economy, 97:4, (August), 905-926.
- Senauer B., M. Garcia and E. Jacinto (1988). "Determinants of the intrahousehold allocation of food in rural Philippines", American Journal of Agricultural Economics, 70:1, 170-180.

- Schultz, T.P. (1981). Economics of Population, Reading, MA: Addison-Wesley.
- _____. (1988). "The Relationship between Local Family Planning Expenditures and Fertility in Thailand, 1976-1981", (processed), New Haven, CT: Yale University
- _____. (1989). "Women in Development: Objectives, Framework and Policy Interventions", (processed), New Haven, CT: Yale University (April).
- Smith, J.P. (ed.) (1980). Female Labor Supply, Princeton, NJ: Princeton University Press.
- Thomas, D. (1989). "Intrahousehold Resource Allocation: An Inferential Approach", Economic Growth Center Discussion Paper 586, New Haven, CT: Yale University (February).
- Treas, J. (1988). "Money in the Bank: Transaction Costs and Privatized Marriage," American Sociological Review (forthcoming).
- U. S. Department of Health and Human Services (1983). Final Report of the Seattle-Denver Income Maintenance Experiment, Washington, D.C.: U.S. Government Printing Office:, Vol. I, Part V.

TESTING THE NEOCLASSICAL MODEL OF FAMILY LABOR SUPPLY AND FERTILITY

NOTES

^{1/} In principle, the measurement of non-earned income is to capture an exogenous difference across persons in their budget constraint that does not also induce a change in money or time prices of various types of consumption or behavior. In practice, non-earned income (rents, dividends, interest, and capital gains) could arise from inheritances that are similar to schooling, in that they are largely financed by parents and family, and can be viewed as exogenous at the start of adult life. But non-earned income also represents returns on a person's lifecycle accumulation of savings, and hence captures in part the person's behavior. It then becomes, for some purposes, an endogenous choice variable. Hence, it is desirable for survey questionnaires to pursue the sources of current nonearned income, current assets, date of receipts of bequest that led to these current assets, and whether they came from the husband's or wife's side of the family. This analysis disaggregates nonearned income to treat separately property and transfer payments (see Table A-1) that probably includes pensions to those who are retired. Exclusion of persons over age 54 attempts to minimize this source of simultaneous equation bias.

^{2/} For Thai women a double sample selection decision rule may be justified, by which one selection equation determines labor force participation and a second selection equation determines wage earner status. This double selection specification of the wage function is reported in Schultz (1989) for women, but here the analysis of wages provides for only a single source of sample selection bias (i.e., wage earner status) and treats men and women in a parallel specification.

^{3/} In principle there might be a superior Pareto efficient allocation of husband and wife labor that would yield a larger output for both members of the family. But in practice, there are costs in monitoring labor inputs over scattered plots and transaction costs in exchange of inputs and outputs that might be required to provide both persons with the incentives needed to achieve Pareto efficiency. These transaction costs might absorb the output gains.

^{4/} The non-negative integer form of the fertility variable led to parallel estimates of these equations using a Poisson specification of the model (see Schultz, 1988). The likelihood ratio test of the equality restriction on the coefficients for the husband's and wife's nonearned income in this Poisson model is rejected by the Thai survey data in both years. Increases in the woman's nonearned income is associated with higher levels of fertility. In the cases of increases in the husband's nonearned income, fertility tends to be somewhat lower but this tendency is statistically significant only in the case of children under age 5.

^{5/} Aggregate data on the proportion of women married are analyzed to make this point, for example, in Chile in 1960 (DaVanzo, 1972), relative education of men and women in Thailand as of 1960 (Maurer, et. al., 1973), the U.S. in 1960 (Frieden, 1974), and in Puerto Rico in 1950 and 1960 (Nerlove and Schultz, 1970).

TABLE 1

JOINTLY ESTIMATED PARTICIPATION AND HOURS OF WORK AND MARRIAGE
OF WOMEN AGE 25-54, THAILAND, 1981^a

Dependent Variable:	Partici- pate	Hours per Week	Husband Present	Partici- pate	Husband and Partici- pant	Hours per Week	Sample Means All Women ^b
Joint Max. Likelihood	(Probit)	(OLS)	(Probit)	(OLS)	(Probit)	(OLS)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Explanatory Variables:							
Market Opportunity Wage:							
Women ^c	.619 (10.6)	-10.3 (8.63)	2.76 (4.92)	.196 (9.23)	.953 (1.66)	-7.16 (7.36)	1.45 (1.24)
Women's Wage Squared ^c	---	---	.0252 (.67)	---	.153 (4.15)	---	---
Men's Wage ^c	-.404 (11.2)	-1.07 (8.63)	---	-.131 (9.36)	---	-3.57 (4.72)	.812 (.728)
Husband Present	.483 (4.89)	.748 (.54)	---	---	---	---	.699 (.459)
Unearned Income:							
(Baht/month)							
Woman's Transfer (x 10 ⁻⁴)	-.170 (15.9)	.137 (.31)	-.663 (26.5)	-.0241 (.92)	-.592 (20.5)	.964 (.82)	.163 (.954)
Woman's Transfer Squared (x 10 ⁻⁹)	---	---	.251 (13.8)	---	.0225 (10.2)	---	---
Woman's Property (x 10 ⁻⁴)	-.263 (3.99)	-1.98 (1.62)	-.534 (4.98)	-.0343 (1.85)	-.510 (4.24)	-.294 (.08)	.0249 (.367)
Woman's Property Squared (x 10 ⁻⁹)	---	---	.463 (3.41)	---	.0202 (.68)	---	---
Man's Transfer (x 10 ⁻⁴)	-.0359 (1.76)	-.188 (.45)	---	-.0113 (2.49)	---	-.212 (.51)	.0863 (.614)
Man's Property (x 10 ⁻⁴)	-.0246 (.62)	.451 (.74)	---	-.00689 (.83)	---	.459 (.74)	.0312 (.431)
Other Adults (x 10 ⁻⁴)	-.0618 (3.45)	-.763 (2.65)	---	.00042 (.02)	---	.0002 (.05)	.136 (.799)
Age of Woman	.130 (5.94)	1.40 (4.46)	.0282 (.57)	.0250 (2.21)	.157 (3.14)	.848 (1.60)	36.1 (8.13)
Age Squared (x 10 ⁻²)	-.181 (6.33)	-.154 (3.67)	-.133 (2.70)	-.0333 (2.24)	-.246 (4.93)	-.798 (1.15)	13.7 (6.18)
Schooling Years of Woman:							
Primary			-.242 (4.85)	---	-.0926 (1.81)	---	---
Secondary			-.475 (6.58)	---	-.224 (3.04)	---	---
Higher			-.158 (5.01)	---	-.0821 (2.74)	---	---
Hectares of Land Owned							
Irrigated Land			-.0018 (.94)	---	.00455 (2.54)	---	---
Dry Land			-.00094 (.72)	---	.00386 (3.14)	---	---
Residential Area:							
Bangkok	-.655 (13.4)	.681 (.54)	-1.20 (5.86)	-.194 (12.7)	-.885 (4.23)	1.90 (1.95)	.267 (.442)
Municipal	-1.03 (12.7)	11.2 (6.06)	-3.07 (5.76)	-.271 (10.5)	-1.83 (3.37)	11.4 (7.11)	.364 (.481)
Sanitary District	-.544 (8.35)	4.54 (4.57)	-1.64 (5.40)	-.108 (5.85)	-.875 (2.83)	5.69 (5.93)	.154 (.361)
Northeast Region	-.288 (5.84)	.409 (.60)	.166 (3.70)	.0958 (6.37)	.0184 (.42)	-1.74 (2.54)	.274 (.446)
Intercept	-.612 (1.54)	29.7 (5.04)	2.06 (1.72)	.664 (2.94)	1.50 (1.22)	45.2 (4.22)	
Sigma (σ_{11})		15.9 (128.9)		.352 (44.0)		16.1 (45.0)	
Rho (λ / σ_{12})		-.0481 (.17)		-.0849 (.50)		-.223 (1.30)	
Log Likelihood		32444.6		6759.896		25032.16	
Sample Size	8380	6994	8380	5858	8380	4793	
Dependent Variable Means (standard deviation)	.835 (.371)	54.8 (16.5)	.699 (.459)	.818 (.386)	.572 (.475)	55.0 (16.4)	

- Notes: ^a Absolute values of asymptotic t ratios are reported beneath coefficients in parentheses.
^b Means of variables in sample of all women aged 24 to 54 in the Thai 1981 SES.
^c Hourly wage rates imputed from wage equations estimated by a sample selection model and reported in Table A-2 and A-3.

TABLE 2
JOINTLY ESTIMATED PARTICIPATION AND HOURS OF WORK AND MARRIAGE
OF MEN AGE 25-54, THAILAND, 1981^a

Dependent Variable	Partici- pate	Hours per Week	Husband Present	Partici- pate	Husband and Partici- pant	Hours per Sample Week	Means All
Joint Max. Likelihood	Women ^b (Probit)	(OLS)	(Probit)	(OLS)	(Probit)	(OLS)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Explanatory Variables:							
Market Opportunity Wage:							
Men's Wage ^c	.0373 (.44)	-9.69 (17.4)	-11.9 (.93)	-.00003 (.01)	33.6 (2.56)	-9.82 (13.3)	1.47 (1.14)
Men's Wage Squared ^c	--	--	.0332 (1.67)	--	.0772 (3.00)	--	--
Wife's Wage ^c	.179 (2.05)	-2.49 (4.56)	--	-.00240 (.78)	--	1.45 (1.79)	.584 (.683)
Wife Present	1.01 (7.81)	4.70 (6.09)	--	--	--	--	.805 (.396)
Unearned Income: (Baht/month)							
Men's Transfer (x 10 ⁻⁴)	-.115 (4.07)	-.242 (.79)	.192 (4.04)	-.0148 (21.2)	.169 (3.03)	-.768 (2.83)	.114 (.718)
Men's Transfer Squared (x 10 ⁻⁹)	--	--	.0394 (1.60)	--	-.00887 (1.76)	--	--
Men's Property (x 10 ⁻⁴)	-.0628 (1.96)	-.115 (.24)	.189 (.76)	-.00904 (15.5)	.368 (1.89)	-.972 (1.51)	.0383 (.484)
Men's Property Squared (x 10 ⁻⁹)	--	--	-.0702 (.32)	--	-.0164 (1.03)	--	--
Women's Transfer (x 10 ⁻⁴)	-.0181 (.09)	.748 (1.61)	--	-.00162 (.32)	--	.682 (1.37)	.0293 (.283)
Women's Property (x 10 ⁻⁴)	-.0937 (1.57)	.276 (.13)	--	-.00600 (8.72)	-.587 (1.85)	-.587 (1.85)	.0116 (.305)
Other Adults (x 10 ⁻⁴)	-.0563 (2.45)	.272 (1.25)	--	-.00330 (2.37)	1.79 (2.52)	1.79 (2.52)	.111 (.794)
Age of Man	.155 (3.84)	1.09 (4.52)	.683 (1.86)	-.0185 (9.23)	.445 (1.17)	.152 (.37)	38.3 (8.41)
Age Squared (x 10 ⁻²)	-.207 (4.10)	-1.10 (3.67)	-.418 (7.85)	.0197 (8.35)	-.517 (10.5)	.00247 (.51)	15.3 (6.57)
Schooling Years of Man:							
Primary			1.42 (.94)		-3.96 (2.52)		
Secondary			1.52 (.90)		-4.61 (2.63)		
Higher			.0703 (.69)		-.386 (3.45)		
Hectares of Land Owned:							
Irrigated Land			.00374 (1.09)		-.0021 (.76)		
Dry Land			.00307 (1.65)		-.0011158 (.98)		
Residential Area:							
Bangkok	-.141 (1.61)	.0992 (.17)	5.24 (.92)	-.00331 (1.00)	-15.4 (2.61)	-.640 (.93)	.268 (.443)
Municipal	-.301 (2.12)	12.0 (12.6)	14.2 (.92)	.00401 (.76)	-41.8 (2.59)	11.9 (10.5)	.356 (.479)
Sanitary District	-.124 (.95)	5.58 (7.89)	8.30 (.92)	.00087 (.18)	-24.1 (2.58)	5.16 (6.15)	.153 (.360)
Northeast Region	-.0237 (.23)	-2.54 (4.68)	-6.44 (.91)	-.00451 (1.11)	19.0 (2.58)	2.71 (4.06)	.273 (.446)
Intercept	-1.14 (1.46)	46.1 (9.81)	-7.46 (8.37)	1.41 (35.3)	7.70 (8.99)	79.5 (9.45)	
Sigma (σ_{11})		15.64 (109.)		.104 (.174)		16.9 (92.6)	
Rho (λ / σ_{12})		.460 (4.11)		-.996 (585.)		-.461 (7.76)	
Log Likelihood		30198.8		3398.0		27458.0	
Sample Size	7278	7081	7278	5858	7278	5858	
Dependent Variable Means (standard deviation)	.973 (.162)	57.4 (16.7)	.805 (.396)	.988 (.108)	.805 (.396)	57.7 (17.6)	

Notes: ^a Absolute values of asymptotic t ratios are reported beneath coefficients in parentheses.
^b Means of variables in sample of all women aged 24 to 54 in the Thai 1981 SES.
^c Hourly wage rates imputed from wage equations estimated by a sample selection model and reported in Table A-2 and A-3.

TABLE 3

FERTILITY OF WOMEN AGED 15-49, THAILAND, 1981^a

Dependent Variable:	Number of Own Coresidential Children Age 0-4 per Woman		Sample Means ^b All Women
Estimation Method:	(OLS)	(ML)	
Explanatory Variables:	(1)	(2)	(3)
Market Opportunity Wages (in Baht/hour)			
Woman ^c	-.126 (7.18)	.606 (4.81)	.663 (.773)
Man ^c	-.0491 (4.73)	-.0803 (1.93)	1.06 (1.21)
Husband Present	.608 (24.7)		.545 (.498)
Husband (Mills Ratio) ⁻¹		-1.74 (6.09)	
Unearned Income (Baht/month x 10 ⁻⁴)			
Woman's Transfer	.0449 (6.56)	.554 (5.09)	.118 (.801)
Woman's Property	.0201 (.84)	.154 (.87)	.0148 (.225)
Man's Transfer	.0058 (.54)	.0145 (.75)	.0556 (.498)
Man's Property	-.0154 (.56)	.0053 (.12)	.0152 (.199)
Other Adults	-.00843 (1.46)	-.0281 (1.11)	.201 (.907)
Age of Woman	.0685 (13.6)	-.495 (5.33)	30.4 (9.32)
Age Squared (x 10 ⁻²)	-.119 (15.7)	.664 (4.94)	10.1 (6.02)
Residential Area			
Bangkok	.0827 (5.12)	-.0663 (1.10)	.265 (.441)
Municipal	.142 (5.43)	-.365 (3.02)	.357 (.479)
Sanitary District	.0468 (2.37)	-.322 (3.89)	.152 (.359)
Northeast Region	.0843 (6.25)	.0706 (1.53)	.277 (.447)
Intercept	-.770 (10.2)	10.2 (6.19)	
R ²	.233	.155	
X ² (14)		1077.0	
F (15)	253.9		
Sample Size	11708	6386/11708	
Dependent Variable Mean (Standard Deviation)	.410 (.663)	.665 (.746)	

kc/TabIndivApp/4/5-15-90

TABLE 3 - Page 2

Fertility of Women aged 15-49
1981 and 1986, Thailand^a

- a Dependent variable is the number of coresidential children age 0-4 of women age 15 to 49. Estimates in Col. (1) are ordinary least squares coefficients with the absolute value of the t ratios reported in parentheses beneath the coefficients. Poisson and Tobit regressions have also been estimated for the fertility relationship by maximum likelihood methods without altering any of the signs or the significance of the OLS coefficients reported here. The estimates in Col. (2) are two-step Heckman (1979) estimates, where the standard error are adjusted for consistency, but joint ML estimates did not converge to a optimum after 100 iterations.
- b Means of entire sample of 1981 SES used in estimation, and standard deviations reported in parentheses.
- c Endogenous variables imputed from wage equations corrected for sample selection bias. See Table A-2 and A-3.
- d Husband present and sample selection criteria is determined by probit equation that includes only woman's characteristics plus quadratic forms in her predicted wage and own property and transfer nonearned income.

TabIndivApp/5/5-15-90

TABLE 4

**PROBIT ESTIMATES OF THE PROBABILITY THAT A SPOUSE IS PRESENT
IN A HOUSEHOLD, WOMEN AND MEN: THAILAND, 1981^a**

Dependent Variable Sample (Age of Sample)	Women Fertility (17-49)	Women Labor (25-54)	Men Labor (25-54)
Explanatory Variables:	(1)	(2)	(3)
Market opportunity wage ^b (log baht per hour)	-.801 (12.0)	-.443 (4.45)	-.478 (3.68)
Wage squared ^b	.0613 (2.75)	.0293 (.95)	.0389 (1.73)
Unearned income by source: (baht per month)			
Property (x 10 ⁻⁴)	-.326 (2.26)	-.508 (4.09)	.299 (2.66)
Property squared (x 10 ⁻⁸)	.0160 (.69)	.0445 (2.97)	-.0121 (2.18)
Transfer (x 10 ⁻⁴)	-.619 (15.2)	-.648 (16.7)	.162 (2.59)
Transfer squared (x 10 ⁻⁸)	.0232 (10.3)	.0245 (11.6)	-.00873 (2.17)
Age	.555 (47.0)	.309 (16.5)	.557 (25.0)
Age squared (x 10 ⁻²)	-.799 (45.7)	-.399 (16.4)	-.643 (22.5)
Residential Area:			
Bangkok	.183 (4.82)	.0321 (.74)	.0177 (.33)
Municipal	.544 (8.69)	.131 (1.72)	.0639 (.68)
Sanitary District	.376 (7.46)	.132 (2.11)	.143 (1.85)
Northeast Region	.0199 (.64)	.0405 (1.08)	-.0295 (.49)
Intercept	-8.46 (45.3)	-4.81 (14.0)	-9.67 (22.4)
χ^2	3217.73	1028.9	1577
Sample Size	11708	8380	7278
Mean of Dependent Variable	.545	.699	.805

Notes:

^a Absolute values of asymptotic t ratios are reported beneath ML coefficients in parentheses.

^b Hourly wage rates imputed from wage equations estimated by a sample selection model and reported in Table A-2 and A-3.

kc/TabIndiv/1/5-15-90

Appendix Table A-1

**Percent of Persons with Various Sources of Nonearned Income
in Thailand 1981 SES, by Sex and Age
of Recipient**

(Mean amount in Bahts per Month for Persons with Source)

Sex and Age of Income Recipient (Total Size of Sample)	Property Income	Rentals	Interest	Transfers Public & Private	Grants, Insurance and Sales	Total Nonearned Income
<u>Women:</u>	(1)	(2)	(3)	(4)	(5)	(1)+(4)+(5)- (6)
All Ages (17002)	3.14 (6954)	1.04 (5484)	1.53 (4263)	11.12 (9952)	4.05 (3769)	15.87 (9309)
Age 15-24 (5763)	.42 (2015)	.02 (1000)	.35 (974)	6.30 (6472)	1.77 (2166)	8.05 (5644)
Age 25-39 (5566)	3.16 (3271)	.49 (3179)	2.07 (2182)	7.08 (17233)	4.99 (3650)	13.30 (11324)
Age 40-54 (3525)	4.57 (10090)	1.50 (8788)	2.30 (8197)	13.84 (10809)	5.59 (4955)	20.28 (11015)
Age 55+ (2148)	8.05 (8467)	4.47 (4354)	2.05 (3959)	30.07 (6819)	5.17 (3435)	36.31 (8014)
<u>Men:</u>						
All Ages (15304)	4.40 (7818)	1.50 (6299)	2.07 (5239)	10.79 (7469)	8.08 (5517)	20.01 (7975)
Age 15-24 (5001)	.36 (2016)	.02 (750)	.26 (516)	5.80 (6308)	2.08 (2208)	7.68 (5456)
Age 25-39 (4851)	3.88 (3884)	.47 (3293)	2.58 (2950)	6.18 (5255)	10.53 (5441)	18.33 (5722)
Age 40-54 (3314)	6.76 (9601)	2.41 (8416)	3.05 (7649)	12.43 (6071)	12.40 (5188)	27.43 (7463)
Age 55+ (2138)	11.37 (9648)	5.85 (5542)	3.65 (6575)	30.40 (9896)	9.82 (7983)	41.16 (11878)

u/kc/Taindhthai/8/6-8-89

TABLE A-2

SAMPLE SELECTION CORRECTED WAGE FUNCTION FOR WOMEN AGE 25-54:
THAILAND, 1981^a

Dependent Variable:	Partici- pation	Wage Earner Status	Log of Hourly Wage Rate	
Estimation Method:	Probit	Probit	ML-Linear	Heckman
Explanatory Variables:	(1)	(2)	(3)	(4)
Schooling in Years:				
Primary	.00410 (.36)	-.0429 (3.74)	.0969 (4.55)	.111 (4.84)
Secondary	.0985 (7.44)	.213 (15.6)	.166 (6.01)	.120 (3.41)
Higher	.165 (3.60)	.104 (2.46)	-.0424 (.70)	-.0605 (1.45)
Post-Schooling Experience in years	.14 (7.32)	.00446 (.44)	.0310 (1.73)	.0287 (1.76)
Experience squared (x 10 ⁻²)	-.189 (7.41)	-.0387 (2.17)	-.0237 (.74)	-.0112 (.37)
Unearned income by source: (baht per month x 10 ⁻⁴)				
Women-property	-.182 (3.04)	-.0747 (.80)		
Women-transfer	-.105 (6.50)	-.0356 (2.43)		
Men's property	-.0744 (2.55)	-.119 (3.79)		
Men's-transfer	-.0799 (3.63)	-.0179 (1.05)		
Other persons-total	.000213 (.01)	-.0647 (2.94)		
Land Owned in Hectares:				
Irrigated	.0247 (5.54)	-.0220 (11.5)		
Dry	.0180 (7.68)	-.0203 (14.6)		
Residential Areas				
Bangkok	.495 (12.0)	-.0223 (.54)	.807 (9.72)	.798 (11.6)
Municipal	-.692 (16.1)	-.423 (10.2)	1.49 (18.3)	1.55 (19.1)
Sanitary Districts (suburban)	-.361 (6.94)	-.0417 (.95)	.836 (12.1)	.832 (10.6)
Northeast Region	.171 (3.77)	-.272 (7.04)	-.0614 (.94)	.0198 (.24)
Intercept	-1.25 (3.35)	-.0448 (.31)	-.0191 (.07)	.304 (1.03)
Wage Earner Status (lambda)				-1.45 (7.49)
Rho (Eq. 2 and 3)		-.755 (21.9)		
Sigma		1.46 (29.4)		
Log likelihood	4029.0	8290.6		3746.9
χ^2 (df)	1166.7 (16)			2264.3 (10)
Sample size	8816			

kc/TabIndiv/3/5-16-90

TABLE A-3

SAMPLE SELECTION CORRECTED WAGE FUNCTION FOR MEN AGE 25-54:
THAILAND, 1981^a

Dependent Variable:	Partici- pation	Wage Earner	Log of Hourly Wage Rate	
Estimation Method:	Probit	Probit	ML-Linear	Heckman
Explanatory Variables:	(1)	(2)	(3)	(4)
Schooling in Years:				
Primary	.0598 (2.27)	.00966 (.79)	.145 (8.03)	.146 (7.04)
Secondary	-.0375 (1.67)	.0923 (7.26)	.160 (8.75)	.123 (6.16)
Higher	.0521 (1.19)	.0331 (.93)	.0355 (.75)	.0255 (.68)
Post-Schooling Experience in years	.101 (5.83)	.0270 (2.85)	.0280 (2.14)	.0167 (1.16)
Experience squared ($\times 10^{-2}$)	-.182 (5.89)	-.0722 (4.38)	-.00265 (.12)	.0269 (.99)
Unearned income by source: (baht per month $\times 10^{-4}$)				
Men-property	-.0656 (1.74)	-.00376 (.16)		
Men-transfer	-.121 (4.69)	-.000205 (.01)		
Women-property	-.104 (2.16)	-.0506 (.55)		
Women-transfer	.00333 (.02)	.0936 (2.55)		
Other persons-total	-.0959 (4.33)	-.0276 (1.74)		
Land Owned in Hectares				
Irrigated	.0112 (1.54)	-.0205 (18.5)		
Dry	.00582 (1.52)	-.0201 (23.0)		
Residential Areas				
Bangkok	-.0405 (.50)	.176 (4.34)	.449 (7.00)	.369 (5.56)
Municipal	-.298 (3.38)	-.277 (6.84)	1.22 (19.5)	1.28 (20.8)
Sanitary Districts (suburban)	-.0883 (.81)	.0305 (.72)	.710 (13.1)	.673 (9.57)
Northeast Region	-.0196 (.22)	.0502 (1.49)	-.557 (12.6)	-.552 (9.47)
Intercept	.827 (3.21)	.0719 (.52)	.128 (.66)	.669 (2.58)
Wage Earner Status (λ)				1.90 (10.8)
Rho (Eq. 2 and 3)			-.845 (62.4)	
Sigma			1.45 (60.5)	
Log likelihood	837.9		11972.00	6961.0
χ^2 (df)	176.9 (16)			3637.2 (10)
Sample size	7986	7986		7986

kc/TabIndiv/4/5-16-90

Table A-4

Labor Force and Wage Employment Participation Rates by Sex and Education
Ages 25 to 54 -- Thailand, SES: 1976, 1981 and 1986

Year, Sex and Education Group	Percent of Persons Aged 25 to 54	Percent of Education Group	
		in Labor Force	in Wage Employment
1976:			
Male:			
0 - 3 years	16.7	95.	32.
4 - 6 years	62.7	98.	37.
7 - 9 years	4.8	96.	50.
10 - 12 years	9.4	95.	71.
12+ years	6.4	95.	85.
All	100.0	97.	43.
Female:			
0 - 3 years	24.7	72.	13.
4 - 6 years	64.0	73.	11.
7 - 9 years	3.0	60.	14.
10 - 12 years	4.6	70.	45.
12+ years	3.7	87.	82.
All	100.0	73.	16.
1981:			
Male:			
0 - 3 years	12.3	97.	45.
4 - 6 years	63.3	99.	53.
7 - 9 years	12.8	97.	66.
10 - 12 years	8.8	95.	82.
12+ years	2.9	92.	86.
All	100.0	98.	57.
Female:			
0 - 3 years	18.9	82.	24.
4 - 6 years	66.1	84.	22.
7 - 9 years	7.2	71.	31.
10 - 12 years	5.9	86.	73.
12+ years	1.9	93.	88.
All	100.0	83.	28.
1986:			
Male:			
0 - 3 years	8.6	94.	46.
4 - 6 years	63.8	98.	49.
7 - 9 years	5.3	97.	52.
10 - 12 years	8.8	96.	68.
12+ years	13.4	95.	80.
All	100.0	97.	55.
Female:			
0 - 3 years	14.0	83.	29.
4 - 6 years	67.4	85.	27.
7 - 9 years	4.3	71.	23.
10 - 12 years	4.0	74.	32.
12+ years	10.4	84.	73.
All	100.0	83.	32.

Taindthai/9/6-8-89