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* The views expressed in this article are solely those of the author, and should not be attributed to the Federal Reserve Bank of Dallas or the Federal Reserve System.

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Labor Choices of Farm Families: Substitutes, Complements and Simultaneous Decision Making

The growing importance of off-farm income in the last 25 years to the well being of the agricultural sector has sparked some research attention to the off-farm labor supply of farmers. Empirical and theoretical work on off-farm labor supply, however, seems to have concentrated for the most part on the farmer's labor supply choices, with only token efforts made to include the possible simultaneous effects of other family members' decisions. If one considers the farm family as a decision unit, then it is likely that household, on-farm, and off-farm labor supply decisions by family members are jointly decided.

Uncovering clues to the labor arrangements of farm households may have important implications for the debate on the structure of agriculture. Some analysts claim that the U.S. is moving to a structure with a greater percentage of small farms, where off-farm work is the norm (Tweeten). Should that be true, then those farm households that exhibit the greatest flexibility in labor choices will likely stand the best chance of survival. If farm family labor inputs to farm production are substitutes, then off-farm work by one or more family members could be accommodated with greater ease. Conversely, if the dominate labor input relationships were complementary in nature then there would be less chance for a full-time farming family to make a transition to a smaller farming enterprise combined with some off-farm work.

This paper makes two methodological contributions: one, farm spouses are explicitly incorporated into the labor supply model, and two, labor supply decisions are simultaneously estimated with a two-stage probit procedure. This paper first reviews the labor supply literature in general, and the off-farm labor supply literature in particular. A simple static model that incorporates farmer and spouse decision making is then developed. From the theoretical model, empirical off-farm participation equations are simultaneously estimated for farmer and spouse. The empirical estimates show that simultaneous estimation makes a large difference in the effects of one spouse's off-farm labor decision on the other spouse. The main results are that farm wives labor tends to substitute for (rather than complement) male farmers on-farm labor when the latter engages in off-farm work.

Labor Supply Framework

Labor supply issues have been extensively studied in the economics literature with a large number of both theoretical and empirical research accomplished primarily in the last 25 years or so (Keeley). Male labor supply (DeVanzo et al) and female labor supply (Mroz) have been treated in depth, as have family labor supply (Blundell and Walker, Hausman and Ruud, Ransom).

The treatment of married females' labor supply is of special interest because analysis of farm families off-farm labor supply is analogous. The problem posed by farm families and nonfarm married women is that many do not hold off-farm or away-from-the-home jobs. That is, for some farm family members and some married women, wages and hours of outside employment are zero. Heckman (1974, 1979) contributed much to static one-period analysis of labor supply with censored samples.

Despite the extensive research of female labor supply response, the likely simultaneous nature of family labor supply decision making was acknowledged by its absence. For example, in the baseline model in Mroz's recent critical review of female labor supply studies, " ... the husband's behavior is considered exogenous" (page 767). Ransom, however, has contributed a model with explicit simultaneous consideration of husband and wife labor supply responses but his estimates for the compensated cross wage elasticities for both the husband and wife were not significant. Explicit treatment of the likely simultaneous nature of off-farm labor supply decisions by farm families is the purpose of this paper.

Farm Labor Supply

There have been a significant number of studies that have considered the economics of farmers working off the farm (Lee, Huffman, Sumner, Simpson and Kapitany, Van Kooten and Arthur). The techniques pioneered by Heckman were soon applied to farmers' off-farm labor supply. Sumner, in a paper published in this journal in 1982, estimated probability-of-participation, wages, and hours equations for a group of Illinois farmers. Van Kooten and Arthur undertook a somewhat similar analysis for Canadian farmers. Off-farm labor supply models have generally been limited to static one-period models. The issue of the labor supply of farm spouses has not been addressed, except as a variable in a more general nonfarm study (for example, Schultz) or as part of studies looking primarily at farmers (Sumner 1978, Lange).

One of the advantages of Heckman's two-stage method is the explicit treatment of the participation decision. In these models, a probit first stage is estimated which determines the probability of participating in off-farm employment. The participation equations offer one opportunity to investigate the interactive or simultaneous nature of off-farm labor supply decisions. In participation equations, the binary dependent variable (whether the farm family member works off the farm or not) is a function of the exogenous variables in the model. Typically in one-period static models, only a participation equation for the farmer is estimated although variables representing labor qualities of the farmer's spouse are usually included. An alternative approach would be to choose a model such that two participation equations would be estimated: one for the farmer, one for the farmer's spouse. In that way, the interactive nature of farm household decision making could be tested. Further, depending upon the signs and significances of the now-endogenous participation decisions, some inferences could be made about whether farmer and spouse labor are substitutes, complements, or independent.

This paper outlines a modest rearrangement of a standard one-period static labor model to include the spouse's contribution and then uses a two-stage simultaneous probit estimation to measure the effect of one spouse's labor off-farm labor supply decision on the other.

Modelling Farm Family Labor Supply

The farm family is abstracted to include just the farmer and the spouse. There is assumed to exist a family utility function whose arguments are family income and leisure time for both farmer and spouse. There is also assumed to be a production function that combines farmer and spouse labor, physical capital, and human capital to produce farm output and home production. The problem can be built up in a series of figures. Considering just the farmer, Figure 1 shows a single input (farmer labor) production function A-B, a wage line w_f, and an indifference curve U^f. In a static framework, this could adequately explain the farmer's equilibrium choice: the farmer equates the marginal returns from farming or home production to the off-farm wage at C to the marginal rate of substitution between income and leisure represented by the slope of the indifference curve U^f at point D. The farmer would work L^0_f hours on the farm, and L^I_f-L^0_f hours off the farm. The distance A-0 represents nonlabor income.

Similarly, the farm spouse could be considered in isolation. Assuming that the spouse works on the farm or for home production then the spouse's labor supply could be represented by Figure 2. Given a similar production function (A-E) with only spouse labor as input, the spouse would equate the marginal returns from farming or home production with the off-farm wage offer at point F, which in equilibrium would be tangent to the spouse's indifference curve U^s at G. That would result in L^0_s hours of work on the farm and L^1_s-L^0_s hours of work off farm.

If the farmer and spouse's labor supply decisions were considered jointly determined, then the process and the diagrams become more complicated. Figure 3, perhaps overly ambitious, attempts to include most of the decisions. The farmer works on the farm, and just considering his labor as input then the production surface reduces to line A-B. The spouse puts in farm labor and home production hours, and if she were alone, the production function would be A-E. The surface in between the two lines shows the increased production when both work on the farm at the same time.

Both farmer and spouse face off-farm wage offers, although they can be different and are in this diagram. The two wage lines intersect and are tangent to the production surface at point H. The two intersecting wage lines form a wage plane IJKL. The family utility surface $U^{f,s}$, represented by the bowl shaped feature, is tangent to the wage plane at point M. The farmer would work L^2_f hours on the farm and $L^3_f - L^2_f$ hours off the farm. Similarly, the spouse would work L^2_s hours on the farm and $L^3_s - L^2_s$ hours at an off-farm job. In this instance, both the farmer and spouse are in equilibrium when their off-farm wage offer equals their marginal return from farming equals their marginal rate of substitution between income and leisure time. One partner's choice influences the other, but the rates are not equalized across the two individuals.

The equilibrium conditions shown in Figure 3 suggest the derivation of the farmer and spouse off-farm labor participation decisions. First there is the farming production function which may be written:

(1) $$Q = f(L^f_f, L^f_s, H_f, H_s, K)$$

where

Q = farm output

$f(\cdot)$ = production function

L^f_f, L^f_s = labor input of farmer (f) and farm spouse (s)

H_f, H_s = human capital input of farmer and spouse

K = physical capital

The marginal return from farming for the farmer and his spouse would be:

(2) $$r_f = P\ Q_f(L^f{}_f,\ L^f{}_f,\ H_f,\ H_s,\ K)$$

(3) $$r_s = P\ Q_s(L^f{}_s,\ L^f{}_s,\ H_f,\ H_s,\ K)$$

where P = price of farm output

$Q_f(\cdot)$, $Q_s(\cdot)$ = marginal product from farming for the farmer and spouse

r_f, r_s = marginal return to farming for farmer and spouse.

Simplified wage equations for the farmer and the spouse may be:

(4) $$w_f = w(M,\ H_f)$$

(5) $$w_s = w(M,\ H_s)$$

where M = labor market characteristics

Finally, the family utility function may be described by

(6) $$U = U(L^n{}_f,\ L^n{}_s,\ Y)$$

where

$L^n{}_f$, $L^n{}_s$ = leisure time of the farmer and spouse,

Y = family income

and

$L^n{}_f$ = total time $- L^f{}_f - L^{of}{}_f$

$L^n{}_s$ = total time $- L^f{}_s - L^{of}{}_s$

$L^{of}{}_f$, $L^{of}{}_s$ = off-farm labor time of farmer and spouse

$Y = P\ Q(L^f{}_f,\ L^f{}_s,\ H_f,\ H_s,\ K) + w_f L^{of}{}_f + w_s L^{of}{}_s + Y_n$

Y_n = nonlabor income of the family

The marginal rate of substitution (MRS) between nonmarket time and family income is

(7) $MRS_f = U_f/U_y$

(8) $MRS_s = U_s/U_y$

where U_f, U_s, and U_y are partial derivatives of the utility function with respect to farmer leisure, spouse leisure, and income.

The standard equilibrium condition holds for each individual with the rates of return from off-farm work equaling the farming rate of return which is equal to the marginal rate of substitution between nonmarket time and family income. That was shown as point M in Figure 3 and in the following two equations:

(9) $r_f = w_f = MRS_f$

(10) $r_s = w_s = MRS_s$

There are 13 unknowns in the model: two rates of return from farming; two off-farm wage rates; two marginal rates of substitution; six time-allocation variables: $L^f{}_f$, $L^f{}_s$, $L^{of}{}_f$, $L^{of}{}_s$, $L^n{}_f$ and $L^n{}_s$; and family income. These 13 unknowns are matched with six definitional equations (equations 2-5,7,8), the time constraints of the farmer and spouse, the definition of family income, and four equilibrium conditions (equations 9 and 10). While the model is theoretically solvable, the main interest for this paper centers on the equilibrium conditions. Note that the model does not require the farmer's equilibrium conditions to equal those of the spouse. Thus wages, rates of return from farm work, and the joint evaluation of leisure time expressed through the family utility function can be different for each individual. While different, that does not mean that decisions are made independently; the family utility function ensures that individual choices conform to mutual preferences.

Given the time constraints, only four of the six time allocation variables are independent. The four selected here are on- and off-farm labor supply decisions for farmer and spouse. Theoretically there is no need for either the farmer or the spouse to work on the farm -- off-farm returns for both could dominate on-farm returns at all levels of work. Such a choice is broader than the scope of this paper and thus only farmers that actually farm will be considered. That leaves three family labor participation choices: on-farm labor by the spouse and off-farm labor by both. All spouses are considered to engage in farm labor either directly through production activities or through support (home production, bookkeeping, marketing, etc). What is left is that both the farmer and the spouse are assumed to be in similar positions: both work on the farm or in the farm household with the option on engaging in off-farm work.

Given that the separate optimizations are joined through the utility function, the participation choices are modeled simultaneously. The participation decisions are simultaneously modeled as functions of the relevant exogenous variables and the endogenous participation decision of the farmer or spouse as appropriate.

$$(11)\quad PL^{of}_{f} = f(\underset{-}{P},\ \underset{-}{K},\ \underset{?}{H_f},\ \underset{+}{M},\ \underset{-}{Y_n},\ \underset{?}{PL^{of}_{s}})$$

$$(12)\quad PL^{of}_{s} = f(\underset{-}{P},\ \underset{-}{K},\ \underset{?}{H_s},\ \underset{+}{M},\ \underset{-}{Y_n},\ \underset{?}{PL^{of}_{f}})$$

The PL variables are binary variables reflecting the decision whether or not to take part in an activity. The signs under the variables indicate expectations one might expect from economic theory. Increased prices for agricultural output would have a positive effect on on-farm work and a negative effect on work off the farm. At the individual level, increases in the amount of agricultural capital that enlarges the scale of the farming operation is likely to leave less time for off-farm work by farmers. That would mean larger capital stocks would have a negative influence on off-farm participation. A competing hypothesis could be that some additional capital, keeping the scale of the operation fixed, would free up labor time, so that increased capital would have a positive effect on off-farm decision making. As the marginal product of farmers' time increases with increased capital and to the degree that spouses' time is substitutable for farmers' time, the value of home production and farming time should increase relative to outside employment for farm spouses on farms and ranches characterized by larger amounts of capital. Strong labor market factors (M) could serve to increase off-farm job opportunities. Nonlabor income is likely to depress the incentive to work more hours, either on or off the farm.

The signs and significances of the coefficients of other-spouse participation decision variables should reveal much about the division of farm household labor. The predicted values of the participation decision variable incorporate the effects of market wage offers through exogenous variables that are usually included in wage equations. (For example, Sumner 1982). This grounds the participation decision in traditional substitution/complementary relationships that are hallmarks of goods in utility functions and inputs in production functions.

Specifically, when the off-farm wage offer changes to one spouse there at least three sets of effects. The first is the own-price effect, that is whether the increase in wage increases hours worked or whether the income effect reduces hours supplied (the backward bending labor supply curve phenomenon). Further, if hours of work are changed, how are they divided between farm work and off-farm employment? The second effect is a cross-price effect on the amount of leisure taken by each spouse. The third, which is tied to the second, is also a cross-price effect: how will the change in one spouse's wage influence the other spouse's labor supply? If the other spouse changes farm labor hours in the same direction as the off-farm wage offer to the first spouse, then husband and wife farm labor inputs are gross substitutes for each other. If, however, the other spouse changes farm labor hours in the opposite direction, then husband and wife farm labor inputs are complements.

The own-price effect is partially captured in the participation estimation, to the degree that taking off-farm employment in addition to farming or home production may well entail more job hours. More properly, however, such determinations would be made from hours equations' estimations (Mroz). The effects on leisure will remain unexamined because neither the model proposed nor the data set chosen can discriminate between home production and leisure. But the off-farm labor participation decisions, being partial functions of the off-farm wage offer, can shed light on the substitute or complementary nature of husband-wife labor used in farming/home production. If the decision variables are insignificant in both equations then the off-farm labor supply decisions of the farmer and the spouse are completely separable. That would confirm the decisions of some previous modelers that the simultaneous treatment of participation decisions was unnecessary.

Various combinations of signs and significances of participation variables and their implications in spouse off-farm labor decisions are shown in Table 1. If the focus on the farm family is made very traditional (considering only married male farmers) then some expectations can be made. For example, suppose the off-farm wage offer to the farmer exceeds on-farm returns at current farm labor input. Figure 1 indicates that the farmer would reduce farm labor hours, equilibrate the returns, and work off the farm. If the effect of the husband's off-farm labor supply decision is positive and significant on the wife's decision, it most likely means that the wife will also reduce home production/farming work hours in favor of work hours off the farm. Such results would indicate a complementary nature to husband-wife farm labor.

Estimating Participation in On- and Off-farm Work

The variables to be included in the equations are suggested by the previous section: output prices, physical and human capital, labor market characteristics, farm production attributes, nonlabor income, and participation decisions regarding other types of work. Given that this is a cross-section analysis, output prices are assumed the same for all and thus are incorporated into the constant term. Data on farm physical capital is not readily available on the data set used so capital is proxied by household farm income. Farm household income is not an ideal proxy because of possible complications with endogeneity. Farmers and farm spouses acceptability as off-farm employees is dependent both on labor market conditions and job qualifications held by the individuals. No effective job market conditions proxies were found; thus that part of the model was unspecified. Personal job qualifying characteristics such as experience and education were proxied by age and schooling. Health can also play a significant role so a binary disability variable was included. The level of nonlabor income, economic theory suggests, would negatively effect labor supply to all endeavors. The characteristics of the production technology are only grossly proxied by a binary variable indicating whether the farm is classified as a livestock operation or a crop farm. The number of children 5 and under has been included because studies of female labor supply have shown this to be a significant factor in a woman's decision on whether to supply labor other than for household production. Rounding out the model are the binary participation decision variables.

Data and Empirical Models

Seemingly important for any study of off-farm labor supply is the definition of farmer that is chosen. The empirical results are likely conditioned by the definition of who is considered a farmer. Most of the recent studies (Van Kooten and Arthur, Simpson and Kapitany, Sumner 1982) did not discuss how the farmer was defined in their papers. One reference definition could be one that is derived from the U.S. Department of Agriculture's (USDA) definition of a farm. As is generally known, the USDA has a very inclusive definition of farms from which springs a relatively large number of operators. The USDA defines a farm as a place that produces or has the potential to produce $1,000 of annual gross sales of agricultural products. A second definition of farmer might be one that selects those who consider their principal occupation to be farming or ranching. The above two definitions of farmers were used in this paper. The first definition attempts to be consistent with the USDA definition of farms by selecting those individuals with at least $130 in Census-defined farm self-employment income. Farm self-employment income correlates closely with the new "net business income" for farmers used by the USDA (Economic Indicators, 1985). The Census data are for the year 1979 and in the three years 1978-1980, farmers' net business income was about about 13 percent, on average, of their gross sales. Since Census data were used, the second definition selects those individuals that listed their occupations as farmers (occupation codes 473 and 474).

The data are from the Public-Use Microdata Sample for Texas and California from the 1980 Census of Population and Housing. Texas and California were chosen because of their diverse agriculture, so that results from these states might be representative of the nation. The desire to capture the most basic family interactions lead to restricting the sample to households with male householders with spouse present. With those restrictions the number of households in the Texas sample totaled 3,053 using the occupational definition of farmer. With the USDA or income-based definition there were 4,971 households. For California, the sample included 1,448 households under the occupation definition, 2,774 with the income definition. Table 2 shows the all the variables used in the model along with their means.

Two sets of models were estimated. First, separate participation equations were estimated for farmer off-farm work and spouse off-farm work. In each, the other spouse's participation decision was included as a binary exogenous variable. In the second model, the two participation equations were estimated simultaneously using a two-stage probit procedure suggested by Mallar.

Mallar's technique is analogous to two-stage least squares in linear estimation. Basically the first stage involves regressing each of the binary decisions variables on all the exogenous variables. The second stage involves probit estimation of the model equations using the first stage predictions of the probit index for each of the endogenous decision variables.

Results

Tables 3-6 give the model estimates for Texas and California, with separate regressions by farmer definition. Besides the model coefficients, t-statistics, and derivatives, three measures of goodness-of-fit are included: -2.0 x likelihood ratio, pseudo-R^2, and the percent correctly classified of those that actually worked off-farm (Judge et al). Comparing the likelihood ratios and the psuedo-R^2 for across spouses, farmer definitions, and states shows that (1) equations for farmers' spouses have better fits that equations for farmers, (2) the income definition of farmer provides a markedly better fit that does the occupational definition, and (3) California data seem to fit the model better than Texas data. The results for the off-farm labor supply decision variables show that (1) when decision variable coefficients are estimated exogenously, the estimates across all the models are positive, significant, and very close to each other in magnitude, and (2) when decision variable coefficients are endogenously determined, signs, significances, and magnitudes change from model to model.

Homing in on the decision variables, the exogenously estimated versions indicate complementarity between the farmer and the spouse across all models. The endogenously estimated decision variable coefficients are not significant in the Texas occupational definition model (Table 3). Given the nature of the two-stage estimation process, the low explanatory power of the farmer first-stage (not reported) may have precluded a meaningful second stage estimate. Alternatively, in Texas, using the occupational definition of farmer, the off-farm work decisions of farmer and spouse are independent.

When the income definition of farmer is used (Table 4), the Texas results change markedly. The goodness of fit measures increase substantially, including correctly classifying 86 percent of farmers that actually worked off the farm. The spouse goodness-of-fit results also show considerable improvement. The endogenously determined decision variable coefficients are now significant. The most noticeable difference is the large change when the farmer participation variable in the spouse equation is estimated as a endogenous variable as opposed to an exogenous one. The estimate goes from being positive and significant to negative and significant. The endogenously determined spouse participation variable in the farmer regression is similar in sign and magnitude to the exogenous estimate. Taken as a pair the endogenously estimated farmer/spouse participation coefficients fall into a category that, as shown in Table 1, seem unlikely: farmer and spouse have significant but oppose effects on the other. Comparing the magnitudes of the derivatives, however, offers some solace -- the farmer's effect is to reduce the spouse's probability of off-farm work by 11 percentage points, about twice the size of the effect of the spouse on the farmer. This probably indicates a net substitution relationship of off-farm labor supply.

Turning to the remainder of the Texas results, the number of children five and under had no effect on the farmer's off-farm labor decisions but was uniformly negative and significant for the spouse. That result is a measure of division of labor between farming and home production. Also, as discovered in unreported regressions, the effect of including the number of children tended to knock the significance out the age variable in the spouse regression. Farm income, which was used as a measure of the scale of operation, proved to be negative and significant as expected. The larger the scale of the farming operation, the greater the likelihood that full-time attention was needed.

For California farmers and their spouses the results (Tables 5 & 6) were generally different from those estimated for Texas. The goodness-of-fit measures were, with one exception, larger in magnitude than the Texas measures. For both definitions of farmer, the endogenously determined farmer decision variable coefficient in the spouse equation was negative and significant, while the spouse off-farm work variable coefficient in the farmer equation was insignificant. These results would indicate that farmer and spouse labor tended to be substitutes. If the farmer worked off the farm, that would influence the spouse to stay on the farm, and conversely. The magnitude of the influence of the farmer's off-farm choice on the spouse's off-farm work decision was quite large. For the occupational definition of farmer (Table 5), a farmer electing to work off the farm would lower the spouse's probability of working off the farm by 19 percentage points. For the income definition of farmer (Table 6), the farmer's choice lowers the spouse's probability of off-farm work by 9 percentage points.

Conclusion

On balance, the results would seem to indicate the following: First, that simultaneous estimation of off-farm participation equations shows that there are real and significant interactive effects in farm family decision making. Second, simultaneous modeling shows farmer/spouse labor to be substitutes rather than complements as exogenous estimation would lead one to be believe. Third, generally the probability of the farmer's spouse working off-farm declines 9 to 19 percentage points, depending on the sample selected, if the farmer chooses to work off the farm. Fourth, this effect however, is not symmetrical: with one exception, the spouse's off-farm work decision has little impact on the farmer's off-farm labor supply choice. Fifth, choice of definition of farmer and choice of sample of farmers can make a difference in the estimated results: most subpopulations are probably not representative of a larger U.S. population of farmers. Even using such large and diverse states as California and Texas, the estimated results contain some significant differences.

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FIGURE 1. ONLY FARMER WORKS

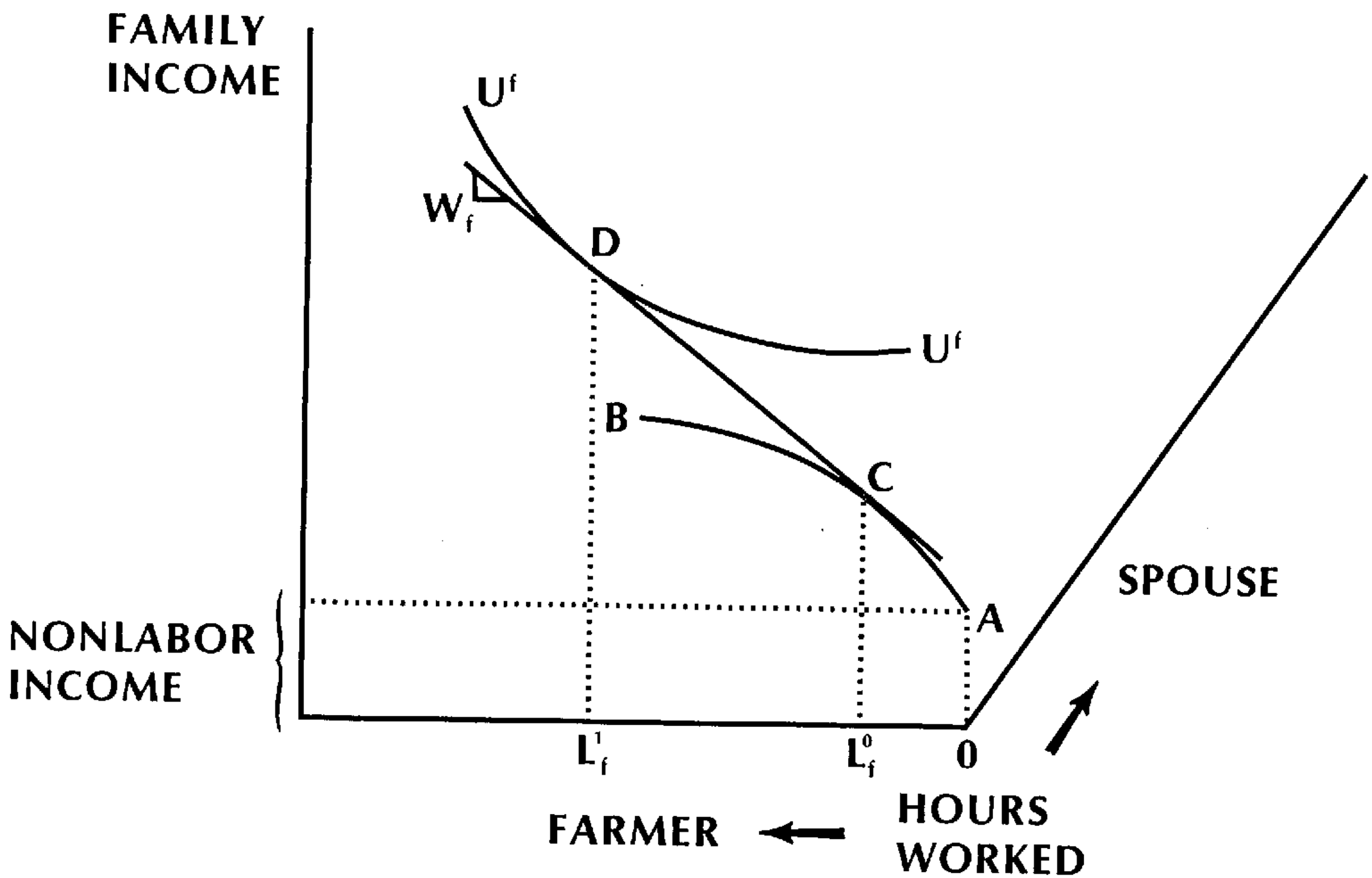

FIGURE 2. ONLY SPOUSE WORKS

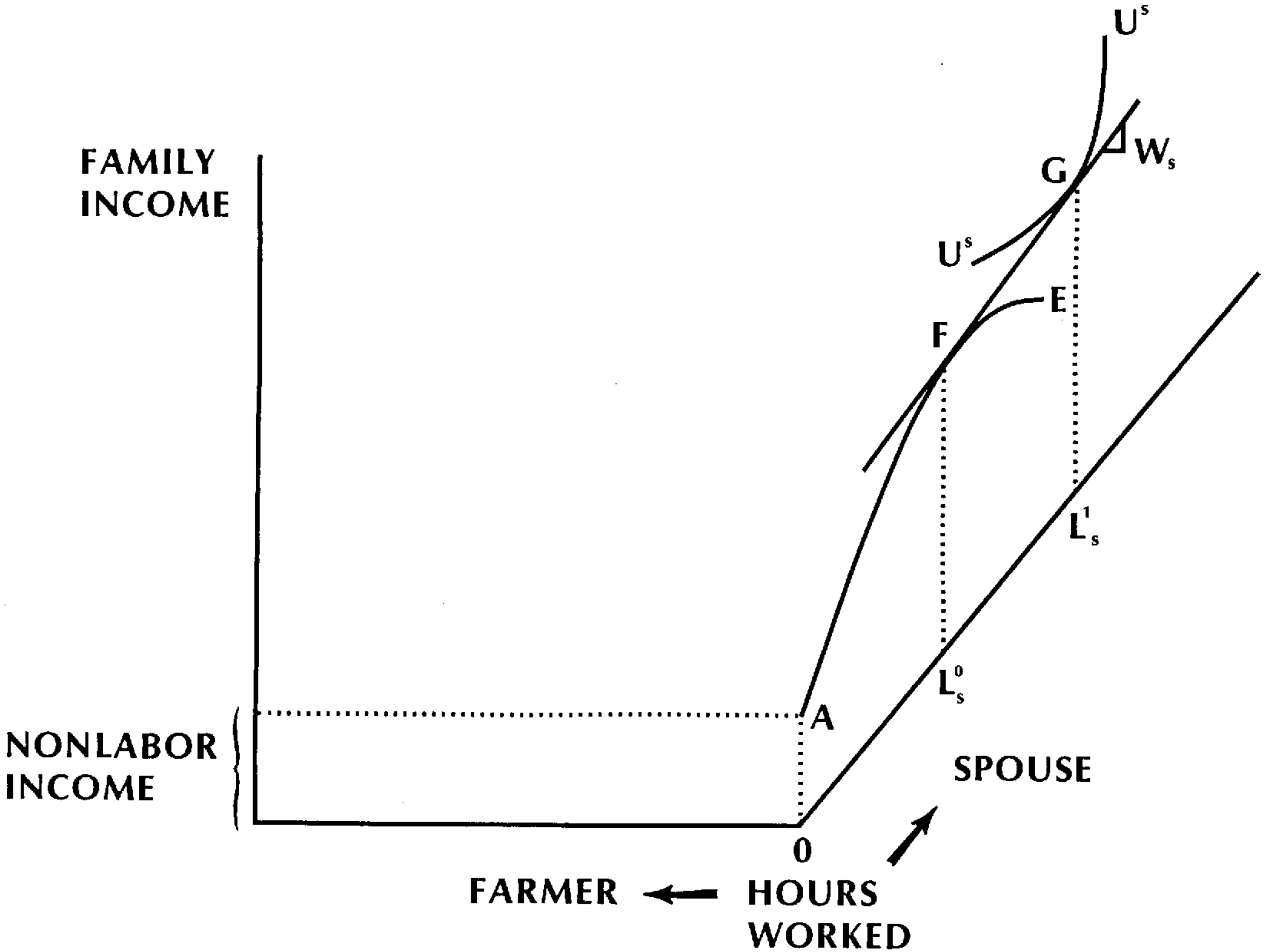

FIGURE 3. FARMER AND SPOUSE WORK ON AND OFF THE FARM

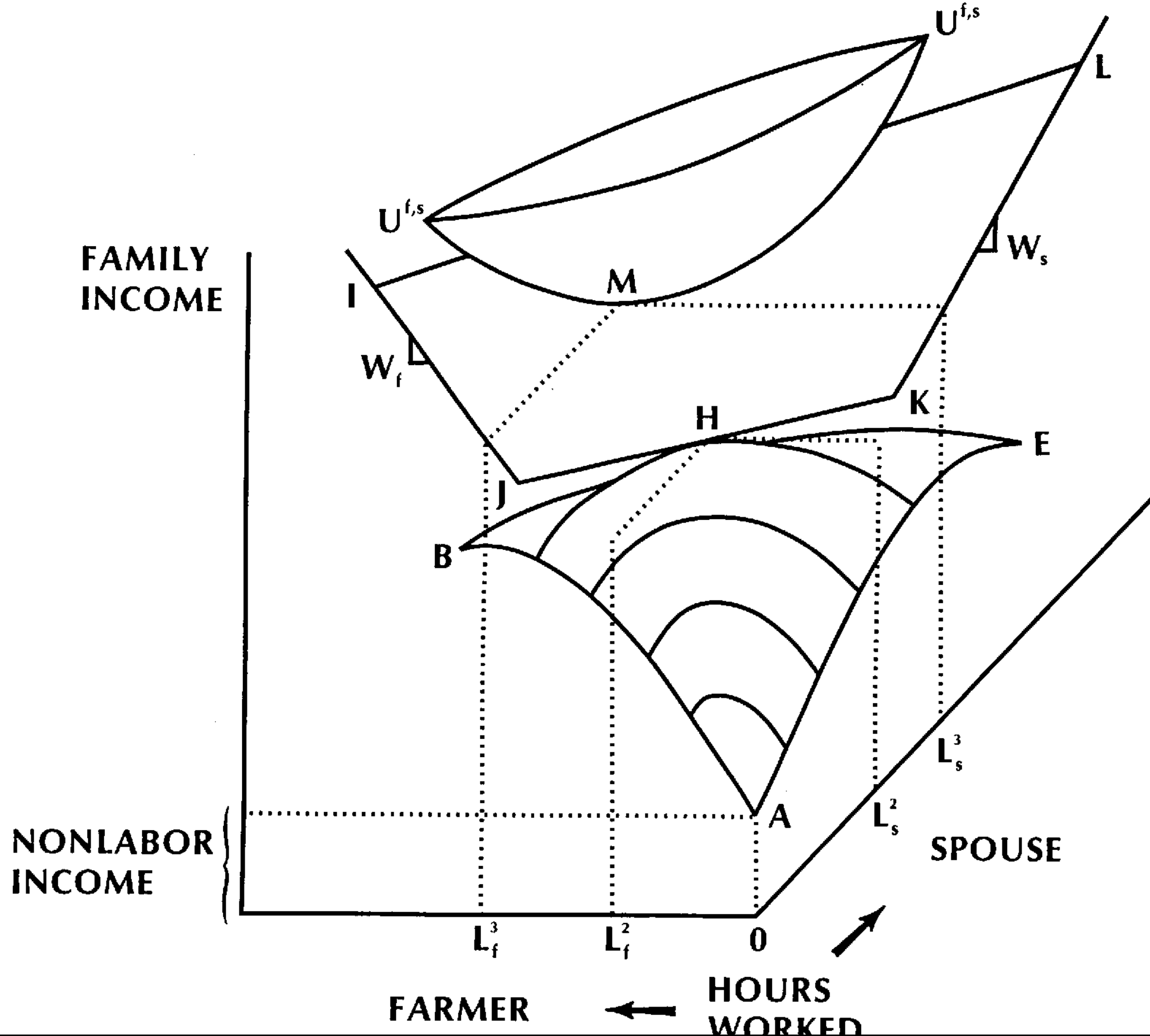

Table 1. Implications of Off-Farm Labor Choices

Effect of Labor Decisions	Signs and Significances of Off-Farm Labor Supply Coefficients	
	Effect of Farmer's Decision on Spouse	Effect of Spouse's Decision on Farmer
Substitutes	Negative Negative	Negative Insignificant
Complements	Positive Positive	Positive Insignificant
Independent	Insignificant	Insignificant
Unlikely	Insignificant Insignificant	Positive Negative
Inconsistent	Positive Negative	Negative Positive

Notes:

"Positive" indicates a coefficient estimate that is positive and significant.

"Negative" indicates a coefficient estimate that is negative and significant.

"Insignificant" indicates a coefficient that is not statistically significant at the 5 percent level.

Table 2. Means of Model Variables

	Definition of Farmer			
	Texas		California	
	Occupation	Income	Occupation	Income
Farmer				
Work Off-Farm (1=yes, 0=no)	0.22	0.59	0.22	0.62
Age (Years)	54.10	51.68	51.58	50.10
Age Squared	3169.49	2887.91	2863.01	2687.70
Schooling (grades completed)	11.13	12.22	11.87	13.05
Health (1=disabled, 0=not)	0.18	0.13	0.12	0.096
Spouse				
Work Off-Farm	0.36	0.45	0.36	0.43
Age	50.82	48.46	47.98	46.76
Age Squared	2814.33	2555.32	2495.98	2359.46
Schooling	11.65	12.21	12.13	12.64
Health	0.11	0.084	0.087	0.076
Family				
Children 5 And Under	0.19	0.20	0.25	0.24
Non-Labor Income ($)	6106.15	5452.71	6279.45	5719.97
Farming Income ($)	10225.94	9437.44	16862.16	13455.90
Livestock Farm (1=Livestock, 0=not)	0.37	0.18	0.26	0.11
Number	3053	4971	1448	2774

Table 3. Probability of Participation in Off-Farm Employment in Texas - Occupational Definition of Farmer

Variable	Farmer	Derivative	Spouse	Derivative
Intercept	-6.68 (-4.91)	-0.16	-0.085 (-1.78)	-0.24
Age	0.031 (2.60)	-0.0020	0.013 (0.94)	-0.0043
Age Squared	0.00034 (-2.96)	----	0.00039 (-2.66)	---
Non-Labor Income1/	0.0017 (0.071)	0.00068	-0.081 (-3.52)	-0.032
Years of Schooling	0.029 (3.19)	0.011	0.088 (8.99)	0.021
Health	0.056 (0.78)	0.022	-0.46 (-4.88)	-0.18
Livestock Farm	0.094 (1.74)	0.037	-0.025 (-0.43)	-0.010
Children 5 And Under	0.058 (0.83)	0.023	-0.42 (-6.85)	-0.17
Farm Income1/	-0.13 (-6.54)	-0.051	-0.098 -(2.64)	-0.039
Spouse Choice of Off-Farm Work Exogenous Estimation2/	0.14 (2.62)	0.058	0.15 (2.62)	0.061
Spouse Choice of Off-Farm Work (Simultaneous Estimation3/	-0.00075 (-0.0091)	-0.00030	-0.16 (-0.62)	-0.064
-2.0 X Log Likelihood Ratio	82.45		441.94	
Pseudo-R^2	0.03		0.11	
Percent Correctly Classified	0		28.79	
Average Probability of Off-Farm Employment Employment	0.21		0.34	

1 Income data used were in units of $10,000.
2 This is an estimate from a separate regression--included here for comparison.
3 In the farmer equations, this is the predicted value of the probit index for the spouse. In the spouse equations, it is the predicted value for the farmer.

Note: Asymptotic t-statistics in parenthesis.

Table 4. Probability of Participation in Off-Farm Employment in Texas - Income Definition of Farmer

Variable	Farmer	Derivative	Spouse	Derivative
Intercept	-2.89 (-10.70)	-0.018	-0.81 (-2.78)	-0.23
Age	0.13 (12.93)	-0.0040	0.038 (3.06)	-0.0035
Age Squared	-0.0013 (-14.02)	---	-0.00074 (-5.41)	--- -.000049
Non-Labor Income1/	0.11 (5.14)	0.044	-0.085 (-4.00)	-0.034
Years of Schooling	0.083 (13.11)	0.020	0.10 (11.66)	0.019
Health	-0.26 (-4.14)	-0.10	-0.40 (-5.07)	-0.16
Livestock Farm	-0.92 (-17.00)	-0.36	-0.40 (4.81)	-0.16
Children 5 and Under	0.63 (1.15)	0.025	-0.44 (-9.89)	-0.17
Farm Income1/	-0.37 (-20.07)	-0.14	-0.22 (-7.38)	-0.085
Spouse Choice of Off-Farm Work (Exogenous Estimation2/	0.20 (4.60)	0.080	0.16 (3.43)	0.062
Spouse Choice of Off-Farm Work (Simultaneous Estimation3/	0.14 (2.04)	0.056	-0.27 (-4.06)	-0.11
-2.0 X Log Likelihood Ratio	1786.27		856.27	
Pseudo-R^2	0.27		0.13	
Percent Correctly Classified	85.55		56.34	
Average Probability of Off-Farm Employment	0.61		0.44	

1 Income data were used in units of $10,000.
2 This is an estimate from a separate regression--included here for comparison.
3 In the farmer equations, this is the predicted value of the probit index for the spouse. In the spouse equations, it is the predicted value for the farmer.

Note: Asymptotic t-statistics in parenthesis.

Table 5. Probability of Participation in Off-Farm Employment in California - Occupational Definition of Farmer

Variable	Farmer	Derivative	Spouse	Derivative
Intercept	-1.41 (-2.83)	-0.21	-1.24 (-2.06)	-0.23
Age	0.0097 (0.52)	-0.00062	0.027 (1.36)	-0.0035
Age Squared	-0.00011 (-0.58)	---	-0.00064 (-3.06)	---
Non-Labor Income1/	0.019 (0.52)	0.0075	-0.021 (-0.60)	-0.0086
Years of Schooling	0.054 (4.39)	0.017	0.095 (4.74)	0.020
Health	-0.21 (-1.71)	-0.085	-0.28 (-1.97)	-0.11
Livestock Farm	0.17 (2.05)	0.070	-0.0013 (-0.014)	-0.0051
Children 5 and Under	-0.032 (-0.33)	-0.013	-0.54 (-6.85)	-0.21
Farm Income1/	-0.13 (-5.46)	-0.052	-0.18 (-4.39)	-0.067
Spouse Choice of Off-Farm Work (Exogenous Estimation2/	0.24 (2.93)	0.094	0.23 (2.69)	0.092
Spouse Choice of Off-Farm Work (Simultaneous Estimation3/	0.073 (0.59)	0.029	-0.52 (-2.03)	-0.19
-2.0 X Log Likelihood Ratio	82.25		202.85	
Pseudo-R^2	0.05		0.11	
Percent Correctly Classified	0		30.72	
Average Probability of Off-Farm Employment	0.21		0.34	

1 Income data were used in units of $10,000.
2 This is an estimate from a separate regression--included here for comparison.
3 In the farmer equations, this is the predicted value of the probit index for the spouse. In the spouse equations, it is the predicted value for the farmer.

Note: Asymptotic t-statistics in parenthesis.

Table 6. Probability of Participation in Off-Farm Employment in California - Income Definition Of Farmer

Variable	Farmer	Derivative	Spouse	Derivative
Intercept	-2.00 (-5.20)	-0.11	-0.72 (-1.90)	-0.22
Age	0.096 (6.48)	-0.0044	0.042 (2.59)	-0.0044
Age Squared	-0.0011 (-7.36)	---	-0.00078 (-4.34)	---
Non-Labor Income1/	0.039 (1.48)	0.015	-0.012 (-0.48)	-0.0046
Years of Schooling	0.076 (9.56)	0.019	0.70 (7.03)	0.019
Health	-0.17 (1.89)	-0.070	-0.36 (3.52)	-0.14
Livestock Farm	-0.85 (-9.59)	-0.34	-0.40 (-3.34)	-0.16
Children 5 and Under	-0.056 (-0.86)	-0.023	-0.42 (-7.58)	-0.17
Farm Income1/	-0.27 (-13.92)	-0.10	-0.18 (-6.00)	-0.070
Spouse Choice of Off-Farm Work (Exogenous Estimation2/	0.26 (4.56)	0.10	0.24 (4.03)	0.093
Spouse Choice of Off-Farm Work (Simultaneous Estimation3/	0.074 (0.75)	0.030	-0.23 (-2.56)	-0.090
-2.0 X Log Likelihood Ratio	799.06		344.98	
Pseudo-R^2	0.22		0.09	
Percent Correctly Classified	87.80		48.46	
Average Probability of Off-Farm Employment	0.64		0.42	

1 Income data were used in units of $10,000.
2 This is an estimate from a separate regression--included here for comparison.
3 In the farmer equations, this is the predicted value of the probit index for the spouse. In the spouse equations, it is the predicted value for the farmer.

Note: Asymptotic t-statistics in parenthesis.