Off-Farm Work Participation, Off-Farm Labor Supply and On-Farm Labor Demand of U.S. Farm Operators

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Abstract

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An agricultural household model provides the framework for modeling off-farm work participation and off-farm and on-farm work decisions of farm operators. The empirical results are obtained from fitting the econometric model to data from a large national survey. In the estimated structural off-farm work participation equation, the operator's off-farm wage offer has a strong positive effect and other household income has a negative effect on the probability of off-farm work. For farm operators who participate in off-farm work, the wage elasticity of their off-farm labor supply is positive but of their on-farm labor demand is zero. The income elasticity of off-farm work for those who participate in off-farm work and of on-farm work for those who specialize in farm work is negative. Implications are developed for the farm problem.

Key words: agricultural household model, farm operator, off-farm work, on-farm work, off-farm wage, time allocation, farm family labor.

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Wallace E. Huffman and Hisham El-Osta*

Multiple job-holding by members of farm households in the U.S. and in other Western countries has become a well established strategy for diversifying households' financial position. Ahearn, Perry, and El-Osta (1993) show that off-farm income in 1990 comprised 85 percent of total household income with most of the off-farm income--82 percent for the reporting household--generated in the form of wages and salaries. With the exception of 1973 and 1975, when farm commodity prices were relatively high, U.S. farm operators' non-farm income has exceeded their net farm income, a trend that has been evident since 1968 (Huffman, 1991). Before World War II about 6 percent of all farm operators worked off the farm 200 or more days each year (Carlin and Ghelfi, 1979), but recent Census data show that the proportion of operators working 200 or more days has risen to over 30 percent (U.S. Department of Commerce, 1994, p.8). The increase in the proportion of dual employment by

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farm operators is part of the long structural change that has occurred in U.S. agriculture (Huffman and Evenson 1997).

Agricultural household models provide the framework for modeling farm and off-farm work participation and hours of work decisions of farm household members. Several U.S. studies have focused on the off-farm participation and hours decisions of the farm operator or farm operator and spouse, e.g., Huffman 1980, Gould and Saupe 1989, Huffman and Lange 1989, Lass, Findeis, and Hallberg 1989, Lass and Gempesaw 1992, Tokle and Huffman 1991, and Jensen and Salant 1985. These studies have almost exclusively used samples where the population resides in one or two states. One exception is a study by Tokle and Huffman 1991 who use a national sample from the Current Population Survey to examine off-farm work participation decisions. Another exception is El-Osta and Ahearn 1996, who use an early USDA Farm Costs and Returns Survey (FCRS) to examine off-farm work participation decisions and to impute opportunity cost to unpaid farm labor for U.S. farm operators. These studies have not focused on the other major dimension of work for farm household members--on farm work.[1] In studies of Israeli farm households, Kimhi 1994 examined both the decision to participate in farm and off-farm work. The Israeli data, however, contain only qualitative information on the extent of on-farm and off-farm work and not data on hours of work.

The purpose of this paper is to provide econometric evidence for off-farm work participation, off-farm hours of work, and on-farm hours of work of U.S. farm operators. On-farm hours decisions are examined for both farm operators who participate in off-farm wage work and those who specialize in on-farm work. Hence, we attempt to advance knowledge about farm operators' work decisions by providing a set of results, including new behavioral estimates for on-farm hours, that permit a broader set of comparisons than earlier studies of off-farm work. The observations for this study are farm operators in the 1991 FCRS, and information from this survey is supplemented by state level data on climate and economic conditions.

The next four sections describe the economic model; the data, variables, and econometric model; the empirical results; and conclusions and implications.

The Economic Model

The agricultural household model is the basis of our economic modeling. The model combines the agricultural producer, consumer, and labor-supply decisions of agricultural households into a single conceptual framework. The practical implication is that a large number of decisions are made jointly, including choice of inputs, outputs, and technologies for farm production, inputs/goods for household consumption, and off-farm work participation and work hours by household members (see Huffman 1991).

The labor supply decisions of members of farm operator households are derived from a behavioral model that permits both farm and off-farm work (see Huffman 1991). Under the assumption that the decision unit considered here is a risk-neutral single-family farm household with one utility function and that operator's and spouse's time are heterogeneous, the optimal allocation of time by farm operators and their spouses between leisure, on-farm work and off-farm work is obtained by solving the following optimization problem:[2]

$$Maximize\ U = U(T_h^o,\ T_h^s,\ Y;\ \zeta^o,\ \zeta^s,\ \tau), \tag{1}$$

subject to the constraints:

$$\bar{T} = T_f^i + T_m^i + T_h^i, \quad T_m^i \geq 0, \qquad i=o,\ s, \tag{2}$$

$$P_y Y = \sum{}_i W_m^i T_m^i + (P_q Q - W_x X) + V, \tag{3}$$

$$Q = Q(T_f^o,\ T_f^s,\ X;\ \zeta^o,\ \zeta^s,\ \phi). \tag{4}$$

where U in (1) is farm household's utility (or welfare) function; Y denotes goods purchased in the market, T_h^o and T_h^s are operator's (o) and the spouse's (s) hours of leisure; ζ is family human capital; and τ represents other factors such as life stage, number of children. In equation (2), $\bar{T}$ is the annual hours endowment for the operator and the spouse, T_f^i is annual hours allocated to farm work, and T_m^i is annual hours allocated to off-farm work. We specifically consider the possibility that optimal off-farm work hours for an individual might be zero in any year and is equal to zero for a significant share of our sample households, a nonnegativity constraint is hence imposed on T_m^i.[3] In equation (3), P_y denotes the price of consumption good Y, W_m^i represents the hourly wage for non-farm work, the term $(P_q Q - W_x X)$ depicts the net income of the farm business where P_q is price of farm output Q and W_x is price of purchased farm inputs X, including hired farm labor, and V signifies other household income. The technology of farm production is described by $Q(.)$ in (4) with ϕ depicting location specific characteristics, e.g., local climate and soils.[4]

The wage-offer for non-farm work (W_m^i where $i=o,\ s$) in (3) depicts the off-farm labor demand facing the operator (or the spouse) and as such, is assumed to depend on the individual's marketable human capital (ζ^i) and job or locational characteristics--local labor market conditions (Ω), local cost of living (ψ), and locational amenities (Δ), but not on the amount of current off-farm work hours (Topel 1986; Kenny and Denslow 1980; Tokle and Huffman, 1991). Local labor markets are linked by human (labor) and employer mobility. This means that compensating wage differentials exist for important personal, local labor market, and local amenity factors (Rosen 1986; Topel 1986). This off-farm labor demand function is summarized as

$$W_m^i = W_m^i(\zeta^i, \Omega, \psi, \Delta), \qquad i = o, s. \tag{5}$$

Upon substituting *Q(.)* into the cash-income constraint represented in (3), the following combined cash income-technology constraint is also obtained:

$$\sum{}_i W_m^i T_m^i + [P_q Q(T_f^o, T_f^s, X; \zeta^o, \zeta^s, \phi) - W_x X] + V - P_y Y = 0. \tag{6}$$

Assuming an interior solution for all allocations except for T_m^i, the Kuhn-Tucker conditions for maximizing (1) subject to (2) and (6) are:

$$\lambda[P_q \partial Q/\partial X - W_x] = 0, \tag{7}$$

$$\lambda P_q \partial Q/\partial T_f^i - \gamma^i = 0, \qquad i = o, s, \tag{8}$$

$$\begin{aligned} &\lambda W_m^i - \gamma^i \leq 0, \\ &\qquad T_m^i \geq 0, T_m^i(\lambda W_m^i - \gamma^i) = 0, \quad i = o, s, \end{aligned} \tag{9}$$

$$\partial U/\partial T_h^i - \gamma^i = 0, \qquad i = o, s \tag{10}$$

$$\partial U/\partial Y - \lambda P_y = 0, \tag{11}$$

$$\bar{T} - T_f^i - T_m^i - T_h^i = 0, \qquad i = o, s. \tag{12}$$

and the budget constraint (6), where λ and γ^i (i=o, s) are Lagrange multipliers for income and for marginal utility of farm operator's and spouse's time, respectively.

Equations (8)-(10) provide the marginal conditions for optimal time allocation by the operator and the spouse. If $W_m^i < \gamma^i/\lambda$, then an individual's hours are allocated between leisure and on-farm work so that $\dfrac{\partial U/\partial T_h^i}{\lambda} = P_q \dfrac{\partial Q}{\partial T_f^i}$ and $T_m^{i*} = 0$, and no off-farm work occurs. If $W_m^i = \gamma^i/\lambda$, then an individual's hours are allocated among leisure, on-farm work, and off-farm work so that $\dfrac{\partial U/\partial T_m^i}{\lambda} = P_q \dfrac{\partial Q}{\partial T_f^i} = W_m^i$. On-farm and off-farm work occur.

When $W_m^i = \gamma^i/\lambda$ an interior solution occurs and the decision on optimal production of Q are separate from optimal consumption decisions (Strauss 1986, Huffman 1991). In this case, equations (7)-(9) can be solved for optimal on-farm work of the operator and spouse and other farm inputs. In particular, the demand functions for hours of on-farm work and purchased farm inputs are summarized as:

$$T_f^{i*} = G_{T_f^i}(W_m^o, W_m^s, W_x, P_q, \zeta^o, \zeta^s, \phi), \qquad i = o, s \tag{13}$$

$$x^* = G_x(W_m^o, W_m^s, W_x, P_q, \zeta^o, \zeta^s, \phi). \tag{14}$$

Using equations (6), (10), (11), (13) and (14), we obtain the demand function for operator's and spouse's leisure:

$$T_h^{i*} = G_{T_h^i}(W_m^o, W_m^s, P_y, V, W_x, P_q, \zeta^o, \zeta^s, \tau, \phi), \qquad i = o, s. \tag{15}$$

Then using the time allocation identity for the husband and wife (12) and substituting equations (13) and (15) for T_h^{j*} and T_f^{i*}, the supply functions for off-farm hours are obtained:

$$T_m^{i*} = \bar{T} - T_h^{i*} - T_f^{i*} = G_{F_m^i}(W_m^o, W_m^s, P_y, V, W_x, P_q, \zeta^o, \zeta^s, \tau, \phi), \qquad i = o, s. \tag{16}$$

When $W_m^i < \gamma^i/\lambda$, then optimal $T_m^i = o$, $i = o, s$, and the farm production decisions are not separable from household consumption decisions. The demand function for operator's and spouse's on-farm work is obtained as part of the solution to equations (6)-(8) and (10)-(12). The demand function for operator's and spouse's on-farm work hours is now:

$$T_f^{i**} = G_{T_f^{i**}}(P_q, P_y, W_x, V, \zeta^o, \zeta^s, \phi), \qquad i = o, s.^5 \tag{17}$$

Hence, the implicit demand functions for on-farm work hours are different for operators and spouses that don't participate in off-farm work than for those that do. P_y and V enter (17) but not (13), and W_m^o and W_m^s enter (13) but not (17).

The Data, Variables, and Econometric Model

This section contains a description of the data, empirical definition of variables, and discussion of the econometric model.

The data

The primary data set for this study is the FCRS (Farm Operator Resource version, 1991) of the U.S. Department of Agriculture. The FCRS is a national annual survey of U.S. farms conducted by NASS and ERS every February-March since 1985. The survey has a complex stratified, multiframe, random design which enhances its statistical properties for some purposes, but the sampling scheme limits its usefulness for examining several relationships jointly. The following limits are placed on our analysis. First, the FCRS requires that only one person per farm be designated the farm operator. In 1991, 94 percent of the farm operators were male, and in order to avoid gender heterogeneity issues in the econometric estimates, this study focuses on the male farm operators.[6] Second, the complex stratified sample design employed by the FCRS makes it impossible to consider time allocation decisions of the farm husband and wife jointly. For example, computer programs that exist for weighted bivariate discrete choice and seemingly-unrelated regressions produce correct parameter estimates but erroneous standard errors, thereby limiting inference beyond the sample.[7] We exclude from the analysis those farm operators where the farm is organized as a non-family corporation or cooperative, those where the operator's household does not receive any of the net income of the farm business, where a wife is not present, and those where the household receives nonfarm self-employment income.[8] A few other observations were excluded because of inconsistencies due to coding errors. The final sample is 2,076 observations which statistically represent about 1.4 million U.S. farm operators (or 67 percent of all U.S. farms) in the 48 contiguous States of the U.S. in 1991.

The econometric model

Empirical models of off-farm participation and off-farm and on-farm work hours for farm operators are presented. Define the empirical off-farm wage (W_{mj}) and reservation wage (W_{rj}) equations for the j-th farm operator as follows:

$$\ln W_{mj} = S_{1j}\alpha_1 + \epsilon_{mj} \tag{18}$$

$$\ln W_{rj} = S_{2j}\alpha_2 + \epsilon_{rj} \tag{19}$$

where ϵ_{mj} and ϵ_{rj} are zero mean random disturbance terms for the population of all farm operators. Operators are assumed to participate in off-farm work when their reservation wage is less than their market wage offer. Hence, define an off-farm wage work participation indicator variable D_j as:

$$D_j = \begin{cases} 1 & if \ln W_{rj} < \ln W_{mj} \\ 0 & if \ln W_{rj} \geq \ln W_{mj} \end{cases}. \tag{20}$$

Because ϵ_{mj} and ϵ_{rj} are random variables, the probability of participating in off-farm work can be obtained as:

$$P_r(D_j = 1) = P_r(\ln W_{rj} < \ln W_{mj}) = P_r(\epsilon_{rj} - \epsilon_{mj} < S_{1j}\alpha_1 - S_{2j}\alpha_2) = F_\upsilon(S_j\alpha) \tag{21}$$

where $\upsilon_j = \epsilon_{rj} - \epsilon_{mj}$, $S_j\alpha = S_{1j}\alpha_1 - S_{2j}\alpha_2$ and F( ) is a cumulative distribution function for the random variable υ. Equation (21) is a reduced-form off-farm wage work participation equation where the explanatory variables S_j are from the market wage and reservation wage equations (18) and (19). If we have a consistent estimate of the wage equation for off-farm work for all farm operators, then we can use $\ln \hat{W}_{mj}$ and S_{2j} as regressors in a structural off-farm work participation equation. Other things equal, an increase of the off-farm wage is expected to increase the probability of off-farm wage work.

For the hours of work component of this study, two sets of behavioral equations are considered. For farm operators that participate in off-farm wage work, we will estimate on-farm labor demand and off-farm labor supply equations:

$$T_f = \beta_{11} W_m + Z_1 \beta_1 + \mu_f \tag{22}$$

$$T_m = \beta_{12} W_m + \beta_{22} V + Z_2 \beta_2 + \mu_m \tag{23}$$

where Z_1 includes regressors other than W_m that are expected to explain on-farm labor demand, Z_2 includes regressors other than W_m and V that are expected to explain off-farm labor supply, and μ_f and μ_m are random disturbance terms. Consistent with our theory, other income (V) does not enter the on-farm labor demand equation (22). In equation (22), we expect the sign of β_{11} to be negative, and in equation (23), we expect β_{22} to be negative (i.e., leisure is a normal good) and β_{12} to be non-negative. With $\beta_{12} > 0$, the implication is that the income effect of a wage rate change and the substitution effect pull in the opposite direction but that the substitution effect dominates.

For farm operators that do not participate in off-farm wage work, we will estimate an on-farm labor demand equation:

$$T_f = \gamma_1 V + Z_3 \gamma_3 + \mu_f^* \tag{24}$$

where Z_3 is regressors other than V that are expected to explain on-farm hours and μ_f^* is a random disturbance term. Consistent with our theory, the set of regressors Z_3 is different from Z_1 because of the demand for operator's on-farm work is not separable from household consumption decisions. In particular, other income (V) is a regressor in the on-farm demand equation (24) but not in (22), and we expect γ_1 to be negative (leisure is a normal good) in equation (24).

A brief empirical definition of all variables included in the econometric model is presented in table 1. Some of the variables are farm/farm-operator specific and others represent state or regional effects on farm operator's behavior. Furthermore, to complete the specification of the econometric model, we designate the variables that are included in Z_1, Z_2, and Z_3. Exactly what farm attributes should be included is subject to debate, e.g., Huffman 1991; Lass, Findies, and Hallberg 1989, 1991; Lass and Gempesaw 1992; Kimhi 1994. Attributes that should be included are ones that are quasi-fixed or exogenous to off-farm participation and hours of on- and off-farm work decisions of farm operators. To accommodate divergent views on this subject, we proceed under two different assumptions. *Assumption 1:* the value of farmland owned (LAND) and value of farm capital in farm machinery and equipment, breeding stock, and farm buildings (FCAPITAL) are to be included in Z_1, Z_2, and Z_3.[9] Hence, on-farm and off-farm work decisions are conditional on LAND and FCAPITAL. *Assumption 2*: LAND and FCAPITAL are attributes that are jointly determined with farm operator's off-farm participation and on- and off-farm hours and they are excluded from Z_1, Z_2, and Z_3.

Other variables are also included in Z_1, Z_2, and Z_3. Additional variables included in Z_1 are: EDS, wife's education is an indicator of the potential productivity/opportunity cost of her time; FRAISED, an indicator of early farm-specific work experiences of the farm operator; FHEALIM, an indicator of a health limiting condition of the farm operator; MILESCITY, an indicator of potential commuting distance to off-farm work and to shopping for farm and household goods and services; FARMWAGE, wage rate for hired farm labor; RAIN and JANT, state climatic indicators that can be expected to affect farm productivity; and NE, MIDWEST, and WEST, regional geographic indicators for real output and nonlabor input prices. Additional variables included in Z_2 are: EDS, FRAISED, FHEALIM, HHSIZE, MILESCITY, FARMWAGE, RAIN, JANT, NE, MIDWEST, and WEST. Additional variables included in Z_3 are: AGE, an indicator of life stage of operator and taste for consumption of leisure relative to purchased goods; ED and EDS, indicators of potential productivity of husband's and wife's time; and FRAISED; FHEALIM; HHSIZE; MILESCITY; FARMWAGE; RAIN; JANT; NE; MIDWEST; and WEST.

In the operator's off-farm wage equation (22), S_1 includes his education (ED), his potential post-schooling experience (EXP) and state amenity factors associated with winter weather (JANT, JANT^2), local labor market conditions, PURATE and ESHOCK, and regional dummy variables. These are variables that have been used by others, e.g. Tokle and

Huffman. EXP is chosen over actual labor market experience because it is less likely to be endogenous to off-farm work decisions (Mroz). EXP is expected to have a quadratic effect on *ln* W because of finite length human life (Becker 1993). Other studies have shown that state labor markets are interrelated through migration and migrants attempt to equalize real compensation. Nominal wage rate differences then exist across states because of cost of living and amenity differences (Tolley 1991; Kenny and Denslow 1980) and because of permanent and transitory labor market adjustments (Topel 1986). Topel and Tokle and Huffman found that nonfarm wage rates were higher, other things equal, where predicted state unemployment rates where high. The higher wage rates compensated for anticipated future unemployment. Some labor market events are unanticipated, and they may affect wage rates, too. Topel and Tokle and Huffman found that a positive shock to state employment growth rate relative to the national rate has a positive effect on wage rates.

In the reduced-form off-farm participation equation, the set of regressors (S) are approximately the set of variables S_1, V, and Z_2.

Return to Table1, and note some of the differences in variables for farm operators who have different off-farm work status. Sample farm operators who participated in off-farm wage work in 1991 had mean annual off-farm work of 1,895 hours and of on-farm work of 1,111 hours. Hence, mean annual on-farm and off-farm work for this group was 3,006 hours. For the sample of farm operators who did not participate in off-farm work, mean annual on-farm work was 2,041 hours. Sample farm operators who participate in off-farm work had significantly less other income (OTHINC), owned farm land (LAND), and farm capital (FCAPITAL) and were younger (AGE), had lower frequency of health problems (HEALIM), and had more schooling (ED) than sample farm operators who did not participate in off-farm work.

The Empirical Results

For the sample of all farm operators, reduced-form and structural off-farm work participation equations are fitted. For the subsample of farm operators who participated in off-farm wage work, an off-farm wage equation, an on-farm labor demand equation, and an off-farm labor supply equation are fitted. For the subsample of farm operators who did not participate in off-farm work, an on-farm labor demand equation is fitted.[10]

Reduced-form off-farm labor participation

The results from fitting the reduced-form logit off-farm work participation equation to data for 2,076 U.S. farm operators are reported in columns (1) and (2) of table 2. The two equations differ in treatment of farm land and farm capital; assumption 1 applies to column (1) and assumption 2 applies to column (2).

Additional other income (OTHINC) reduces the probability of off-farm work. It is consistent with leisure being a normal good, and supports earlier results for U.S. farm operators by Sumner; Huffman and Lange; Lass, Findies, and Hallberg 1989; Gould and Saupe; and Tokle and Huffman. The effect of operator's age on the probability of off-farm work is quadratic. The marginal effect of AGE is positive up to 45 years, and then becomes negative. Hence, participating in off-farm work is not primarily a new entrant to farming phenomena. Studies using relatively recent surveys have found similar results for U.S. farm operators, e.g., Gould and Saupe; Lass, Finders, and Hallberg 1989, Tokle and Huffman, but some of the earlier studies found the probability of off-farm work decreasing with age, e.g., Huffman and Lange.

Our study shows impacts of several human capital variables on off-farm work participation. Operator's education (ED) has a positive marginal effect on his probability of off-farm work. For individuals engaged in farming, the implication is that additional schooling increases their off-farm wage (offer) by more than it increases their reservation wage at on-farm work or leisure. The net effect is increased household income diversification.[11] Our result is in agreement with other studies of off-farm work participation of U.S. farmers. Wife's schooling (EDS) has a negative but statistically insignificant effect on the probability of husband's off-farm work participation. In other studies of male operators' off-farm work participation, wife's schooling has generally been ignored; exceptions are Huffman and Lange and Tokle and Huffman who found negative and significant effects.

A farm operator being farm raised (FRAISED), an indicator of early farm-sector-specific experience, reduces the probability of his off-farm work. The implication is that this is a type of experience that is imperfectly transferable to the nonfarm labor market and increases an individual's long-term attachment to farming. A farm operator's health status also affects his probability of off-farm work. A chronic health problem that limits the amount or type of farm work (FHEALIM) also reduces the probability of off-farm work. Although the health limitation is defined specifically to farm work, our results suggest that its impact is relatively more severe for off-farm work. Being self-employed as a farmer rather than as a wage worker may give an individual more flexibility for managing work and a chronic health problem.[12]

The impact of a larger household size is to increase the probability of off-farm work, but the confidence is low for this coefficient. The effect of MILESCITY on the probability of off-farm work is statistically insignificant.

Characteristics of the farm affect the probability of off-farm work. In column (1) additional LAND and FCAPITAL decrease the probability of off-farm work. These variables seem to have their effects by increasing the productivity of operator's on-farm work, which raises the opportunity cost of off-farm work. In column (2), these two variables are excluded, and although all of the estimated coefficients change, the performance of FRAISED changes the most--becoming significantly more negative. A higher wage rate for hired farm labor increases the probability of off-farm work, suggesting that operator and hired labor may be complements in farm production. A larger amount of annual precipitation increases the probability of off-farm work.

Under assumptions 1 and 2, state labor market and regional variables tend to affect the probability of off-farm work. For operators in the Northeast and Midwest, their probability of off-farm work is significantly lower than for operators in the South.

Holding other regressors unchanged, farm operators in the West have a probability of off-farm work that is not significantly different from that of operators in the South.

Off-farm wage/labor demand

The farm operator's off-farm wage equation is of interest because the predicted wage is an instrument for the actual or potential off-farm wage of farmers, and it provides evidence on the returns to human capital of farm operators in the nonfarm labor market. The off-farm wage equation is fitted to 551 observations on male farm operators that reported off-farm earnings in 1991.[13] The results are reported in column (5), table 2.

The primary focus is on the human capital variables. An additional year of education increases farmer operator's off-farm wage by 8.6 percent. This is 56 percent larger than Tokle and Huffman obtained for U.S. rural nonfarm males 1978-82, using a similar specification. It is also a larger return than Sumner obtained for a 1971 sample of Illinois farmers and Huffman and Lange obtained using a 1978 sample of Iowa farmers but similar to the estimate obtained by Gould and Saupe obtained with a 1982 and 1986 sample of Wisconsin farmers. Evidence from Murphy and Welch (1992) and Juhn, Murphy, and Pierce (1993) shows that the return to schooling of U.S. male wage earners was declining and relatively low during the 1970s and then rose dramatically during the 1980s to a relatively high level by 1989. Hence, there is collaborating evidence to our finding of high return in the nonfarm labor market to farmer operators schooling in 1991.

An additional year of post-schooling experience (EXP) has a positive but diminishing marginal effect on operator's off-farm wage rate. The maximum effect of experience occurs at 27 years. Our *ln* wage-experience profile is significantly more concave than Tokle and Huffman found for U.S. rural nonfarm married males (in 1978-82). Their data show that the peak comes later, 37 vs. 27 years, and the return to experience is larger at the peak. Given that EXP measures years of potential experience at all types of work, one explanation for the difference is that farming experience is relatively sector-specific human capital and not as valuable as off-farm experience for determining the off-farm wage.

Our results show regional differences in wage rates are partially explained by local amenity factors (normal January temperature) and local labor market conditions (PURATE and ESHOCK), but some regional differences remain. The wage rates of farm operators is 24 percent higher (statistically significant) in the West than the South. In the Northeast and Midwest, the point estimate is for higher off-farm wage rates than for the South, but the difference is not statistically significant.

Structural off-farm participation equation

The results from fitting the structural logit off-farm wage work participation equation for farm operators is reported in table 2, columns (3) and (4). This equation differs from the reduced-form off-farm participation equations in that the off-farm wage rate is predicted for all sample operators using equation (5), table 2, and included as a regressor, and regressors that enter only the off-farm wage equation are excluded.[14]

The off-farm wage rate has a positive and statistically significant effect on the operator's probability of off-farm work. At the sample mean and other things equal, a $1 per hour increase in the operator's off-farm wage rate increases the probability of off-farm work by 3.4 percent. Hence, the off-farm work participation decision is strongly affected by the financial attractiveness of the off-farm wage. For variables that are included in both the reduced-form and structural off-farm participation equations, the sign of the estimated coefficients are the same. Household size (HHSIZE) and the two climate variables RAIN and JANT are, however, statistically stronger in the structural than in the reduced-form participation equation.

Off-farm and on-farm hours: Off-farm work participants

The off-farm labor supply and on-farm labor demand equations are fitted to data for the 551 observations on farm operators who participated in off-farm work. In table 3, columns (1)-(4), results are reported for assumption 1 and 2 about LAND and FCAPITAL. The equations are fitted without a sample selection variable. Nawata and Nagase (1996) show that Heckman's two-step procedure (Heckman 1979) for sample selection correction sometimes yields highly biased parameter estimates. This occurs when the sample selection variable is highly correlated with the other regressors included in the behavioral equation of interest. For our sample, the selection variable is highly correlated with the regressors in the off-farm labor supply equation, and the estimated coefficients of the variables in the off-farm labor supply equation tend to reverse sign and fall in statistical significance when the selection variable is included.[15] Hence, we judge that the unadjusted parameter estimates are better than the adjusted ones.[16,17]

Operator's on-farm hours are not significantly affected by a higher off-farm wage rate, but his off-farm hours increase, i.e., β_{11} in the on-farm labor demand equation (22) is not significantly different from zero and β_{12} in the off-farm labor supply equation is positive. Furthermore, given the operator's time constraint (equation 12), the larger off-farm hours imply a reduction in his leisure hours. The effect of OTHINC on off-farm hours is negative (i.e., $\beta_{22} < 0$ in equation (23) and the off-farm labor supply curve shifts back or left), the on-farm hours effect is constrained to be zero, so the impact on operator's leisure hours is positive (shifts demand curve for leisure out or right). The conclusion is that operator's leisure is a normal good.

When the farm operator is farm raised, his on-farm work is 208 hours per year larger but no significant change in off-farm hours occurs. Hence, the increase in on-farm hours comes primarily from reduced leisure hours. When an operator lives farther from a city of 10,000 or more people, his hours of on-farm work increase and off-farm work decrease by approximately off-setting magnitudes. Hence, the net effect of MILESCITY, a commuting distance measure, on operator's leisure hours is approximately zero.[18]

Under assumption 1, a larger amount of owned land (LAND) reduces operator's on-farm work hours and does not have a significant effect on his off-farm work hours. Hence larger LAND increases operator's leisure hours. A larger amount of farm capital (FCAPITAL) increases his hours of on-farm work (4.3 annual hours per $1,000) and reduces the hours of off-farm work (1.6 annual hours per $1,000). The net effect, however, is a reduction in operator's leisure hours (2.7 annual hours per $1,000).

Under assumptions 1 and 2, a higher wage rate for hired farm labor (FARMWAGE) tends to increase the operator's on-farm hours and to reduce his off-farm hours. Given the different magnitude of the estimated coefficient, they imply an increase in operator's leisure hours. The confidence in these results is low, although consistent across assumptions 1 and 2. Additional annual precipitation (RAIN) tends to reduce operator's hours of on-farm and off-farm hours and hence to increase his leisure. A higher normal average January temperature reduces the demand for operator's on-farm hours (11 to 13 annual hours per degree under assumptions 1 and 2, respectively) and to increase off-farm labor supply (20 annual hours per degree). Hence, the net effect of JANT is a decrease in operator's leisure hours.

Regional differences in on-farm and off-farm hours of work are generally insignificant, except that farm operator's in the West work less on-farm (333 and 408 annual hours under assumptions 1 and 2, respectively).

On-farm hours: No off-farm work

The on-farm labor demand equation is fitted to 1,525 observations on farm operators who specialize in farm work. In table 3, columns (5) and (6), results are reported for assumptions 1 and 2 about LAND and FCAPITAL. No sample selection variable is included.

Additional OTHINC reduces operator's on farm hours (statistically significant). Given the operator's time constraint (equation 12) and off-farm hours is zero, the implication is that operator's leisure hours increases. Furthermore, given the empirical specification of the on-farm labor demand equation, we infer that operator's leisure is also a normal consumption good for farm operators who do not work off-farm.

Although operator's education (ED) does not have a significant effect on on-farm hours, his other attributes do affect the quantity demanded of on-farm work. As a farm operator becomes older (AGE), his hours of off-farm work are reduced and leisure hours increased (24 annual hours per year of age). If the operator was farm raised, his hours of on-farm work is larger (404 and 473 hours per year under assumptions 1 and 2, respectively). The magnitude is relatively large--20 to 25 percent of samples mean on-farm hours of work, and they come from reduced leisure hours. If the farm operator has a chronic health problem (FHEALIM), his annual on-farm work is reduced 341 and 389 hours under assumptions 1 and 2, respectively. Although the estimated coefficients for HHSIZE and MILESCITY are positive, we have low confidence in these estimates.

Under assumption 1, larger LAND and FCAPITAL increase operator's hours of on-farm work (and reduces leisure hours). The p-value for the coefficient of LAND is, however, only 13 percent. A higher JANT reduces operator's on-farm hours (and increases his leisure hours) about 13 annual hours per degree of normal temperature. The sign of FARMWAGE is negative and of RAIN is positive, but we have low confidence in these effects being different from zero. The results also suggest, other things equal, that farm operators in the Northeast, Midwest, and West work on-farm more hours per year (200 to 440 hours) than farm operators in the South. This implies larger leisure hours of farm operators in the South than in other regions.

Implications

This study has important implications for valuing the hours of farm work of farm operators. In cost-and-returns studies and agricultural productivity statistics, the hours of farm work of farmers has been generally valued at the wage rate for farm hired labor (see Ball 1985; Huffman 1996). Our study shows that farm operators who worked off farm at wage and salary work in 1991 had an average off-farm wage that was more than twice as large as the average wage rate for hired farm labor (see table 1). Hence, the wage rate for hired farm labor is a very poor estimate of the opportunity cost of operators' time. The primary reason for this large difference is that U.S. farm operators have on average significantly more education and experience than hired farm labor (Huffman 1996; Gabbard and Mines 1995).

Following the logic of our economic model, farm operators who do not participate in off-farm wage work are expected to have a reservation wage that exceeds their off-farm wage prospect. This information, however, is not generally available to researchers. We use our fitted wage equation (table 2) to predict the likely off-farm wage offer of all 2,076 male farm operators in our sample. The distribution of these predicted wage rates is reported in table 4. The geometric mean is \$10.26 per hour, the top 5 percent of the distribution has a predicted hourly off-farm wage exceeding \$17.00 and the lowest 10 percent of the distribution has a predicted wage rate below \$5.84 per hour. Hence, the point we emphasize is using the wage rate of hired farm labor (which had a mean of \$5.95 per hour in 1991) to value farm operator farm labor can be expected to grossly undervalue this farm input and to contribute to underestimates of the cost of production of most agricultural commodities. In some cases, a better estimate is the predicted wage rate that the individual might earn from off-farm work.

Conclusions and Further Implications

This study has shown that farm operators' decisions for on-farm hours of work, off-farm work participation, and off-farm hours of work are consistent with predictions from an agricultural household model. The strength of our empirical results, however, do differ between the participation and work-hours models, and we attribute the difference to dramatically less measurement error in the off-farm work participation indicator than in the hours of work data. The fact that we place somewhat greater confidence in our participation results is given added credibility by Heckman's (1993) conclusion that empirical evidence on individuals' labor-force participation decisions is a very important part of understanding aggregate labor supply.

In the estimated structural off-farm work participation equations, the operator's off-farm wage offer and other farm-household income are shown to have effects consistent with expectations and to be statistically strong predictors. At the sample mean and other things equal, a $1 per hour increase in the operator's off-farm wage was shown to increase his probability of off-farm work by 3.4 percent. A $1,000 increase in other income decreases the probability of off-farm work by 0.5 percent. For farm operators who participated in off-farm work, the results showed their hours of on-farm work were unresponsive to the off-farm wage, i.e., the on-farm labor demand curve for operator's hours is perfectly wage inelastic, but the operators's off-farm hours responded positively to the off-farm wage. At the sample mean, our parameter estimates imply a compensated own-wage elasticity of operator's off-farm hours is about 0.16. The income elasticity of off-farm labor supply is about -0.018. Furthermore, the size of these wage and income elasticity estimates is not affected significantly by assumptions about operator's hours of work being conditioned on or endogenous to the amount of owned farm land and farm capital. For farm operators who specialized in on-farm work, the income elasticity of demand for operator's on-farm hours is negative, -0.015 at the sample mean. Hence, given the time constraint on operator's total available hours, the empirical results imply their leisure hours are a normal consumption good irrespective of their off-farm work status.

Our empirical results seem to be consistent with long-term events in U.S. agriculture. The farm problem as described by Gardner (1992) exists partly because of an upward sloping labor supply to agriculture. Furthermore, it is ameliorated by improved off-farm work opportunities when labor moves between the farm and nonfarm sectors. Taking off-farm work by some farm operators is one method of reducing the quantity of labor employed in agriculture. Leaving agriculture permanently is of course another option, but farm-sector specific human capital would be lost. Second, our results imply that farm operators that have better off-farm wage opportunities respond positively to these incentives--increased probability of off-farm work and increased hours of off-farm work, given a decision to participate. Third, the conclusion from our results that operators' leisure hours are a normal consumption good irrespective of their off-farm work status seems consistent with some empirical evidence and a general belief that operator's hours of work, while still relatively large, have declined over time.

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Endnotes

1. Lange 1980, however, examined off-farm and on-farm hours decisions for a sample of Iowa farm operators and wives.

2. In order to keep the analysis simple, the time allocation of other members of the households are not considered.

3. To simplify the model, we have chosen to ignore the nonnegativity constraint for on-farm hours of work. Kimhi (1994), however, found this to be an important constraint to Israeli farm households.

4. Note that the utility function U and the nonstochastic farm production function of the household Q are quasi-concave, continuous, and twice differentiable.

5. For this case, the demand equation for X, Y, T_h^i, and T_f^i are all a function of the same variables.

6. The dominance of operators who are male arises partly from the fact that the FCRS does not permit a designation of <u>husband-wife</u> jointly operated farm (Ahearn, Perry, and El-Osta).

7. We do not consider this limitation to be serious. When U.S. studies have considered the joint off-farm work participation of a farm husband and wife, most have found statistically insignificant correlation, e.g., Lass and Gempesaw; Lass, Findeis and Hallberg 1989; and Huffman and Lange.

8. In the 1991 FCRS, 16.9 percent of the farm operator households had off-farm self-employment income, and 10.4 percent of male farm operators were not married. Exclusion of observations where the farm operator or the operator's spouse reported self-employment off-farm earnings is done in order for wage rates computed here as wages and salaries divided by annual off-farm work hours to be computed with more accuracy.

9. We acknowledge that farm land operated on most U.S. farms consists of owned land and rented land. We, however, chose owned farm land as a regressor rather than operated farm land because owned farm land is more likely to be exogenous to the on-farm and off-farm work decisions of farm operators. With active cropland rental markets existing across the United States, farm operators can annually make joint decisions on acres operated and hours of on-farm and off-farm work. When decisions are joint, including acres operated as a regressor in the on-farm or off-farm work hours equation will cause simultaneous equation bias (Green 1997, Ch. 16). The value of dairy herd breeding stock is included in FCAPITAL, and we believe that this is a better method of including the effect of a dairy operation than to define a dummy variable for presence or absence of a dairy enterprise on a farm.

10. Estimation of equations was completed in PC-CARP (Fuller et al.) to take account of the complex stratified sample design and weighting system. The program adjusts all standard errors for heteroscedasticity of unknown form by the Taylor approximation for the variance (see Fuller et al.; Kott 1991).

11. Huang and Orazem (1997) have shown with county data that an increase in schooling also increases the likelihood of a net exit from farming.

12. Having off-farm employment does, however, have a major advantage of access to relatively inexpensive health insurance, e.g., Jensen and Salant.

13. When a sample selection variable λ was derived (see Lee 1982) from the fitted off-farm participation equation reported in column (1) and (2), table 1, and included as a regressor in the wage equation, the coefficient of the selection variable was not significantly different from zero.

14. AGE and EDS are excluded because EXP = AGE-ED-6, and they are not included in Z_1 and Z_2.

15. When $\hat{\lambda}$, the selection variable, is derived from the reduced-form participation equation (column 2, table 2), and regressed on the variables of the off-farm labor supply equation (column 1, table 3), the R^2 is 0.8. When $\hat{\lambda}$ is regressed on the variables of the off-farm wage equation (from column 5, table 2), the R^2 is only 0.4.

16. Other potential methods for dealing with sample selection include a one-step maximum likelihood estimator and semi-parametric estimation (Newey, Powell, and Walker 1990). They were not pursued because of the complex nature of the survey design.

17. We also judge that the data on farm operators' hours of work to be relatively noisey. In the 1991 FCRS, NASS asked farm operators in March or April of 1992 to estimate (1) on average, how many <u>hours per week</u> did you do farm or ranch work on this operation during each month in 1991 and (2) on average, how many <u>hours per week</u> did you work during each month in 1991 at off-farm jobs? This approach is subject to major recall bias. Furthermore, the questions pertaining to on-farm and off-farm work hours were 18 pages apart in the survey questionnaire, so the survey does not encourage farm operators to think about the reasonableness of their total hours of work on- and off-farm.

18. All AGE or EXP effects on hours of work for these farm operators are channeled through the predicted off-farm wage. When AGE is included as a separate regressor in these hours of work equations, its coefficient is not significantly different from zero. Because relatively few of these operators were less than 35 years of age, a quadratic AGE effect seemed unreasonable.

Table 1. Variable names and sample mean values, U.S. farm operators by off-farm work status, 1991.

Variable symbols	Variable definition	Farm operators (mean)	
		No off-farm work	With off-farm wage work
D	1 if farm operator worked off-farm for a wage or salary in 1991; 0 otherwise	0	1.0
OFFHOURS	Farm operator's annual hours of off-farm wage or salary work in 1991	0	1,895
FARMHOURS	Farm operator's annual hours of own on-farm or ranch work in 1991	2,041	1,111
OFFWAGE	Off-farm wage = gross cash wages, salaries, commissions, including cash bonuses, from working off own farm in 1991 divided by OFFHOURS, $/hr	---	14.07
OTHINC	Farm operator household's other income = total household cash income less net farm income and gross cash wages, salaries, tips, commissions and cash bonuses for work off own farm by operator and his wife in 1991 ($)	15,329	4,256
AGE	Farm operator's age	57.7	47.2
ED	Years of schooling completed by farm operator	12.4	13.0
EDS	Years of schooling completed by wife of farm operator	12.7	13.1
EXP	Farm operator's potential post-schooling experience = AGE - ED - 6	39.3	28.19
FRAISED	1 if farm operator was raised on a farm; 0 otherwise	0.83	0.72
FHEALIM	1 if operator has any chronic health problems that limit amount or kind of farm work; 0 otherwise	0.14	0.04 [a]
HHSIZE	Number of persons who live in the household	2.87	3.50
MILESCITY	Miles from farm to nearest city having population of at least 10,000	25.6	23.1

Table 1. (continued)

Variable symbols	Variable definition	Farm operators (mean)	
		No off-farm work	With off-farm wage work
LAND	Value of farmland owned = value of farmland owned 12-31-91 less expenditures for construction, repairs and maintenance during 1991, $1000	218.2	87.2
FCAPITAL	Value of farm machinery and equipment, breeding stock, and farm buildings (excluding the farm dwelling), 1-1-91, $1000	129.4	49.7
FARMWAGE	State average wage rate for hired farm labor in 1991 ($)	5.94	5.95
RAIN	State normal annual precipitation (divided by 12) [Teigen]	3.02	3.17
JANT	State normal January average temperature (degree F) [Weiss et al.]	31.6	32.1
PURATE	Predicted or anticipated state unemployment rate. Prediction obtained from OLS regression of state annual unemployment rate on intercept, trend, and trend squared, 1967-1991.	5.58	5.81
ESHOCK	Relative state employment growth shock. OLS residual from state annual employment equation less OLS residual from national annual employment equation, 1967-1991.	2.78	2.60
NE	1 if household is located in Northeast Census region; 0 otherwise	0.06	0.04
MIDWEST	1 if household is located in Midwest Census region; 0 otherwise	0.45	0.41
WEST	1 if household is located in West Census region; 0 otherwise	0.12	0.12
SOUTH	1 if household is located in South Census region; 0 otherwise	0.37	0.42
Sample Size		1,525	551
Population		863,939	504,130

Table 2. Estimated coefficients for off-farm wage labor participation and off-farm wage equations: U.S. farm operators, 1991 (adjusted t-ratios in parentheses)

Regressors	Off-Farm Wage Labor Participation: Reduced-form Equation (1)	(2)	Structural Equation (3)	(4)	Off-Farm Wage Eq. [1] (5)
OTHINC	-3.75×10^{-3} (3.63)	-3.39×10^{-5} (3.72)	-5.76×10^{-5} (4.86)	-5.38×10^{-5} (4.90)	
$OTHINC^2/1000$	3.97×10^{-8} (2.84)	3.44×10^{-8} (2.51)	6.59×10^{-8} (4.27)	6.09×10^{-8} (4.22)	
AGE	0.400 (6.52)	0.343 (6.11)			
$AGE^2/100$	-0.439 (7.03)	-0.382 (6.75)			
ED	0.117 (2.47)	0.098 (2.12)			0.086 (4.70)
EDS	-0.020 (0.36)	-0.068 (1.32)	-1.11×10^{-3} (0.02)	-0.062 (1.23)	
EXP					0.040 (2.79)
$EXP^2/100$					-0.073 (2.81)
FRAISED	-0.387 (1.60)	-0.717 (3.17)	-0.351 (1.48)	-0.692 (3.12)	
FHEALIM	-0.701 (2.16)	-0.637 (1.96)	-0.786 (2.34)	-0.718 (2.15)	
HHSIZE	0.090 (1.29)	0.091 (1.48)	0.211 (3.43)	0.216 (3.85)	
MILESCITY	7.78×10^{-4} (0.22)	-1.13×10^{-3} (0.33)	-1.08×10^{-4} (0.03)	-2.72×10^{-3} (0.81)	
LAND	-6.28×10^{-4} (1.29)		-9.74×10^{-4} (1.92)		
FCAPITAL	-9.49×10^{-3} (5.88)		-8.84×10^{-3} (5.72)		

Table 2. (continued)

Regressors	Off-Farm Wage Labor Participation: Reduced-form Equation (1)	(2)	Structural Equation (3)	(4)	Off-Farm Wage Eq. [1] (5)
FARMWAGE	0.526	0.582	0.517	0.524	
	(1.69)	(2.09)	(1.72)	(1.93)	
RAIN	0.281	0.281	0.389	0.436	
	(1.72)	(1.78)	(2.47)	(2.88)	
JANT	-0.013	0.014	-0.067	-0.056	-0.017
	(0.29)	(0.36)	(4.49)	(4.00)	(1.42)
$JANT^2/100$	-0.071	-0.090			0.023
	(1.17)	(1.62)			(1.11)
PURATE	0.128	0.146			0.098
	(1.63)	(1.87)			(2.73)
ESHOCK	-0.071	-0.064			-0.049
	(1.89)	(1.84)			(2.74)
NE	-1.690	-1.901	-2.290	-2.482	0.190
	(2.81)	(3.90)	(3.89)	(5.17)	(1.06)
MIDWEST	-1.023	-1.056	-1.209	-1.223	0.037
	(2.61)	(2.87)	(2.97)	(3.23)	(0.33)
WEST	0.258	0.023	-0.148	-0.250	0.237
	(0.49)	(0.05)	(0.30)	(0.55)	(2.42)
OFFWAGE[2]			0.215	0.194	
			(7.56)	(6.69)	
Intercept	-11.70	-11.11	-3.405	-3.435	0.631
	(4.53)	(4.89)	(1.94)	(2.23)	(1.61)
X^2-statistic	155.6	144.8	167.5	159.7	--
McFadden's R^2	0.323	0.230	0.281	0.185	
R^2					0.206
Sample	2,076	2,076	2,076	2,076	551

[1] Dependent variable is ℓn(OFFWAGE).
[2] Wage is predicted for all farm operators using column (5) of the table.

Table 3. Estimated coefficients for off-farm labor supply and on-farm labor demand equations: U.S. farm operators, 1991 (adjusted t-ratios in parentheses)

Regressors	Farm operators reporting off-farm wage work				No off-farm wage work	
	Assumption 1		Assumption 2		Asspt. 1	Asspt. 2
	Off-farm hours	On-farm hours	Off-farm hours	On-farm hours	On-farm hours	On-farm hours
OFFWAGE [a]	25.30	1.95	24.54	-1.36		
	(1.84)	(0.15)	(1.77)	(0.09)		
OTHINC	-0.008		-0.010		-0.002	-0.002
	(1.94)		(2.36)		(2.01)	(2.10)
AGE					-24.15	-24.01
					(5.21)	(4.97)
ED					20.56	27.65
					(0.67)	(0.89)
EDS	11.16	-21.13	9.68	-18.33	35.38	54.66
	(0.50)	(-0.86)	(0.41)	(0.67)	(1.29)	(1.94)
FRAISED	-26.28	207.61	-60.69	280.13	404.25	473.49
	(0.28)	(2.34)	(0.66)	(2.79)	(3.10)	(3.52)
FHEALIM	-103.75	205.60	-77.95	161.51	-341.04	-389.03
	(0.45)	(0.85)	(0.34)	(0.63)	(2.75)	(3.07)
HHSIZE	-26.34		-18.68		8.50	18.10
	(0.95)		(0.66)		(0.18)	(0.37)
MILESCITY	-4.82	4.90	-5.28	5.58	2.22	2.07
	(3.05)	(2.92)	(3.32)	(2.96)	(1.10)	(1.00)
LAND	0.023	-0.72			0.15	
	(0.09)	(2.27)			(1.55)	
FCAPITAL	-1.57	4.30			0.83	
	(2.75)	(4.01)			(2.06)	
FARMWAGE	-123.84	45.57	-121.61	20.51	-12.26	-12.52
	(1.01)	(0.36)	(0.96)	(0.15)	(0.08)	(0.08)
RAIN	-54.05	-99.72	-36.69	-127.02	42.14	44.01
	(0.90)	(1.52)	(0.61)	(1.84)	(0.57)	(0.58)
JANT	19.49	-10.71	20.13	-13.01	-12.85	-13.75
	(3.42)	(1.66)	(3.41)	(1.83)	(1.78)	(1.86)
NE	175.28	69.23	144.30	115.49	400.77	441.45
	(0.73)	(0.24)	(0.60)	(0.37)	(1.60)	(1.69)
MIDWEST	241.83	-46.47	233.14	-30.09	257.88	275.00
	(1.39)	(0.25)	(1.31)	(0.14)	(1.15)	(1.76)
WEST	-92.67	-332.73	-68.39	-407.82	206.64	294.82
	(0.50)	(1.65)	(0.37)	(1.86)	(0.85)	(1.18)
Intercept	1,977.4	1,387.5	1,857.45	1,783.87	2,442.62	2,172.29
	(2.51)	(1.78)	(2.24)	(2.08)	(2.41)	(2.01)
R^2	0.140	0.257	0.112	0.131	0.295	0.254
Sample size	551	551	551	551	1,525	1,525

[a] The wage is predicted using the estimates from table 2, column 5.

Table 4. Predicted off-farm hourly wage rates: U.S. farm operators, 1991 [a]

	Wage Rate ($/hr)	Standard Error
Quantiles		
0.05	4.76	0.24
0.10	5.84	0.24
0.25	7.74	0.14
0.50	9.92	0.12
0.75	12.18	0.14
0.90	15.33	0.25
0.95	17.23	0.41
Mean	10.26	0.13
Sample	2,076	
Population	1,368,069	

[a] This distribution was derived using PC CARP (Fuller et al.), coefficient estimates reported in table 2, column (5), and actual sample data on regressors.