Review of Agricultural Economics—Volume 30, Number 2—Pages 311–332
DOI:10.1111/j.1467-9353.2008.00406.x

Off-Farm Labor Participation Decisions of Married Farm Couples and the Role of Government Payments

Hisham S. El-Osta, Ashok K. Mishra, and Mitchell J. Morehart

The determinants of off-farm work by married farm couples are examined using data from the 2004 Agricultural Resource Management Survey and multinomial logistic regression. Expected government payment is found important in decreasing the likelihood of off-farm work strategies involving work by the husband only or by both husband and wife relative to a strategy of no work by either husband or wife. The marginal impact of government payments on the probability of the wife working off farm alone is found positive suggesting the possibility of nonpecuniary motives for off-farm employment for 21% of farm households in the selected weighted sample.

A recently published report by Mishra et al. has repudiated the generally held belief that farm households are financially disadvantaged compared with other U.S. households. Two other important observations were noted. First, farm households are no different than other households in pursuing two careers and in diversifying earnings. Second, more than half of all U.S. farm operators work off farm (with 80% of these working full-time jobs) and nearly half of all spouses also are employed off the farm. Ahearn and El-Osta have remarked that off-farm work can no longer be viewed as a transitional position between agricultural and the industrial economy, but rather as a lifestyle choice, with farming as a second job or investment. The fact that nearly 80% of total household income originates from off-farm sources, with income from off-farm wages and salaries being the

■ *Hisham S. El-Osta is an economist with the Economic Research Service, U.S. Department of Agriculture.*
■ *Ashok K. Mishra is an associate professor in the Department of Agricultural Economics and Agribusiness at Louisiana State University.*
■ *Mitchell J. Morehart is a senior economist with the Economic Research Service, U.S. Department of Agriculture.*

major contributor, is a case in point to the importance of these sources of income to the economic well-being of the household.

The closing of the income gap between farm and nonfarm households has been attributed to the growth in the earnings from off-farm sources (Ahearn, Johnson, and Strickland; Findeis and Reddy; Mishra et al.; Hopkins and Morehart). Because of the growth in the importance of off-farm earnings, the objective of this article is to use national data to try to ascertain the factors that contribute to the decision to work off the farm for a select group of U.S. farm operator households, namely, those with married farm couples. Considering the fact that the government transfers to the agricultural sector are sizeable ($12.5 billions in 2004, with farm operator households receiving 82%), a primary focus of this article is to try to assess the likely impact of government payments in 2004 on the off-farm labor participation decisions of married U.S. farm couples. Of all the types of payments received by the farm household, and because of their policy relevance, consideration is given to those received from any one of the nine commodity-related payment types (i.e., direct, countercyclical, loan deficiency, marketing loan gains, net value of commodity certificates, government payments received through cooperatives, peanut quota buyout program payments, milk income loss contract payments, and agriculture disaster payments). Taken together, these types of payments accounted for 81% of what an average participating farm operator household received from farm programs in 2004.

Literature Review

Many economists have noted the changing structure in U.S. agriculture and its implications for farm businesses and farm households. For example, Gebremedhin and Christy point out that the ownership and control of land and technology plus the distribution mechanisms are becoming increasingly concentrated in the hands of fewer farm operators and/or corporations. They further note the risk to the survivability of small farms if this trend continues unabated. Among the strategies adopted by small farm households to insure their economic viability is to participate in off-farm employment. The importance of a strategy of increased reliance by small farm households on income from off-farm sources was noted by Hoppe and by Newton and Hoppe. Newton and Hoppe also pointed to the need of maintaining a healthy rural economy as a prerequisite to the economic viability of these households.

While policies aimed at increasing access to off-farm job opportunities is a viable tool to improve the economic well-being of farm households, past studies have shown that such access is likely to be more important for husbands than for wives, in terms of both participation and earnings potential (LeClere). Ahearn, Perry, and El-Osta reported similar findings. For example, in 1988, when a spouse was present, the study found operators somewhat more likely to work off farm than the spouse (47% versus 42%, respectively). In households where the farm operator worked off farm, the farms were more likely smaller in terms of gross sales, net farm income, and net worth. A 1999 study by Korb shows that younger, better-educated farmers and spouses are most likely to work off farm. In that the operator’s age and education are both factors that are associated with off-farm employment have been empirically tested and supported in a number of studies (e.g., see Huffman, 1980; Huffman and Lange; Gould and Saupe; Lass, Findeis, and Hallberg; Gunter and McNamara; Lass and Gempesaw; Huffman and El-Osta; Corsi and Findeis; among others).

Yet many studies have also examined the role government payments play in impacting the decision to work off farm, particularly the type of payments initiated by the 1996 Federal Agricultural Improvement and Reform Act where payments were designed to be "decoupled" from current production decisions (El-Osta, Ahearn, and Mishra; El-Osta, Mishra, and Ahearn; Goodwin and Mishra; Ahearn, El-Osta, and Dewbre). Findings of these studies have demonstrated that receipt of government payments, regardless to whether the payments come from programs that tie payments to current year production or not, tend to decrease the likelihood of farm operators working off the farm and/or the amount of off-farm working hours. This article will add to the literature by assessing the role of commodity-related government payments in impacting the off-farm work preferences of husbands and wives of farm operator households using a national survey.

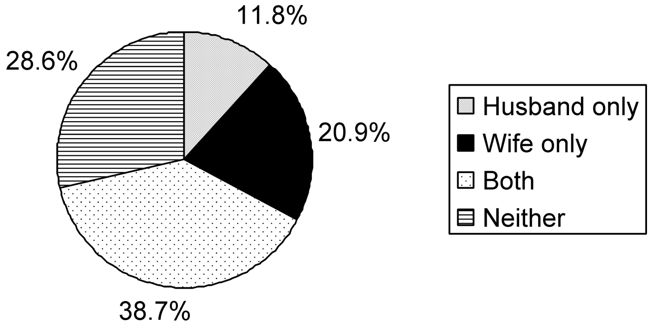
Data

The primary data used in the analysis are from the 2004 Agricultural Resource Management Survey (ARMS). The ARMS, which is a survey conducted in the lower 48 states, is collected annually by the National Agricultural Statistics Service (NASS) and the Economic Research Service (ERS) (for more detail, see http://www.ers.usda.gov/Briefing/ARMS/). Information on the local area characteristics are based on county-level data from the 2003 Regional Economic Information System files (Bureau of Economic Analysis), the 2003 Local Area Unemployment Statistics (Bureau of Labor Statistics) files, and the 2000 Census of Population, SF-3 file.

The size of the initial probability-based ARMS sample in 2004 was 7,074, which when properly expanded using survey weights, yielded a population of farms totaling 2,107,377.[1] Of these farms, nearly 2.07 million farms represented by a subsample of 6,706 observations were classified as sole proprietorships, legal partnerships, and family corporations. As noted by Ahearn, Perry, and El-Osta, individuals and the members of their households who operate these types of farms tend to receive the bulk of the residual income from agricultural production, and as such, they are likely to be most impacted by market and policy shifts. Accordingly, the number of observations in the final subsample chosen for the analysis was 4,208, which has captured, based on survey weights, a total of 764,438 of these farm operator households. Included in this selected subsample are farm households where the operators are males and married, and where the household has reported at least $10,000 in annual farm sales in 2004.[2] The farms of these nearly 0.8 million households accounted for 36% of the 2.11 million farms represented in the survey and captured 76% of the total farm output.

In this article, participation in off-farm work by the farm operator household is defined based on income received by the married farm couple from off-farm wages and/or salaries and/or an off-farm business. Figure 1 shows the distribution of the farm operator households among the four possible off-farm work outcomes.

Figure 1. **Distribution of married farm-couple households by off-farm work status, 2004**



Theoretical Model

Underlying many of the studies that examine the labor allocation decisions among married couples is the seminal work by Becker, which delineated a household model that allowed for the concurrent determination of the economic value of leisure and productive nonmarket activities. Based on the theoretical constructs initiated by Becker, the basic tenet of off-farm labor decisions by a single farm family composed of a married farm couple is the trade-off that occurs between the consumption of goods and that of leisure (Huffman and Lange).

Following Huffman and Lange; Huffman (1991), Tokle and Huffman; and Huffman and El-Osta, the optimal allocation of time by the husband (*H*) and the wife (*W*) among leisure, on-farm work, and off-farm work under the assumption of risk neutrality is obtained by solving the following simplified one-period optimization problem:[3]

(1) $$\text{Maximize} \quad U = U\left(T_h^H, T_h^W, C; \zeta^H, \zeta^W, \tau\right)$$

subject to the constraints:

(2) $$\bar{T} = T_f^i + T_m^i + T_h^i, \quad T_m^i \geq 0, \quad i = H, W$$

(3) $$P_c C = \sum_i W_m^i T_m^i + (P_q Q - W_x X) + V$$

(4) $$Q = Q\left(T_f^H, T_f^W, X; \zeta^H, \zeta^W, \phi\right),$$

where U in equation (1) is farm household's utility (or welfare) function; C denotes consumption goods purchased in the market; T_h^i and ζ^i denote hours of leisure and stock of human capital by the husband and the wife ($i = H, W$), respectively; and τ represents other factors as age and number of children. In equation (2), $\bar{T}$ is the annual total time endowment for the husband and the wife, T_f^i is annual hours allocated to farm work, and T_m^i is annual hours allocated to off-farm work. The nonnegativity constraint imposed on T_m^i in equation (2) allows for the possibility that the optimal hours allocated by individual i for off-farm work might be 0 in any year, and is consistent with the fact that a significant share of the individuals in our sample report no participation in off-farm employment.[4] In equation (3), P_c is the price of consumption good C, W_m^i is the hourly nonfarm wage rate earned by individual i, P_q is the price of farm output Q, W_x is the price of purchased inputs X including hired farm labor, and V denotes other household nonlabor income including income from farm subsidies. Equation (4) describes the technology of farm production with ϕ depicting location-specific characteristics such as local climate and soils. The utility function U in equation (1) and the nonstochastic production function Q in equation (4) are assumed to be concave, continuous, and twice differentiable.

The hourly nonfarm wage rate (i.e., W_m^i) in equation (3) describes the market labor demand or the off-farm wage function facing individual i. It is assumed here that W_m^i is a function of individual ith stock of marketable human capital (ζ^i) and local labor market conditions (ψ) as in

$$W_m^i = W_m^i(\zeta^i, \psi) \quad i = H, W. \tag{5}$$

After substituting equation (4) into (3), the budget constraint can be written as

$$\sum_i W_m^i T_m^i + P_q Q(T_f^i, X, \zeta^i, \phi) - W_x X + V - P_c C = 0 \tag{6.1}$$

$$I = \sum_i W_m^i T_m^i + V + P_q Q(T_f^i, X, \zeta^i, \phi) = W_x X + P_c C \tag{6.2}$$

where I is the household's full income, which by definition, represents the household's total economic resources in terms of the husband's and wife's time, their human capital, and income from assets owned (Thomas and Senauer). Equation (6.2) establishes the requirement that household's full income I should equal its total expenditures.

The conditions for optimal allocation of time by the household are obtained by maximizing equation (1) subject to the restrictions as defined by equations (2) and (6.1). Equivalently, the optimality conditions can be obtained by first forming the following Lagrange function (ℓ):

$$\begin{aligned}\ell = {} & U(T_h^H, T_h^W, C; \zeta^H, \zeta^W \tau) \\ & + \lambda\left[\sum_i W_m^i T_m^i + P_q Q(T_f^H, T_f^W, X, \zeta^H, \zeta^W, \phi) - W_x X + V - P_c C\right] \\ & + \gamma^H(\bar{T} - T_f^H - T_m^H - T_h^H) + \gamma^W(\bar{T} - T_f^W - T_m^W - T_h^W),\end{aligned} \tag{7}$$

where λ and $\gamma^i (i = H, W)$ are Lagrange multipliers for marginal utility of income and of husband's and wife's time, respectively. The next step needed is to maximize ℓ, which is achieved by deriving the following first-order conditions:

(8) $$\frac{\partial \ell}{\partial X} = \lambda \left[P_q \frac{\partial Q}{\partial X} - W_x \right] = 0$$

(9) $$\frac{\partial \ell}{\partial T_f^i} = \lambda P_q \frac{\partial Q}{\partial T_f^i} - \gamma^i = 0, \quad i = H, W$$

(10) $$\frac{\partial \ell}{\partial T_m^i} = \lambda W_m^i - \gamma^i \leq 0$$
$$T_m^i \geq 0, T_m^i(\lambda W_m^i - \gamma^i) = 0, \quad i = H, W$$

(11) $$\frac{\partial \ell}{\partial T_h^i} = \frac{\partial U}{\partial T_h^i} - \gamma^i = 0, \quad i = H, W$$

(12) $$\frac{\partial \ell}{\partial C} = \frac{\partial U}{\partial C} - \lambda P_c = 0$$

(13) $$\frac{\partial \ell}{\partial \gamma^i} = \bar{T} - T_f^i - T_m^i - T_h^i = 0.$$

A subset of these first-order conditions (equations (9)–(11)) allows for the discernment of how the husband or the wife would optimally allocate time to leisure only, or to leisure and to work activities including on and/or off the farm (for detail, see Huffman and Lange). Accordingly, the participation rule adopted by the husband or the wife based on equation (10) suggests that individual i will decide to participate in off-farm labor market when the reservation wage from farm work ($W_r^i = \frac{\gamma^i}{\lambda}$) and leisure is less than the offered off-farm wage rate (W_m^i).[5] Resolution of these first-order conditions allows for four off-farm work strategies: only the husband works, only the wife works, both work, and neither spouse works. The strategies considered here are variants of those utilized by Benjamin, Corsi, and Guyomard, and Benjamin and Kimhi where off-farm work choices of French farm couples were analyzed in conjunction with the decision to hire farm labor.

Model Estimation

In this article, a multinomial logit (MNL) model is used to examine the determinants of off-farm labor participation among farm husbands and farm wives, respectively. The dependent variable for the discrete outcome equation is defined according to four off-farm work strategies (M): only the husband works (I_1), only the wife works (I_2), both work (I_3), and neither spouse works (I_4). Let Y_j take the value 1 if the jth household chooses the qth off-farm work strategy (where the decision by the individual within the household itself to work off-farm is determined based on the goods-leisure trade-off model described above, i.e., $W_r^i < W_m^i$); 0 otherwise. The relative odds (P) of off-farm work choices are expressed using the following MNL model:

$$\log\left(\frac{P_{jq}}{P_{jM}}\right) = Z'_j\vartheta_q + \varepsilon_j, \quad j = (1,\ldots,n), \quad q = (1,\ldots,M-1), \tag{14}$$

where *log* is the natural logarithm, Z is a vector of exogenous explanatory, ϑ is a vector of parameters to be estimated, and ε is a random disturbance term.[6] The means of explanatory variables as defined by vector Z and based on the distinct M strategies of off-farm labor participation are presented in table 1. Nine farm resource regions are entered in equation (14) in order to control for the geographic location of the farm (for more detail and for a map, see http://www.ers.usda.gov/Briefing/ARMS/resourceregions/resourceregions.htm).

The conditional probability for the choice q is derived as in the following (for more detail, see Greene, p. 721).

$$P_{jq} = \text{Prob}(Y_{jq} = 1) = \frac{\exp(Z'_j\vartheta_q)}{\sum_{k=1}^{M}\exp(Z'_j\vartheta_k)}, \quad q = (1,\ldots,M-1) \tag{15}$$

This, alternatively, can be written as

$$P_{jq} = \frac{\exp(Z'_j\vartheta_q)}{1+\sum_{k=1}^{M-1}\exp(Z'_j\vartheta_k)}, \quad q = (1,\ldots,M-1), \tag{16}$$

$$P_{jM} = \frac{1}{1+\sum_{k=1}^{M-1}\exp(Z'_j\vartheta_k)}.$$

In the context of this article, elements of ϑ_q in equation (14) measure the marginal effects of the explanatory variables on the logarithm of the odds of a farm household being in off-farm work category I_1 relative to I_4, in category I_2 relative to I_4, and in category I_3 relative to I_4. The interpretation of ϑ_q is simplified even further by computing the marginal effects of Z_j on the probabilities of being in I_1, I_2, or I_3 as in (for more detail, see Greene, p. 722):

$$\begin{aligned}\delta_q = \frac{\partial P_q}{\partial Z_q} &= P_q\left[\vartheta_q - \sum_{q=1}^{M-1}P_q\vartheta_q\right] \\ &= P_q(\vartheta_q - \bar{\vartheta}),\end{aligned} \tag{17}$$

where $\bar{\vartheta}$ is a vector whose elements are the averages of all estimated $\vartheta_q (q = 1, 2, 3)$. The signs of any particular ϑ_q and δ_q need not be the same.[7] Although by definition $\vartheta_4 = 0$, which is done for the purpose of facilitating the computation, the marginal effects of the attributes on the probability of a farm household being in off-farm category I_4 are themselves not zero, and in fact they are computed as $\delta_4 = -P_4\bar{\vartheta}$.

Table 1. Weighted means of variables used in the off-farm labor participation model, 2004

	Weighted Means[1]				
Variables	Only Husband Working	Only Wife Working	Both Working	Neither Working	All ARMS Sample
Age of husband	54*	54*	52*	64	56
Years of education of husband	13.11	13.34	13.78*	12.83	13.34
Years of education of wife	13.06	14.15	14.12*	12.83	13.63
Husband was raised on a farm (dummy variable)	0.83	0.92	0.81	0.86	0.85
Wife was raised on a farm (dummy variable)	0.60	0.56	0.46	0.61	0.54
Household size (excluding children under 6)	3.02	2.92	2.91	2.73	2.88
Number of children under 6	0.36	0.13	0.14	0.16	0.17
Log (interest and dividends earned by the household, $)	7.42	7.35	7.44*	7.59	7.46
Log (farm capital, $)[2]	11.53	12.22	11.54*	11.85	11.77
Expected government payments ($1,000)	7.37*	17.63	9.76	10.87	11.44
Miles to nearest town with a population of at least 10,000	25.03	28.01	25.04	25.19	25.70
State average wage rate for hired labor in 2004 ($)	9.98	10.13*	9.98	9.92	9.99
Expected monthly rainfall for the county, mm	924.84	894.05	903.78	903.05	904.02
Heartland region (dummy variable)	0.23	0.30	0.34	0.20	0.28
Northern Crescent region (dummy variable)	0.15	0.13	0.09	0.15	0.12
Prairie Gateway region (dummy variable)	0.17	0.12	0.18	0.19	0.17

Continued

Table 1. Continued

Variables	Weighted Means[1] Only Husband Working	Only Wife Working	Both Working	Neither Working	All ARMS Sample
Eastern Uplands region (dummy variable)	0.17	0.11	0.10	0.15	0.12
Southern Seaboard region (dummy variable)	0.09	0.11	0.06	0.07	0.08
Fruitful Rim region (dummy variable)	0.07	0.08	0.08	0.11	0.09
Basin and Range region (dummy variable)	0.06	0.03	0.05	0.03	0.04
Mississippi Portal region (dummy variable)[3]	0.03	0.03	0.04	0.04	0.04
Unemployment rate in 2003 (%)	5.86	5.61	5.84	5.82	5.79
County's population living in urban areas (%)	41.51	41.25	44.27	41.84	42.62
County's income from agriculture in 2003 (%)	5.23	6.62	5.14	6.68	5.90
County's employment in manufacturing in 2003 (%)	11.11	10.59	10.96	10.71	10.83
County's employment in construction in 2003 (%)	5.64	5.60	5.84	5.60	5.70
County's employment in transportation and utilities in 2003 (%)	2.47	2.55	2.67	2.62	2.61
County's employment in finance, insurance, and real estate in 2003 (%)	4.99	5.25	5.51	5.35	5.35
County's employment in government in 2003 (%)	16.09	15.58	15.66	15.19	15.56
County's employment in trade in 2003 (%)	13.67	13.64	13.93	13.69	13.77
Sample size	440	1,188	1,056	1,524	4,208
Farm operator households	90,237	159,862	295,586	218,752	764,438

[1] *Primary Data Source:* 2004 Agricultural Resource Management Survey (Version 1, Phase III).
[2] Value of farm machinery and equipment, breeding stock, and farm buildings (excluding the farm dwelling), 1-1-2004, $1,000.
[3] Excluded region: "Northern Great Plains."
Note: The coefficients of variation (CVs) of estimates of all continuous variables, except those that are underlined, are below 25%. Differences in the means of these estimates in the first, second, and third off-farm work categories and those in the fourth category (i.e., "Neither working" are examined with * indicating that the respective means within each row are statistically different [at 10% level, or higher] from the means in the fourth category).
CVs were computed based on the delete-a-group Jackknife procedure using a SAS computer code provided by Robert Dubman (see Dubman, April, 2000).

Empirical Findings

A primary determinant to be examined, among others, is the importance of government payments to off-farm work decisions.[8] The article accounts for the potential endogeneity of this household decision variable in the off-farm labor participation model, which if left unattended may result in biased and inconsistent estimators, by utilizing a two-step procedure (see Smith and Blundell; Rivers and Vuong; Wooldridge, pp. 472–77).[9] In the first step, a tobit regression model of government payments was estimated using maximum likelihood and Jackknife variance estimation. The explanatory variables of this tobit model included those, in addition to the control variables delineated in vector Z in the off-farm labor participation model (see equation (14)), that were available in the 2004 ARMS data set and that were reasonable enough to be used as instruments for government payments since they were more likely to be correlated with payments than with off-farm decisions. The second step involved replacing the observed values of government payments in the off-farm labor participation model by their expected values based on the estimated tobit regression model.[10]

Results of the government payments model, along with a summary statistic of the underlying data including the average level of farm subsidy received by the farm household are presented in the Appendix. A cursory look at the results points to the importance of farmer's occupation, farm size, farm tenancy, and soil productivity. This subsidiary regression used to predict the level of government payment received by the farm household, in light of the limited number of viable instruments, is deemed to be fairly successful as indicated by the correlation coefficient between predicted and observed values (0.61) and by the magnitude of the pseudo-R^2 (0.28).[11]

Table 2 reports estimation results for the *MNL* model, which were also reached based on maximum likelihood and Jackknife variance estimation methods.[12] The estimated model demonstrated a fairly superior predictive capability as indicated by a McFadden pseudo-R^2 value of 0.20.[13]

Column 1 in table 2 presents the results of the model depicting the likelihood of occurrence of the off-farm work strategy where only the husband works off the farm relative to the strategy where no off-farm work is undertaken by either the husband or the wife. Findings are, in general, consistent with expectations based on theoretical grounds and based on findings of previous studies on the determinants of off-farm labor participation. Variables *OPAGE* and *OPAGESQ*, for example, are found to be statistically significant with the expected opposite signs indicating an inverted U-shaped relationship between age of the operator and the likelihood of off-farm work. This also means, other things being equal, that the likelihood that the farm operator working off farm alone increases throughout the life of the operator until it reaches a maximum at 44 years of age based on point estimates, then declines as the operator grows older. The findings pertaining to the nonlinear effect of age on participation in off-farm work are consistent with those by, among others, Sumner; Gould and Saupe; Huffman and El-Osta; and Ahearn and El-Osta.

Seven specific characteristics of the farm business including a set of dummy variables depicting the regional location of the farm are investigated in terms of their likely impact on the probability of off-farm work. Of these, only expected

Table 2. Multinomial logit estimates of factors affecting off-farm labor participation decisions by farm husbands and their wives, 2004

Variables	Off-Farm Work Status[1] (1) Only Husband Working: $log(P_1/P_4)$	(2) Only Wife Working: $log(P_2/P_4)$	(3) Both Husband and Wife Working: $log(P_3/P_4)$
Intercept (*INTERCEPT*)	−7.0823	−8.0704**	−8.7233***
Age of husband (*OPAGE*)	0.2205***	0.1845*	0.3565***
Age of husband, squared (*OPAGESQ/100*)	−0.2530***	−0.2243**	−0.4249***
Education of husband (*OPEDUC*)	0.0108	−0.1213	0.0065
Education of wife (*SPEDUC*)	0.0990	0.3387***	0.2952***
Husband farming experience (*OPFARMR*)	0.1826	0.5478	0.1511
Wife farming experience (*SPFARMR*)	0.1900	−0.0252	−0.1260
Household size (*HHSIZEL6*)	−0.1471	−0.1937**	−0.2669***
Number of children under 6 (*CHILDREN*)	0.1641	−0.4150	−0.4625*
Log of interest income (*LOFFINT*)	0.0867	−0.0993	0.1263
Log of farm capital (*LFCAPITAL*)	−0.1777	0.0311	−0.2308**
Expected government payments (*EXPGPYMT*)	−0.0701***	0.0188	−0.0556**
Miles (*MILES*)	−0.0022	0.0039	−0.0018
Wage rate (*WAGERATE*)	0.1933	0.2356	0.1206
Precipitation (*PRECIP*)	−0.0000	0.0002	0.0000
Heartland region, dummy (*HEARTLND*)	1.1979	−0.0937	0.3914
Northern Crescent region, dummy (*NRTHCRST*)	0.4059	−0.3249	−0.9238
Prairie Gateway region, dummy (*PRGATEWY*)	0.8606	−0.2011	−0.1125
Eastern Uplands region, dummy (*EASTUPLN*)	0.6075	0.1683	−0.8857
Southern Seaboard region, dummy (*STHSEABD*)	0.4793	0.1748	−1.1872
Fruitful Rim region, dummy (*FRUITRIM*)	−0.1621	−0.3965	−1.4409*
Basin and Range region, dummy (*BASINRNG*)	0.7935	−0.2768	−0.7140
Mississippi Portal region, dummy (*MISSPORT*)	0.4846	−0.2805	−0.5146
Unemployment rate (*UNEMP*)	−0.0390	−0.0463	−0.0227
Urban areas (*URBAN*)	0.0035	0.0055	0.0065
Percentage of income from agriculture (*AGRIN*)	−0.0130	−0.0108	−0.0123
Employment in manufacturing (*MANUF*)	−0.0057	−0.0181	0.0031
Employment in construction (*CONST*)	0.0040	0.0274	0.0291
Employment in transportation and utilities (*TRANU*)	−0.0422	0.0028	−0.0134
Employment in finance, insurance, & real estate (*FIR*)	−0.1113	−0.0307	−0.0569
Employment in government (*GOVERNMENT*)	0.0505**	0.0092	0.0427*
Employment in wholesale and retail trade (*TRADE*)	0.0576	−0.0128	0.0556
McFadden pseudo-$R^2 = 0.201$			

*Significant at 10%, ** Significant at 5%, *** Significant at 1%.
Note: The Northern Great Plains region was the deleted group in the regression analysis.
[1] P_1, P_2, P_3, and P_4 are the probabilities of only the husband working off farm, of only the wife working off-farm, of both husband and wife working off farm, and of neither working off farm, respectively (see equations (14) and (16)).

government payments (*EXPGPYMT*), because of their likely impact in reducing the risk of farming or in potentially influencing farm productivity or leisure demand, are negatively related (at 1% level of significance) to the probability of off-farm work by the husband.

The next set of variables capture the characteristics of the local labor markets that may impact the likelihood of off-farm work. Column 1 in table 2 shows that these variables, with the exception of the one depicting the percentage of the county's population working in government-related jobs (*GOVERNMENT*), are not important in explaining the likelihood of off-farm work by the farm operator. Finding in this article of a positive and statistically significant (at the 1% level) coefficient of *GOVERNMENT* points to increased likelihood of off-farm work attributed to this type of off-farm employment. This positive association may be explained by the higher wages associated with government jobs relative to wages of jobs in other industries.[14]

Column 2 in table 2 presents the findings pertaining to the factors that impact the likelihood of a strategy of off-farm work by only the wife relative to a strategy where neither spouse works off-farm. The first two significant variables are *OPAGE* and *OPAGESQ*, which indicate that the likelihood of off-farm work by the wife increases with the age of her husband at a decreasing rate. Consistent with the human capital thesis that points to the positive impact of education on earnings and on the ability of individuals to adapt to changes and to engage in a various employment opportunities (see Nelson and Phelps; Deseran, Falk, and Jenkins), educational attainment of farm wives (*SPEDUC*) is found to be positively correlated with off-farm work decisions.[15] The negative and statistically significant coefficient of *HHSIZEL6* implies less work outside the home by farm wives as the size of the farm household increases.

The final column in table 2 presents the findings of the effect of the explanatory variables on the probability of both the husband and the wife participating in off-farm employment relative to a strategy of no such participation by either of them. The signs and the statistical significance of the variables depicting the age of the husband and of its quadratic term (*OPAGE* and *OPAGESQ*) along with point estimates indicate a maximum probability for both the husband and the wife to work off-farm at an earlier stage in husband's life-cycle, at 42 years. Consistent with expectation, higher levels of education by farm wives (*SPEDUC*) impact positively the likelihood of their participation in off-farm employment. As in the case of the strategy where only the wife works of the farm (column 2), having a larger-sized household or having more children under six years of age (*CHILDREN*), which tends to increase the opportunity cost of home production (see Gronau), seems to decrease the likelihood of off-farm work by both husbands and wives.

Consistent with expectation, the coefficients of the variables that increase the productivity of husbands' and wives' on-farm work and that decrease the riskiness of farming due to an increase in their levels, as reflected by both *LFCAPITAL* and *EXPGPYMT*, are negative and statistically significant. This indicates, as has been found by others (e.g., Ahituv and Kimhi; Ahearn, El-Osta, and Dewbre), that both farm capital and government payments have a negative impact on the probability of off-farm work by both husbands and wives. Similarly, a negative and statistically significant coefficient is found for *FRUITRIM*, which indicates that husbands and wives who are located in the Fruitful Rim region are less likely to work off-farm than their counterparts who are located in the Northern Great Plain region.

Table 3 presents the predicted marginal changes in the probabilities of off-farm work by the husband and/or the wife (see equation 17) due to a per-unit increase in continuous explanatory variables, and due to a change in value from 1 to 0 for dummy variables. Findings indicate that farm operator households whose farms are located in the Heartland and the Basin and Range regions are significantly more likely, with the probability being higher by 11.6% and 13.2%, respectively, than those households whose farms are located in the Northern Great Plains to have husbands working off-farm alone. A one-year increase in the educational attainment of the wife increases the probability of her working off the farm alone by 3.3%. Farm households located in the Northern Great Plains are 4.8% and 7.3% more likely to have, respectively, a wife that works off farm alone than farm households who are located in the Prairie Gateway or the Heartland. Similarly, the likelihood that both the husband and the wife will both work off farm are significantly higher if the farm operator household is located in the Northern Great Plains rather than in the Basin and Range (12.9%), Northern Crescent (14.1%), Eastern Uplands (16.8%), Fruitful Rim (18.4%), or the Southern Seaboard (20.4%).

In highlighting the impact of government payments on off-farm work strategies, which is the main focus of this article, findings indicate that a $10,000 increase in expected payments (*EXPGPYMT*) tends to increase the likelihood of the wife working off farm alone (columns 2) by 9.0% and to decrease such likelihood by 8.6% for the strategy where both the husband and the wife work concurrently off farm. The unexpected finding of a positive and significant change in the probability of off-farm work by the wife due to a per-unit increase in government payments, when the strategy is that of only the wife working off farm, may be attributed to a number of reasons (see Goodwin and Holt, for evidence of a positive association between off-farm work and greater household earnings). One reason might be the dependence of farm households in this group where only the wife works off farm on farming, this despite the wives' participation in off-farm labor markets. Evidence from the 2004 ARMS shows 91% of the farm operators in this group with farming as their main occupation, dramatically higher than what was reported by husbands in the other three groupings of farm households.[16] Furthermore, evidence of the dependence of households in this category on farming is further corroborated by noting that both the levels of investment in farm capital and expected government payments received (*EXPGPYMT*) are much higher (at $17,630 and 12.22, respectively, as evident in table 1) for households in this group than for those in the other off-farm work groups.

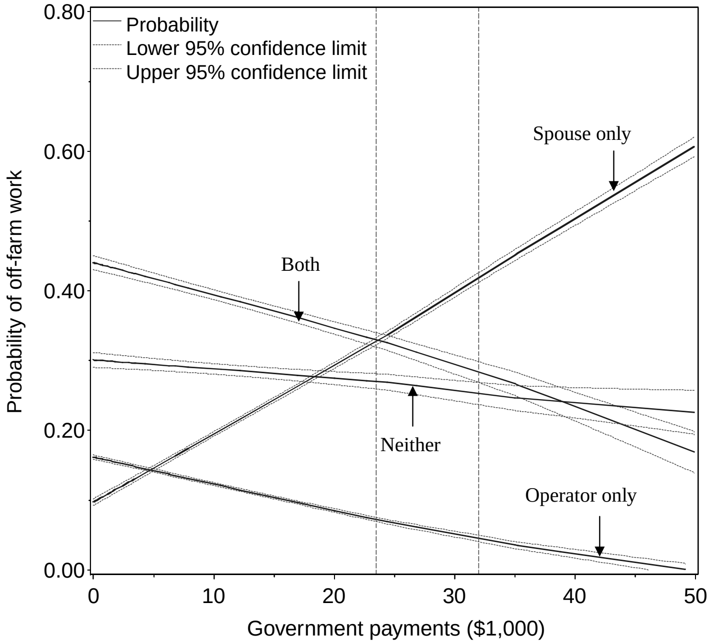
Accordingly, the potential increase in the likelihood of off-farm work by farm wives resulting from an increase in the level of government payments suggests that the payments will not prompt the wives in this category to increase their demand of leisure. This in turn might indicate that off-farm labor participation by the wife, when only the wife is working off farm, is not undertaken for monetary reason as a way to supplement the income generated by the household from farming, but instead is undertaken to secure some "nonpecuniary" benefits such

Table 3. Predicted marginal effects (averaged over individuals) of factors affecting the probabilities of off-farm labor participation decisions by farm husbands and their wives, 2004[1]

	Off-Farm Work Status			
Variables	**(1) Only Husband Working**	**(2) Only Wife Working**	**(3) Both Husband and Wife Working**	**(4) Neither Husband nor Wife Working**
INTERCEPT	−0.1150	−0.5494	**−0.6346**	**1.2989**
OPAGE	0.0019	−0.0009	**0.0397**	**−0.0408**
OPAGESQ/100	−0.0014	0.0001	**−0.0473**	**0.0486**
OPEDUC	0.0032	**−0.0214**	0.0102	0.0080
SPEDUC	−0.0093	**0.0327**	0.0214	**−0.0448**
OPFARMR	−0.0005	**0.0741**	−0.0201	**−0.0535**
SPFARMR	0.0209	**0.0016**	**−0.0268**	0.0043
HHSIZEL6	0.0012	−0.0092	**−0.0260**	**0.0340**
CHILDREN	0.0390	**−0.0382**	**−0.0539**	**0.0532**
LOFFINT	0.0048	**−0.0285**	**0.0266**	−0.0029
LFCAPITAL	−0.0073	**0.0269**	**−0.0361**	0.0165
EXPGPYMT	−0.0043	**0.0090**	**−0.0086**	0.0039
MILES	−0.0002	**0.0009**	**−0.0005**	−0.0001
WAGERATE	0.0070	**0.0267**	−0.0043	**−0.0295**
PRECIP	−0.0000	**0.0000**	−0.0000	−0.0000
HEARTLND	**0.1159**	**−0.0732**	0.0156	−0.0583
NRTHCRST	0.0862	0.0046	**−0.1411**	**0.0596**
PRGATEWY	**0.1052**	**−0.0483**	−0.0447	−0.0122
EASTUPLN	0.0906	0.0693	**−0.1682**	0.0083
STHSEABD	0.0852	0.0941	**−0.2040**	0.0248
FRUITRIM	0.0415	0.0271	**−0.1844**	**0.1158**
BASINRNG	**0.1319**	−0.0257	**−0.1291**	0.0229
MISSPORT	0.0799	−0.0247	**−0.0858**	0.0305
UNEMP	−0.0015	**−0.0053**	0.0010	**0.0058**
URBAN	−0.0001	0.0004	**0.0006**	**−0.0009**
AGRIN	−0.0004	−0.0006	**−0.0008**	**0.0019**
MANUF	−0.0002	**−0.0032**	**0.0022**	0.0013
CONST	−0.0013	0.0023	**0.0028**	**−0.0038**
TRANU	−0.0031	**0.0024**	−0.0010	0.0018
FIR	−0.0067	0.0015	−0.0035	**0.0087**
GOVERNMENT	0.0025	−0.00280	**0.0049**	**−0.0046**
TRADE	0.0031	**−0.0077**	**0.0086**	−0.0040

[1]The computation of the marginal effect for a continuous variable is done based on equation (17). For a dummy variable, the marginal effect is computed as the difference in the probability of choosing a particular off-farm work strategy when the value of the binary variable is 1 and when it is 0 (see endnote 6 for more detail).
Note: Bolded numbers indicate statistical significance at 10% (or better) significance level.

Figure 2. **Simulated probabilities of off-farm work, 2004**



as, among others, insurance (both life and medical) coverage. Studies by Johnson, Morehart, and Mishra, and Mishra, El-Osta, and Johnson, based on 2001 and 2003 ARMS data, respectively, show that the majority of spouses who tend to work off-farm full time (primarily in private companies followed by local governments and schools) tend to report also that nonfarm occupation is their career choice. The literature suggests, among others, that diversion, camaraderie, learning experiences, career aspiration, and job satisfaction might be reasons for market work and for the consumption of less leisure even in the presence of higher levels of household income (see Mincer and Polachek; Long and Jones).

Figure 2 provides visual depiction of the impact of government payments on the choices of off-farm work by married farm couples based on the results obtained from fitting four nonparametric regressions where the dependent variables are, as described in equation (16), the corresponding vectors of off-farm work probabilities.[17] In the absence of payments, the likelihood of off-farm work by both the husband and wife exceeds the likelihood of any other off-farm work strategy. This finding is also corroborated from the selected 2004 ARMS' sample that shows the off-farm participation rate for households receiving no farm subsidies of the type considered in this article to be highest (42.1%) when the choice for market work is that of both husbands and wives working. As the level of farm subsidies starts to increase, the likelihood of off-farm work by both husbands and wives, while decreasing, nevertheless remains higher than the likelihoods of other off-farm work choices until the level of payments reaches $23,500 (see first vertical line in chart).

When the level of farm subsidies increases beyond $23,500 and up to $32,000, the likelihood that the wife will work off farm alone moves from being equal to the likelihood of off-farm work by both husband and wife to become increasingly higher than all other likelihoods. At levels of payments equal to or greater than $32,000, graphical evidence suggests that it is just as likely that both husbands and wives will work off-farm or none of the married farm couples will commit to such an activity, and instead, the evidence further shows that it is extremely likely that only the wives will work off farm. Figure 2 also highlights rather dramatically the impact of payments on the likelihood of off-farm work by the husband. Over the range of payments considered, the likelihood of the husband working off farm alone decreases from about 16% under a scenario of no payments to nearly 2% when payment levels reach $50,000.

Summary and Conclusion

Variability in commodity prices, vagaries of weather, and the general conditions of the economy in relation to the availability of off-farm employment opportunities are all factors that can impact the economic well-being of farm operator households. An established role for federal programs since their inception in the 1930s is to prevent a significant drop in national farm income. This article informs the debate by examining the role government payments play, among others, in impacting the off-farm work decisions of married farm couples using data from a national survey and a multinomial regression procedure.

Of the demographic variables considered, age of the husband showed the typical inverted–U-shaped relationship involving the likelihood of off-farm work either alone or with the wife. Education of the wife was found to be positively related with the decision to work off-farm either alone or with the husband. Presence of children younger than six years was found to be negatively correlated with the decision of the wife to work off-farm alone or jointly with the husband. Of the farm-specific variables considered, increased investment in farm capital tended to adversely impact the off-farm labor participation decision for both husbands and wives. For the livelihood strategies considered where only the farm husband works off farm, and where both the farm husband and the farm wife work off farm, increased levels of payments were found to decrease the likelihood of the household adopting these strategies relative to a strategy where neither the husband nor the wife work off farm.

Farm operator households with multiple job holdings are protected by a social safety net comprising unemployment insurance, the earned income tax credit, and food stamps. Evidence suggested by this article seems to indicate that increased levels of farm subsidies as witnessed in recent years may have the unintended effect of lowering the likelihood of continued off-farm work by at least some groups of farm households, particularly by those where off-farm work tends to be undertaken solely by the husband or by both the husband and the wife. A policy tool such as the 1997 tax legislation aimed at increasing the number of Empowerment Zones (i.e., areas with pervasive poverty and unemployment targeted for economic development where tax incentives are provided for the purpose of attracting private sector investment) may not work at increasing off-farm labor participation in an environment of increased government transfers.

Appendix. Weighted means of variables and weighted tobit estimates of government payments model, 2004

Explanatory Variables	Weighted Means[1]	$\hat{\beta}$
Intercept	–	−180.636***
OPOCCUPF [2]	0.60	8.680***
LNACRES [3]	5.73	10.770***
RNTPC_50[4]	0.37	7.321*
CONT_CROP[5]	0.31	2.554
SOLE[6]	0.88	−7.452
PARTNERSHIP[7]	0.07	6.076
PRODINDEX [8]	74.50	0.207**
OPAGE	56	0.401
OPAGESQ/100	30	−0.348
OPEDUC	13.34	−0.145
SPEDUC	13.63	0.297
OPFARMR	0.85	9.934***
SPFARMR	0.54	−2.877
HHSIZEL6	2.88	−0.212
CHILDREN	0.17	−0.809
LOFFINT	7.46	1.213
LFCAPITAL	11.77	1.046
MILES	25.70	−0.066
WAGERATE	9.99	3.381**
PRECIP	904.02	−0.009
HEARTLND	0.28	18.801***
NRTHCRST	0.12	13.034*
PRGATEWY	0.17	3.156
EASTUPLN	0.12	0.130
STHSEABD	0.08	14.186
FRUITRIM	0.09	0.327
BASINRNG	0.04	−8.546
MISSPORT	0.04	24.286
UNEMP	5.79	0.049
URBAN	42.62	0.061
AGRIN	5.90	0.256*
MANUF	10.83	0.333***
CONST	5.70	−0.586
TRANU	2.61	−0.543
FIR	5.35	0.143
GOVERNMENT	15.56	0.232
TRADE	13.77	1.036*
Dependent variable (Y):		
Government payments to household, $1,000	$9.075[9]	

Censored observations = 1,930 (representing 346,619 nonparticipating farm households)
Noncensored observations = 2,278 (representing 417,819 participating farm households)
ρ = Correlation (Y, $\hat{Y}$)0.612; Pseudo $R^2 = 0.281$

*Significant at 10%, **significant at 5%, ***significant at 1%.
Note: [1]All nonbinary variables have coefficients of variation of less than 25 %. [2]Husband's major occupation is farming (dummy variable). [3]Log of acres. [4]Household is more likely to rent (more than 50% of operated acres) than own land years (dummy variable). [5]Continuous cropping practice; three or more years (dummy variable). [6]Farm is organized as a sole proprietorship (dummy variable). [7]Farm is organized as a partnership (dummy variable). [8]Productivity index. This index uses the Natural Resources Inventory data (U.S. Department of Agriculture) to delineate information on soil productivity, and as such, it is used as an indicator of soil's ability to produce crops. The index begins at zero, which indicates county where farm is located having the least productive soils, and ends at 100, which reflects the county as having the most productive soils. [9]The $9.075 is the level of government payments received by the average farm household regardless of the level of participation in government programs (i.e., the averaging is carried over the full sample of 4,208 observations from the 2004 ARMS). The weighted average level of payments received by the participating households (i.e., based on the 2,278 noncensored observations) is $16,603.

Acknowledgments

The authors wish to gratefully acknowledge the helpful comments of two anonymous reviewers. The views expressed are those of the authors and do not necessarily represent the policies of USDA.

Endnotes

[1]In its data collection effort, the USDA defines a farm as "any operation that sells at least one thousand dollars of agricultural commodities or that would have sold that amount of produce under normal circumstances" (see http://www.ers.usda.gov/Data/FarmIncome/Sizedefinition.htm).

[2]The sample used in the analysis thus excludes those observations where the operator is not married and where the gender of the operator is female. This is in addition to excluding any farm organized as a nonfamily corporation or cooperative, or where none of the net income generated by the farm business is received by the farm operator household itself. Yet also excluded is any farm business with annual farm sales of under $10,000.

[3]Because of lack of data, factors such as commuting costs to off-farm jobs, household production, and possible nonpecuniary income from farming are ignored. For surveys of how commuting costs and nonpecuniary income can impact market work and/or household response, see studies by Cogan; Warner and Goldberg; Axe and Golden; Kiker and Mendes de Oliveira; Solberg and Wong; and Key, Sadoulet, and de Janvry.

[4]In order to keep the model simple, the nonnegativity constraint for on-farm work hours is ignored here. Studies by Kimhi and Kimhi and Lee, however, found this to be an important constraint for Israeli farm households.

[5]Studies by Strauss, and Huffman point out that when $W_m^i = \frac{\gamma^i}{\lambda}$, this indicates that the decision on optimal production of Q is separate from optimal consumption decisions. Abdulai and Regmi note that this assumption is justifiable if rural labor markets are efficient and free of transaction costs, and that the family and hired labor are perfect substitutes.

[6]Since the primary data underlying the *MNL* regression model are from the ARMS, which is a multiphase survey with its attending pre- and post-sampling complexity, any inference based on estimated parameters from classical statistical algorithms become suspect (see Rust; Roy and Safiquzzaman). Sharma and Giaccotto note, for example, that complex survey-based variance estimates are biased and the standard test statistics (e.g., *t*- and *F*-test) may lead to incorrect conclusions. To attend to this complexity, standard errors of regression parameters are computed based on the delete-a-group Jackknife variance (*JKV*) estimation, which in the case of this article utilizes, in addition to a vector of full sample weights, 15 vectors of replicate weights. This technique, which is a variant of bootstrapping, dates back to the work of Quenouille and was later utilized by Miller, and Layard, among others, in a number of statistical tests. For more detail on the delete-a-group Jackknife approach, see Kott as well as Dubman. To the extent that the *JKV* estimation method is tailored for regression based on full samples (i.e., in the case of this article, on a sample with 7,074 observations as described in the data section), and in order to correct for the smaller sample needed in the analysis, a process of recalibration of the replicate weights was implemented. Specifically, prior to model estimation, the weights of the remaining observations (after the initial data set was reduced to its current size of 4,208) with missing values for any of the dependent or independent variables due to the delete-a-group method of variance estimation were distributed equally among the remaining observations (see Archer and Lemeshow).

[7]This method of measuring the marginal changes in probability due to a unit increase in the explanatory variable is appropriate when the variable is continuous. For a k*th* dummy variable in the q*th* work status category, the marginal change in probability for the *j*th household is computed alternatively as (see Greene, p. 676)): $\Delta_{\mathrm{jq}} = P_{qj}(Z_k = 1) - P_{qj}(Z_k = 0)$.

[8]One reviewer suggested the use of intensity of payments (as measured by the ratio of commodity-related payments to gross cash farm income) rather than the level of payments as a determinant in the off-farm labor participation model. An attempt at using this seemingly preferred measure, based on a two-limit tobit procedure (see Nelson), did not produce reasonable prediction and thus was ignored. The poor performance of this variable was due to a number of reasons including the presence of a large number of zeros, the crunching of values close to the lower limit, and the highly skewed and long-tailed nature of its corresponding distribution.

[9]The endogeneity of the government payments variable in the off-farm labor participation model (see equation (14)) was tested based on a simplified likelihood ratio (*SLR*) test derived from a two-step approach (see Smith). The test involved first the estimation of the government payment model using tobit regression. This was followed by estimating the off-farm labor participation model twice; one with the residuals (see Greene, p. 764) from the estimated tobit model of government payments

included (M_f), and the other, with the residuals excluded (M_r) . The *SLR* statistic was then computed as "minus" twice the difference of maximized log likelihoods of models M_f and M_r, respectively. The result of this was an $SLR = 141.34$, which, when compared with the critical value of $\chi^2_{df=1}$ (0 .01) = 6.64 allowed for a rejection of the exogeneity assumption of the government payments variable.

[10]As was pointed by Lehrer, fertility and female labor supply behavior are jointly determined. Accordingly, inclusion of the variable depicting the number of children (*CHILDREN*) in the wife's off-farm labor participation equation could lead to simultaneous equation bias. Because of lack of adequate instruments, this article follows Blank and treats the children's variable as predetermined.

[11]The pseudo-R^2 for the tobit regression model is computed in the same way as R^2 in ordinary least squares regression, but with the following adjustment to the estimated "residuals":

$$\hat{u}_i = Y_i - \hat{Y}_i = Y_i - \Phi\left(\frac{\hat{\beta}' X_i}{\hat{\sigma}}\right)(\hat{\beta}' X + \hat{\sigma}\hat{\lambda}_i),$$

where $\hat{\lambda}_i = \frac{\phi(\hat{\beta}' X_i/\hat{\sigma})}{\Phi(\hat{\beta}' X_i/\hat{\sigma})}$, and where $\hat{\sigma}$ is the standard deviation of u, and ϕ and Φ are the standard normal probability density function and the standard normal cumulative density function, respectively (see Greene, p. 764). Consequently, the pseudo-R^2 as

$$R^2 = 1 - \frac{\sum_{i=1}^{n} \hat{u}_i^2}{\sum_{i=1}^{n} (Y_i - \bar{Y})^2},$$

where $\bar{Y}$ is the weighted sample mean of the Y_i's (see Bierens).

[12]In estimating the MNL model as described in equation (14), the equation for the odds of q versus M is

$$\frac{P(I = q \mid Z)}{P(I = M \mid Z)} = \exp(Z[\vartheta_q - \vartheta_M]).$$

As noted by Long (p. 182) and Greene (p. 724), the odds are determined without any consideration of the other potential outcomes that might be available (i.e., allowing the reference category to be other than I_4). This is known in the literature as the independence of irrelevant alternatives (IIA). Hausman and McFadden proposed a Hausman-type test to examine the validity of the IIA assumption. The basic elements of the test in the context of this article involved the comparison of a model estimated using a full set of choice alternative ($\hat{\vartheta}_F = (\hat{\vartheta}_{1F}, \hat{\vartheta}_{2F}, \hat{\vartheta}_{3F})'$) with estimated covariance matrix $\hat{\Omega}_F$ against a model using a restricted set of choice alternative (e.g., $\hat{\vartheta}_R = (\hat{\vartheta}_{1F}, \hat{\vartheta}_{2F})'$) with estimated covariance matrix $\hat{\Omega}_R$. The Hausman test of IIA is defined as

$$H_{HA} = (\hat{\beta}_R - \hat{\beta}^*_F)'[\hat{\Omega}_R - \hat{\Omega}^*_F]^{-1}(\hat{\beta}_R - \hat{\beta}^*_F),$$

which is asymptotically distributed as chi-square with degrees of freedom equal to the rank of $\hat{\Omega}_R - \hat{\Omega}^*_F$. Note that $\hat{\beta}^*_F$ and $\hat{\Omega}^*_F$ are the same as $\hat{\beta}_F$ and $\hat{\Omega}_F$ with further deletion of row-vectors and column-vectors to allow for conformity of matrices in the H_{HA} test (for further detail, see Long, p. 184). A significant value of H_{HA} would indicate the IIA assumption is invalid. In this article, and regardless of which off-farm work category was deleted in the process of conducting the Hausman test of IIA, the resulting quadratic forms $\hat{\Omega}_R - \hat{\Omega}^*_F$ were not positive definite. Under these circumstances, the appropriateness of using the MNL procedure is taken as a maintained assumption.

[13]A rule of thump among practitioners is that the regression model is deemed to have excellent predictive power if the computed value of McFadden pseudo-R^2 falls between 0.20 and 0.40 (for detail, see McFadden, p. 122, Amemiya; Maddala, p. 39).

[14]For example, published numbers from the U.S. Department of Labor show that the average wage for various state government jobs ranged between \$12.50 and \$23.87 in May 2004, much higher than the prevailing federal minimum wage of \$5.15 (See http://www.bls.gov/oes/2004/may/table2.pdf).

[15]The large and significant coefficient of *SPEDUC*, which signifies a higher likelihood of a strategy by the farm household to have only the wife working off farm, may suggest that the wife's education does enhance her husband's reservation wage, thus contributing to the husband's decision to only work on the farm. A study by Loh, for example, finds that the wife's education enhances the husband's wage premium, which for the married sample used here, seems to also suggest (see Devereux) the presence of positive assertive mating (i.e., high-wage men are more likely to be married to high-wage women). Table 1 shows the educational attainment of farm couples in the livelihood strategies where either the wife works off farm or both husband and wife work off farm to be similar at high levels.

[16]For example, among households where only the operator worked off farm in 2004, 40% of operators reported that their major occupation was farming/ranching, compared to 39% and 72% by the operators in the other two groups where either both the husband and the wife worked off farm or where neither of them worked off the farm, respectively.

[17]A locally weighted regression is used to trace the relationship between the likelihood of off-farm work by the husband and the wife and to derive the model-based confidence intervals (for more detail, see Bowman and Azzalini).

References

Abdulai, A., and P.P. Regmi. "Estimating Labor Supply of Farm Households under Nonseparability: Empirical Evidence from Nepal." *Agri. Econ.* 22 (April 2000):309–20.

Ahearn, M., and H. El-Osta. "The Role of Off-Farm Employment: Permanent or Transitional State?" Paper presented at AAEA annual meeting, Baltimore, MD, 9–12 August 1992.

Ahearn, M., J. Johnson, and R. Strickland. "The Distribution of Income and Wealth of Farm Operator Households." *Amer. J. Agr. Econ.* 67(December 1985):1087–94.

Ahearn, M., J. Perry, and H. El-Osta. *The Economic Well-Being of Farm Operator Households, 1988–90*. Washington, DC: U.S. Department of Agriculture ERS (AER-666), January 1993.

Ahearn, M., H. El-Osta, and J. Dewbre. "The Impact of Coupled and Decoupled Government Subsidies on Off-Farm Labor Participation of U.S. Farm Operations." *Amer. J. Agr. Econ.* 88(May 2006):393–408.

Ahituv, A., and A. Kimhi. "Off-Farm Work and Capital Accumulation Decisions of Farmers over the Life-Cycle: The Role of Heterogeneity and State-Dependence." *J. Devel. Econ.* 68(August 2002):329–53.

Amemiya, T. "Qualitative Response Models: A Survey." *J. Econ. Lit.* 19(December 1981):1483–1536.

Archer, K.J., and S. Lemeshow. "Goodness-of-Fit Test for Logistic Regression Model Fitted Using Survey Sample Data." *Stata J.* 6(First Quarter 2006):97–105.

Axe, B., and L. Golden. "The Augmented Labor Supply Functions: Working Evidence from Japan." *Eastern Econ. J.* 17(July-September 1991):305–17.

Becker, G.S. "A Theory of the Allocation of Time." *Econ. J.* 75, 299(September 1965):493–517.

Benjamin, C., A. Corsi, and H. Guyomard. "Modelling Labour Decisions of French Agricultural Households." *Appl. Econ.* 28(December 1996):1577–89.

Benjamin, C., and A. Kimhi. "Farm Work, Off-Farm Work, and Hired Farm Labour: Estimating a Discrete-Choice Model of French Farm Couples' Labour Decisions." *Europ. Rev. Agr. Econ.* 33(June 2006):149–71.

Bowman, A., and A. Azzalini. *Applied Smoothing Techniques for Data Analysis*. Oxford: Clarendon Press, 1997.

Bierens, H.J. *The Tobit Model*. 17 September 2004. Available at http://econ.la.psu.edu/~hbierens/EasyRegTours/TOBIT_Tourfiles/TOBIT.PDF

Blank, R.M. "The Role of Part-Time Work in Women's Labor Market Choices over Time." *Amer. Econ. Rev.* 79(May 1989):295–99.

Cogan, J.F. "Fixed Costs and Labor Supply." *Econometrica*. 49(July 1981):945–63.

Corsi, A., and J .L. Findeis. "True State Dependence and Heterogeneity in Off-Farm Labour Participation." *Europ. Rev. Agr. Econ.* 27, 2(June 2000):127–51.

Deseran, F.A., W.W. Falk, and P. Jenkins. "Determinants of Earnings of Farm Families in the U.S." *Rural Soc*. 49(Summer 1984):210–29.

Devereux, P.J. "Changes in Relative Wages and Family Labor Supply." *J. Human Res.* 31(Summer 2004):696–722.

Dubman, R. *Variance Estimation with USDA's Farm Costs and Returns Surveys and Agricultural Resource Management Study Surveys*. Washington, DC: U.S. Department of Agriculture ERS (Staff Report AGES 00–01), April 2000.

El-Osta, H., M. Ahearn, and A.K. Mishra. "Implications of 'Decoupled' Payments for Farm and Off-Farm Labor Allocations." Paper presented at the International Conference on Agricultural Policy Reform and the WTO: Where Are We Heading? Capri, Italy, 23–26 June 2003.

El-Osta, H., A. Mishra, and M.C. Ahearn. "Labor Supply by Farm Operators under 'Decoupled' Farm Program Payments." *Rev. Econ. Household.* 2(December 2004):367–85.
Findeis, J.L., and V.K. Reddy. "Decomposition of Income Distribution among Farm Families." *Northeastern J. Agr. Res. Econ.* 16(October 1987):165–73.
Gebremedhin, T.G., and R.D. Christy. "Structural Changes in U.S. Agriculture: Implications for Small Farms," *J. Agr. Appl. Econ.* 28(July 1996):57–66.
Goodwin, B.K., and M.T. Holt. "Parametric and Semiparametric Modeling of the Off-Farm Labor Supply of Agrarian Households in Transition Bulgaria." *Amer. J. Agr. Econ.* 84(February 2002):184–209.
Goodwin, B.K., and A.K. Mishra. "Farming Efficiency and the Determinants of Multiple Job Holding by Farm Operators." *Amer. J. Agr. Econ.* 86(August 2004):722–29.
Gould, B.W., and W.E. Saupe. "Off-Farm Labor Market Entry and Exit." *Amer. J. Agr. Econ.* 71(November 1989):960–69.
Greene, W.H. *Econometric Analysis*, 5th ed. Upper Saddle River, NJ: Prentice-Hall, 2002.
Gronau, R. "The Intrafamily Allocation of Time: The Value of the Housewives' Time." *Amer. Econ. Rev.* 63(September 1973):634–51.
Gunter, L., and K. McNamara. "The Impact of Local Labor Market Conditions on the Off-Farm Earnings of Farm Operators." *Southern J. Agr. Econ.* 22(July 1990):155–65.
Hausman, J., and D. McFadden. "Specification Tests for the Multinomial Logit Model." *Econometrica.* 52(September 1984):1219–40.
Hopkins, J., and M. Morehart. "Assessing Farm Household Well-Being—Beyond Farmers and Farm Income." *Amber Waves* 2, 1(February 2004):8.
Hoppe, R.A., ed. *Structural and Financial Characteristics of U.S. Farms-2001 Family Farm Report*. Washington, DC: U.S. Department of Agriculture ERS (AIB-768), May 2001.
Huffman, W.E. "Agricultural Household Models: Survey and Critique." In *Multiple Job-Holding among Farm Families*. M.C. Hallberg, J.L. Findeis, and D.A. Lass, eds., pp. 79–111. Ames, IA: Iowa State University Press, 1991.
Huffman, W.E. "Farm and Off-Farm Work Decisions: The Role of Human Capital." *Rev. Econ. Statist.* 62(February 1980):14–23.
Huffman, W.E., and H.S. El-Osta. "Off-Farm Work Participation, Off-Farm Labor Supply and On-Farm Labor Demand of U.S. Farm Operators." Dept. Econ. SP-290, Iowa State University, December 1997.
Huffman, W.E., and M.D. Lange. "Off-Farm Work Decisions of Husbands and Wives: Joint Decision Making." *Rev. Econ. Statist.* 71(August 1989):471–80.
Johnson, J.D., M.J. Morehart, and A.K. Mishra. "Livelihood, Retirement, Succession: The Farm ad Choices of Farm Households." Paper presented at AAEA annual meeting, Montreal, Canada, 27–30 July 2003.
Key, N., E. Sadoulet, and A. de Janvry. "Transactions Costs and Agricultural Household Supply Response." *Amer. J. Agr. Econ.* 82(May 2000):245–59.
Kiker, B.F., and M. Mendes deOliveira. "Optimal Allocation of Time and Estimation of Market Wage Functions." *J. Human Res.* 27(Summer 1992):445–71.
Kimhi, A. "Quasi Maximum Likelihood Estimation of Multivariate Probit Models: Farm Couples' Labor Participation." *Amer. J. Agr. Econ.* 76(November 1994):828–35.
Kimhi, A., and M. Lee. "Off-Farm Work Decisions of Farm Couples: Estimating Structural Simultaneous Equations with Ordered Categorical Dependent Variables." *Amer. J. Agr. Econ.* 78(August 1996):687–98.
Korb, P. "Choosing to Work Off Farm." *Rural Devel. Perspect.* 14(May 1999):44–48.
Kott, P. *Using the Delete-a-Group Jackknife Variance Estimator in NASS Surveys*. Washington, DC: U.S. Department of Agriculture NASS (RD-98-01), 1998.
Lass, D., and C. Gempesaw. "The Supply of Off-Farm Labor: A Random Coefficients Approach." *Amer. J. Agr. Econ.* 74(May 1992):400–11.
Lass, D.A., J.L. Findeis, and M.C. Hallberg. "Off-Farm Labor Employment Decisions by Massachusetts Farm Households." *Northeastern J. Agr. Res. Econ.* 18(October 1989):149–59.
Layard, M.W.J. "Robust Large-Sample Tests for Homogeneity of Variances." *J. Amer. Statist. Assoc.* 68, 341(March 1973):195–98.
LeClere, F.B. "The Effects of Metropolitan Residence on the Off-Farm Earnings of Farm Families in the United States." *Rural Soc.* 56(Fall 1991):366–90.
Lehrer, E.L. "The Impact of Children on Married Women's Labor Supply: Black-White Differentials Revisited." *J. Human Res.* 27(Summer 1992):422–44.
Loh, E.S. "Productivity Differences and the Marriage Wage Premium for White Males." *J. Human Res.* 31(Summer 1996):566–89.
Long, J.S. *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks, CA: Sage Publishing, 1997.

Long, J.E., and E.B. Jones. "Labor Force Entry and Exit by Married Women: A Longitudinal Analysis." *Rev. Econ. Statist.* 62(February 1980):1–6.
Maddala, G.S. *Limited-Dependent and Qualitative Variables in Econometrics.* Cambridge: Cambridge University Press. 1983.
McFadden, D. "Conditional Logit Analysis of Quantitative Choice Behavior." In *Frontier of Econometrics*, P. Zarembka, ed., pp. 105–142. New York: Academic Press, 1973.
Miller, R.G., Jr. "Jackknifing Variances." *Ann. Math. Statist.* 39(April 1968):567–82.
Mincer J., and S. Polachek. "Family Investments in Human Capital: Earnings of Women." *J. Polit. Econ.* 82, No. 2, Part 2(March-April 1974):S76–108.
Mishra, A.K., H.S. El-Osta, M.J. Morehart, J.D. Johnson, and J.W. Hopkins. *Income, Wealth, and the Economic Well-Being of Farm Households*. Washington, DC: U.S. Department of Agriculture ERS (AER-812), July 2002.
Mishra, A., H. El-Osta, and J. Johnson. *Succession Decisions and Retirement Income of Farm Households*. Proceedings of Presented Papers at the Agricultural Outlook Forum. Arlington, VA, 24–25 February 2005.
Nelson, F.D. "On a General Computer Algorithm for the Analysis of Models with Limited Dependent Variables." *Ann. Econ. Soc. Meas.* 5(1976):493–509.
Nelson, R.R., and E.S. Phelps. "Investment in Humans, Technological Diffusion, and Economic Growth." *Amer. Econ. Rev.* 56, No. 1/2 (March 1966):69–75.
Newton, D.J., and R.A. Hoppe. "Financial Well-Being of Small Farm Households Depends on the Health of Rural Economies." *Rural Amer.* 16, 1(May 2001):2–11.
Quenouille, M.H. "Notes on Bias in Estimation." *Biometrika* 43, No. 3/4(Dec. 1956):353–60.
Rivers, D., and Q.H. Vuong. "Limited Information Estimators and Exogeneity Tests for Simultaneous Probit Models." *J. Econometrics*39(November 1988):347–66.
Roy, D., and M. Safiquzzaman. "Variance Estimation by Jackknife Method under Two-Phase Complex Survey Design." *J. Official Statist.* 22(March 2006):35–51.
Rust, K. "Variance Estimation for Complex Estimators in Sample Surveys." *J. Official Statist.* 1(December 1985):381–97.
Sharma, S.C., and C. Giaccotto. "Power and Robustness of Jackknife and Likelihood-Ratio Tests for Grouped Heteroscedasticity." *J. Econometrics* 49(September 1991):343–72.
Smith, R.J. "Testing for Exogeneity in Limited Dependent Variable Models Using Simplified Likelihood Ratio Statistics." *J. Appl. Econometrics* 2(July 1987):237–45.
Smith, R.J., and R.W. Blundell. "An Exogeneity Test for a Simultaneous Equation Tobit Model with an Application to Labor Supply." *Econometrica* 54(May 1986):679–85.
Solberg, E.J., and D.C. Wong. "Family Time Use: Leisure, Home Production, Market Work, and Work Related Travel." *J. Human Res.* 27(Summer 1992):485–510.
Strauss, John. "The Theory and Comparative Statics of Agricultural Household Models: A General Approach." In *Agricultural Household Models*, I. Singh, L. Squire, and J. Strauss, eds., pp. 71–94. Baltimore: John Hopkins University Press, 1986.
Sumner, D.A. "The Off-Farm Labor Supply of Farmers." *Amer. J. Agr. Econ.* 64(August 1982):498–509.
Thomas, S., and B. Senauer. "The Distribution of Full Income versus Money Income in the United States." *Department of Applied Economics* SP-P93–19. University of Minnesota, August 1993.
Tokle, J.G., and W.E. Huffman. "Local Economic Conditions and Wage Labor Decisions of Farm and Rural Nonfarm Couples." *Amer. J. Agr. Econ..* 73(August 1991):652–70.
Warner, J.T., and M.S. Goldberg. "The Influence of Non-Pecuniary Factors on Labor Supply: The Case of Navy Enlisted Personnel." *Rev. Econ. Statist.* 66(February 1984):26–35.
Wooldridge, J.M. *Econometric Analysis of Cross Section and Panel Data.* Cambridge, MA: MIT Press, 2002.