The Impact of Government Subsidies on the Off-farm Labor Supply of Farm Operators

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Abstract: In addition to farm work, most farm families have someone working in off-farm employment. The purpose of this paper is to examine if, and how, the change in the nature of government farm programs in the recent past has affected the labor allocation of farm operator households to off-farm employment activities. The ultimate goal of this research is to investigate the potential impacts of decoupled payments on farm output.

Key words: Government farm programs, logit regression, off-farm labor market areas, off-farm labor supply.

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Introduction

Agricultural policies are arguably one of the most contentious issues in international trade negotiations and, at times, domestic policy discussions. International and domestic discussions about agricultural policy are centered on concerns about the distortions that agricultural subsidies can cause in agricultural markets (Boschwitz, 1987; OECD, 2001). These distortions can send signals to farmers that encourage production decisions that are not efficient for the economy as a whole. There is a commonly held view among most economists that societies will benefit from an efficient economy, one free of distortions, and an open international trading environment. At the same time, countries must be free to pursue their desired domestic agenda. A domestic agricultural program could be designed to accomplish a variety of national goals, but most economists would argue that it do so by not distorting the signals that farmers receive from the marketplace as they formulate their production decisions. If this were the case, domestic goals and programs would not unfairly distort open trade among countries. While many countries agree with this concept, it has proven to be extremely difficult in practice to design domestic agricultural programs that meet this standard.

As part of the 1996 Federal Agriculture Improvement and Reform Act (FAIR), the U.S. began paying farmers production flexibility contract (PFC) payments designed to be somewhat "decoupled" from current production decisions (Lin, *et al*., 2000). It is not accurate to view production flexibility contract payments as totally decoupled and other commodity payments, before or after the Act, as totally coupled. In this study, we view the production flexibility contract payments as *less* coupled than other commodity payments. In the context of the standard labor-leisure model, decoupled payments would be expected to only have an income effect. In contrast, coupled payments are more like an increase in a wage rate and would be expected to have both a substitution and an income effect. Whether or not the payments developed under the 1996 Act are viewed by farmers as coupled or decoupled is central to the international trade discussion on the WTO classification of U.S. farm payments. Payments that are effectively coupled could affect agricultural output and markets, whereas decoupled payments would not.

The majority of workers on U.S. farms are the operators and their families, contributing at least two-thirds of the labor hours worked. Each of the 2.1 million farms in the U.S. has an operator working on the farm, and approximately 800,000 spouses of operators also contribute labor to the farm, as well as other family members. In addition, most farm families have at least one family member working in a non-farm occupation and receive more income from off farm sources than from farm sources. Historically, farm policy was driven in large part by the premise that farm households were economically disadvantaged relative to nonfarm households. However, evidence indicates that has not been the case since at least 1972 (Ahearn, 1986). Off-farm income has played a major role in closing the income gap between farm and non-farm households and in reducing income inequality among farm operator households (Ahearn, Johnson, and Strickland, 1985; Ahearn, El-Osta, and Perry, 1993; El-Osta, Bernat, and Ahearn, 1995). The most recent Census of Agriculture reports that off-farm income of farm households increased 300 percent between 1988 and 1998. It also reports that off-farm income was 6 times that of cash farm income in 1998 (USDA, 2001). In addition, farm operator households who participate in the off-farm labor market receive the majority of government payments.

USDA routinely collects farm household income and labor allocations data.[1] Farm and off-farm labor allocations data can be examined for the time periods before the enactment of the 1996 Act, for 1996, and for a recent year. Figure 1 reports the hours worked in farm and off-farm activities for 1991, 1996, and 2000 (Ahearn, *et al*., 2001). The first two clusters show the operators' hours for those that received payments and those that did not. The second two clusters report corresponding data for spouses. In 1991, all payments would be for the major commodity programs (feed grains, wheat, rice, and cotton), as well as conservation programs. For 1996, payments would largely be classified as the more "decoupled" production flexibility contract payments. And, in 2000, payments were a mixture of production flexibility contract payments, loan deficiency payments, and emergency assistance payments. We did not see any movement towards a greater consumption of leisure on the part of those that received the new production flexibility contract payments with a somewhat decoupled nature. This was true for both operators and spouses. The data do show that operators and spouses, while working the same total hours, decreased the hours worked on the farm and increased the hours worked off the farm. This was especially true from 1996 to 2000, and was true for those receiving subsidies as well as those that did not.

[1] The first survey was conducted as the Farm Operator Resource version of the 1988 Farm Costs and Returns Survey in 1989.

To better understand the descriptive results of the labor allocations summarized above, a more involved analysis is required. The purpose of this paper is to examine if, and how, the change in the nature of government farm programs in the recent past has affected important labor allocations, namely off-farm allocations, of farm operator households. Given the importance of off-farm wage and salary income to farm operator households' well-being and the knowledge that operators and spouses allocated more hours to off-farm work since enactment of the 1996 Act, this study focuses on the impact of government payments on the labor force participation decision and the labor supply (quantity of hours) decision of U.S. farm operators.

Theory of Time Allocation

Households maximize their utility in considering how they allocate their labor between work and leisure. A key factor in determining the time allocation is the wage rate from working in the market place. This market wage rate is the opportunity cost or price of leisure. When an individual chooses to enjoy leisure, rather than work and receive a wage, he or she is giving up that market wage to do so. In the standard labor-leisure model, where an individual receives an increase in nonlabor income there is no ambiguity in the direction of the impact on labor hours worked because there is no change in the hourly return from work. An individual will prefer to work less and enjoy more leisure. There is no substitution effect at play; there is only a wealth effect. We know that the impact of the wealth effect is to decrease the hours worked. When an individual receives an increase in labor income it is not possible to predict the direction of the impact on labor hours worked because there are two opposite effects. First, it can cause an individual to want to work more, because each hour of work now brings a greater return, i.e., a substitution effect. Or, it can cause an individual to want to work less, because he or she can get the same income as before by working less, and have more free time for leisure, i.e., the wealth effect. Whichever effect is greater will determine the impact on the hours of time allocated to work. Figure 2 shows the case where, when the hourly wage rate increases, the individual prefers to work more hours. Hence, the substitution effect outweighs the wealth effect. However, the opposite result could have occurred. It is only by observing the behavior of individuals that we will know the impact of a change in the hourly wage rate on hours worked.

The standard labor-leisure model needs to be broadened in two ways to consider how a farm household would adjust labor allocations in the face of government subsidies. First, the decision of a farm operator household is a tripartite choice in allocating their time: farm work, off-farm work, and leisure. (A fourth dimension could be added, as well, for the necessity of household maintenance. For simplicity, we do not here.) Secondly, it is important to recognize the nature of the subsidy and how the farm operator household views the subsidy, i.e., as nonlabor or labor income.

Farm Work, Off-farm Work, and Leisure Choices

The conceptual model combines the decisions of agricultural households relating to producer, consumer, and labor supply into a theoretically consistent model (Singh, Squire, and Strauss, 1986). The individual is assumed to allocate time to farm work, off-farm work, and leisure in such a fashion that the optimal allocation is achieved when the marginal values of time devoted to the activities are equal. In this paper, the analysis is simplified by ignoring many of the possible complexities of the model. Specifically, the paper ignores the interdependence of the allocation decision between operator and spouse, the utility of others in the household, non-farm home production, commuting costs to off-farm jobs, possible psychic income from farming, and household savings.

The farm operator household is assumed to have the optimization problem:

$$(1) \qquad Maximize\, U = U(Y, L^o, L^s),$$

subject to:

$$(2) \qquad \mathrm{T}^{\mathrm{o}} = L^o + E^o + F^o$$

$$(3) \qquad \mathrm{T}^{\mathrm{s}} = L^s + E^s + F^s$$

$$(4) \qquad P_y Y = \mathrm{w}^{\mathrm{o}}\, E^o + w^s E^s + p_f Y_f - w_f X_f + V$$

$$(5) \qquad Y_f = f(F^o, F^s, X_f, C^o, C^s, R),$$

where P_y denotes the price of consumption good Y; L^O is home time (leisure) of the farm operator, *O*, and L^S is home time (leisure) for the spouse of the farm operator, *S*; *T* is the total time endowment, *L* is the time allocated to leisure, *E* is time allocated to off-farm work, and *F* is time allocated to farm work for both the operator and spouse; *w* is the off-farm wage rate and *E* are the hours allocated to off-farm work activity of the operator and spouse; $\mathrm{p_f}$ are farm output prices, Y_f are farm output quantities; w_f are farm input prices, X_f are farm input quantities, V signifies other household non-labor income including income from government payments, *C* is human capital, and *R* describes location specific characteristics (e.g., local climate and soils). Equations (4) and (5) are budget (cash income) and production technology constraints, respectively. After substituting (5) into (4), the budget constraint can be written as:

$$(6) \qquad P_y\, Y = \mathrm{w}^{\mathrm{o}}\, E^o + w^s E^s + p_f f(F^o, F^s, X_f, C^o, C^s, R) - w_f X_f + V.$$

The utility function and the production function are assumed to be concave, continuous, and twice differentiable. The first-order conditions for the above model provide many useful results, including the optimality conditions for off-farm work participation and for the supply of off-farm work hours.

With regard to the decision to participate in the off-farm labor market (I =1; 0 otherwise), rational individuals are expected to participate when their reservation wage for farm and leisure is less than the off-farm wage rate offered,

$$(7) \qquad \begin{aligned} E[I|X] &= P\,(I_i = 1) \\ &= P(w^r < w^i) \qquad \qquad \text{i = O, S} \\ &= \beta' X, \end{aligned}$$

where P (.) is the equivalent of the probability of the participation in off-farm work occurring, w^r is the reservation wage and w^i is the off-farm wage for the operator or spouse, X is a vector of exogenous variables, and β is a vector of parameters to be estimated. The probability of an individual participating depends on all of the exogenous variables that enter his or her reservation wage and off-farm wage equations. Variables that increase the off-farm wage rate increase the probability of off-farm work and vice versa for variables that decrease the off-farm wage rate (Huffman, 1988).

The supply function for off-farm time is determined based on the optimal levels of leisure hours and of farm work hours based on the optimization problem described above as in:

$$(8) \qquad E^{i*} = T^i - L^{i*} - F^{i*} = f\;(w^i, p_f, V, w_f, C, R).$$

Government Payments

The term "coupled" payment is used to describe a payment that comes with a requirement that the landowner and/or producer plant a specified commodity in exchange for receipt of the subsidy. This notion of a "coupled" subsidy payment is more like an increase in the farm wage rate. The notion behind a "decoupled" payment is that producers are not required to produce specific commodities in order to receive a subsidy. Hence, in concept, a decoupled payment is more like receiving nonlabor income. With the enactment of the FAIR Act in 1996, the less coupled production flexibility contract payments[2] replaced the traditional commodity payments. However, since that time, significant emergency payments have been paid to eligible producers in response to low market prices. Figure 3 presents the calendar year payments paid to eligible producers from federal CCC funds. The traditional commodity payments and the production flexibility contracts that replaced them in 1996 ranged from \$4-\$9 billion during the decade of the 1990s, averaging under \$6 billion. Conservation payments were even more stable during the decade, ranging from \$1.5-2.0 billion. Since the enactment of the 1996 Act, however, payments under the marketing loan program and emergency assistance payments have soared. Consequently, total payments in both 1999 and 2000 exceeded \$20 billion.

It is not totally clear how long an adjustment period should be for farmers' expectations to be based on a changing policy regime, especially if it is one perceived as very different from the past, it is being altered on a yearly basis, and there is a long history of transferring incomes to farmers from nonfarmers. The 1996 Act was passed in April of that year, but the nature of the payments was understood months before that. It is likely that only those who planted winter

[2] The eligible land is permitted to be in fallow uses. It is not permitted to be in the CRP or to be planted to certain fruits and vegetables for payment eligibility.

wheat in the fall of 1995 would have not had clear signals on the program changes. Hence, we assume that for the majority of producers, knowledge of the nature of the program was understood in time for the 1996 production period. Knowledge of the program changes does not necessarily mean producers are able to fully respond to the changes; there may be a lag in their response time. Furthermore, by 1998, total payments had nearly doubled due to increases in the loan deficiency payments and emergency assistance payments, and hence, farmers were being sent mixed signals about the extent of decoupling in transfer payments.

Questions about operator responses to policy changes remain unanswered. Do farm landowners and producers view the production flexibility contracts as decoupled payments in their decisions? And, have the impacts of the other payments since 1996 (loan deficiency and emergency assistance) overshadowed the intended lack of market impacts of the production flexibility contracts.

Literature on Off-farm Labor Supply

As noted, the purpose of this paper is limited to examining the impacts of different payments on off-farm labor supply, with the aim of eventually contributing to our understanding of how decoupled payments would affect production. The literature on off-farm labor supply and participation is well established. Lee (1965) was among the first to extend the standard labor-leisure model to consider the special situation of farm operator households. The primary assumption is that operator's labor is allocated between farm and off-farm activities such that the marginal value of working on the farm (or reservation wage) equals the wage rate of an off-farm activity.

A related extension of the basic labor-leisure model is found in the household production literature (see Gronau (1977) for an example of an early summary). The empirical literature on estimating off-farm labor participation and supply covers a variety of issues. Huffman (1980) was the first in the literature to estimate off-farm labor supply/participation models for farm households using aggregate county data.

Refinements in the literature have included: the incorporation of a test for Heckman's sample selectivity bias and analysis with disaggregated data (Sumner, 1982); allowance for the possible lack of independence between utility maximization and profit maximization (Lopez, 1984); treatment of the role played by fringe benefits from off-farm employment (Jensen and Salant, 1986); a recognition of the role of the spouse's decision-making and off-farm labor participation (Huffman and Lange, 1989; Gould and Saupe, 1989; Lass, Findeis, and Hallberg, 1989; Lass and Gempesaw, 1992); the inclusion of local labor market considerations (Tokle and Huffman, 1989; Gunter and McNamara, 1990; Ahearn and El-Osta,1992; Lass and Gempesaw, 1992; El-Osta and Ahearn, 1996); the importance of recognizing the jointness in the decision to hire farm labor and the allocation of family labor to farm and off-farm activities (Findeis, 1992); the impact of government payments on off-farm labor supply and the use of national off-farm labor participation and wage models in estimating the cost of unpaid farm work in cost of production estimates (El-Osta and Ahearn, 1996); the use of national off-farm and on-farm labor models to consider issues of endogeniety, complementarity of own and hired labor, and the nature of leisure as a normal good (Huffman and El-Osta, 1997); and the role of farm income risk in explaining off-farm labor supply (Mishra and Goodwin, 1997).

Data and Model Estimation

Data Description

The farm household data are from the 1991 Farm Operator Resource (FOR) version of the Farm Costs and Returns Survey (FCRS), and from the 1996 and the 1999 Costs and Returns Report (CRR) version of the Agricultural Resource Management Survey (ARMS), USDA. The definition of variables and their means are presented in table 1 for the off-farm labor participation model, which includes the full sample of farm operators, and in table 2 for the off-farm supply model, which is a subsample of only those operators who worked off the farm. Figure 4 provides a map of our regional delineation for our regional dummy variables.

The FCRS is a national, annual survey of farms conducted by the USDA every February-March until 1996. The sample has a complex stratified, multi-frame design. The FCRS is composed of several versions designed to collect whole farm and minimal farm household data on every version, with different, additional questions on each version dedicated to a unique set of issues. Each of the versions has its corresponding set of expansion factors, or weights, which allows for the version to be expanded up to a national level using only the observations in that version. The FOR version was dedicated to collect special detail on farm operator households, e.g., their hours worked on their farm, hired employees, other household details, as well as the standard detail on the farm business.

The ARMS, since its inception in 1996, is USDA's primary vehicle for collecting and disseminating data on a wide range of issues about resource use and costs and farm financial conditions (ERS Website). As its predecessor the FCRS, the ARMS, which has many versions, performs many functions. Specifically, it is used to gather information about the relationships among agricultural production, resources, and the environment. It also helps in the determination of production costs and returns of agricultural commodities and in the measurement of net-farm income of farm businesses. Yet another aspect of ARMS' important contribution is the information it provides on the characteristics and financial conditions of farm households, including information on management strategies and off-farm income.

For the 1991, 1996, and 1999 data sets, a few observations were eliminated due to erroneous coding of information by enumerators or due to respondents' refusals. Additional observations were eliminated from this study if the operation was a nonfamily corporation or a cooperative. The final sample count in 1991 was 3,061, which statistically represents almost 2.1 million farms in the continental U.S. In 1996 and 1999, the samples used in the analyses were 6,976 and 9,774, respectively. When these samples were expanded based on survey expansion factors, they stood to represent nearly 2.0 and 2.1 million farms.

The study also utilizes some auxiliary data. Specifically, the local area characteristics in commuting zones are based on county level data from the Bureau of Economic Analysis income files for 1995 and 1998, the Bureau of Economic Analysis employment files for 1995 and 1998, the Bureau of Labor Statistics, and the 1990 Census of Population, STF-3 file.

Empirical Estimation

The off-farm labor participation model described in equation (7) is represented by the conditional mean of I given a vector of exogenous variables, X, as in:

$$(9) \qquad E[I|X] = P\,(I_j = 1) = \frac{e^{\beta' X}}{1 + e^{\beta' X}}, = \delta\,(X)$$

where $\delta\,(X)$ indicates the logistic cumulative distribution. Let $\ell\,(X)$ denote the logit transformation of $\delta\,(X)$, which also measures the probability of off-farm labor participation. This transformation yields the following logistic regression model, which is estimated using a maximum likelihood procedure:

$$(10) \qquad \ell\,(X) = \ln\left[\frac{\delta\,(X)}{1-\delta\,(X)}\right] = \beta'\,X.$$

The benefit of this transformation is that $\ell\,(X)$ has many of the desirable properties of a linear regression model. Specifically, $\ell\,(X)$ is linear in the parameters, may be continuous, and may range from $-\infty$ to $+\infty$, depending on the range of X (see Hosmer and Lemeshow, 1989). The marginal effects denoting a unit change of a particular explanatory variable on the probability of off-farm participation is measured as (see Greene, 1997):

$$(11) \qquad \frac{\partial E[I \mid X]}{\partial X} = \delta\,(X)\,[1-\delta\,(X)]\,\beta.$$

The econometric representation of the off-farm labor supply model in equation (8) is estimated using weighted least squares. Our study will compare estimation results from labor supply models in three periods, 1991, 1996, and 1999. For 1999, we have specified two models, model 1999A and model 1999B. In the 1999A model, government payments are specified as they are for the 1991 and the 1996 models, as $1,000 of total payments (*GOVT*). In model 1999B, we have specified 4 different variables for government payments, which are its major components:

the production flexibility contract payments (*TRANSPYT*), loan deficiency payments (*LOANDPYT*), emergency assistance payments (*DISASTPYT*), and conservation payments (*CRPPYT*).

In attending to the empirical estimation, it is important to note the following. First, logit analysis as depicted in (10) is used to estimate an off-farm participation model for all farm operators. Secondly, an off-farm labor supply model is estimated for those operators who worked any hours off the farm. We have chosen not to include a test and adjustment for sample selection bias as is commonly done in labor supply models (Heckman, 1979). One of our earlier models with a selection variable found that variable to be highly significant and account for most of the explanatory power of a model. Given that our overriding interest in these models is on the relationship between labor hours supplied and government transfer payments, we chose not to include a sample selection adjustment variable. Without the sample selection variable, our results are strictly interpretable as those for the expanded sample only, namely those operators that supplied any hours to off-farm work. However, others (e.g., Huffman and El-Osta, 1997) have also not used the sample selection adjustment based on the argument by Nawata and Nagase (1996) that the unadjusted estimates may be preferable to adjusted estimates for the whole population when the sample selection variable is highly correlated with the other regressors.

The complex sample design of the FCRS imposes significant restrictions on econometric analysis. The restrictions caused by the sample design are often recognized by statisticians, for example, see Kott (1991), but ignored by economists and other users of the data. As an example of the problem, standard software yields biased standard errors, although parameter coefficients are unbiased. Some software, such as *PCCARP* and *SUDAAN*, has been developed to correctly account for the sample design in the computation of parameter variances. However, these products are limited to the simplest of models. In the context of an off-farm labor participation model based on the FCRS, for example, software does not exist that allows for a joint estimation of operator and spouse labor allocations, e.g., a bivariate probit or a logit model.

For the 1991 time period, we have independently estimated a reduced form functional equation of the decision of the farm operator to participate in off-farm work using the logit analysis available for data with complex sample designs in *PCCARP* (see Fuller *et al*, 1986). As for the off-farm labor supply model in 1991, the estimation of the weighted least squares regression was also performed using *PCCARP.* For the 1996 and 1999 time periods where the ARMS survey was used, estimation of the logit model depicting the off-farm labor participation equation and of the least squares regression depicting the off-farm labor participation was undertaken by means of the jackknife variance method (see Dubman 2000).

Results

Table 3 presents the results for the off-farm labor participation model. These results are based on logistic regression analyses of U.S. samples of 3,061, 6,976, and 9,774 farm operators for 1991, 1996, and 1999, respectively. McFadden's R^2 is used to evaluate the fit of the model, and ranged from a reasonable 0.224 to 0.292. In addition, the models correctly predicted the off-farm participation of farm operators at least 76 percent of the time.

The variables *OPAGESQ*, *OPEDUC*, and *SPOFFW* were significant in all of the models. The expected relationship of *OPAGESQ* and *OPEDUC* with labor supply has been straightforward to predict in the literature; our results are consistent with the literature. The direction of the relationship for *SPOFFW* could be hypothesized as either positive or negative. We found that having a spouse who works off the farm is positively related to the operator working off the farm. This result is consistent with previous empirical work on off-farm participation models, such as El-Osta and Ahearn's (1996) analysis of 1988 data. In the 1991 and 1999 off-farm participation models *OPAGE* had the expected sign and was significant. In the 1991 model, *HHSIZE* was also significant and with the expected sign. Unearned income from interest and dividends, or *OFFINT*, was the only household specific variable that was not significant in any of the models. A dummy variable for dairy farms, *DAIRY*, was significant and negative as expected because of the large labor requirements of dairy operations.

We included a set of variables that captures characteristics of the local area that are expected to affect participation in off-farm work. We found that the local area variables were relatively unimportant in explaining the participation likelihood and in some cases the direction of the relationships were surprising. This has been true in the other national studies, as well (Ahearn and El-Osta (1992); El-Osta and Ahearn (1996); Huffman and El-Osta (1997)). For example, no consistent story emerged about the dominance of any particular industry in a local area and the likelihood of off-farm participation of farm operators. Similarly, the unemployment rate was not significant in any model. Although it was only significant in the 1996 model, and then only at the 10% level, the share of the local area classified as urban (*URBAN*) was unexpectedly negatively related to the participation in off-farm work. Huffman and El-Osta (1997) found a similar unexpected relationship between off-farm participation and the distance to a city. These can only be described as curious results and indicate a need of further investigation.

The variables of special interest in this study, those measuring government transfer payments (*GOVT*, *TRANSPYT*, *LOANDPYT*, *CRPPYT*, and *DISASTPYT*) were all significant, with the exception of the variable measuring Conservation Reserve Payments. Moreover, the payment coefficients were all negative, indicating that as payments increased, the likelihood of the operator working off the farm declined. This is true even when controlling for farm size, and it is known that large farms receive higher average transfer payments. Farm size, as measured by an indicator of machinery capacity, was significant in all but the 1996 model. The sign was negative in all years, indicating that operators of larger farms are less likely to work off the farm.

In 1991, direct payments included those made for conservation and traditional commodity payments, considered to be more coupled than production flexibility contract payments. The payment impact on the probability of working off the farm in 1991 was a marginal decrease of 0.01371 for every $1,000 in direct government payments. In 1996, the impact of payments on the probability of off-farm work was very similar. Hence, we did not see a difference in the impact of payments on off-farm participation when the policy approach switched to a more decoupled payment approach. In the 1996 model, there was a decline in the marginal probability of 0.01204 for every $1,000 in payments.

The results for the 1999A model were different, however, from the 1991 and the 1996 results. The marginal probability with respect to a $1,000 change in payments was a much smaller –0.00615. Figure 5 shows this result graphically, i.e., a simulation of the probability of off-farm participation with respect to a $1000 change in government payments, holding all other variables constant and at their mean value.

Was this decline in the impact of 1999 payments on off-farm participation a result of the introduction of PFC payments in 1996, but which had an adjustment delay until sometime after 1996? Or, was this change in the marginal probability the result of the large increase in payments in 1999? Although the average 1999 PFC payments were very similar in level to the 1996 PFC levels, the total payments were more than double in 1999. We estimated an additional model 1999B to identify the effects of PFC payments and other payments separately. These results are reported in the last two columns of table 3. First of all, *CRPPYT*, or conservation payments were not significant. More importantly, the impacts of the PFC payments, *TRANSPYT*, on the marginal probability to participate in off-farm employment, were very similar to the effects of the other payments, *LOANDPYT* and *DISASTPYT*. Hence, we found no difference in the effect between payments that varied in their degree of "decoupledness" on the marginal probabilities of off-farm participation in 1999. Figure 6 shows little difference in the simulated probabilities of working off the farm as a result of payments from the three categories of payments defined for 1999. The lower marginal probability per $1,000 in payments for 1999 compared to the earlier years is likely the result of the larger payments, rather than the inclusion of PFC payments in the policy mix. This is supported by the relatively small effect of payments on off-farm participation relative to other variables in the model, such as age, education and the spouse working off the farm. Payments have a negative effect on off-farm participation, but that effect is small and likely not very sensitive to changes in the level of the subsidy.

Table 4 presents the results for the off-farm labor supply model. These results are based on weighted least squares regression analyses of samples of 1,093, 2,265, and 3,589, farm operators for 1991, 1996, and 1999, respectively. The R^2s ranged from 0.091 to 0.178, similar to what was reported by Huffman and El-Osta, 1997. The specification of the 'hours' model resembles the specification of the participation model with a few key exceptions. In 1991, the 'hours' model includes a predicted off-farm wage rate and none of the models included the *OPAGESQ* or *OPEDUC* variables. The reason that the variable *OPEDUC* was excluded from the 'hours' model was to mitigate the problem of near perfect multi-collinearity resulting from the use of the off-farm wage instrument, which, in and by itself, was derived based on operator's educational level. In addition, in all three supply models, size is measured as the value of production. The labor supply is measured as annual hours worked off the farm.

Fewer of the personal and household characteristics were significant in the supply models than in the participation models. As in the participation models, the results for the local area labor market conditions are inconsistent over time and weak, preventing any strong interpretations of these variables.

The results for the government payments variables, except for *CRPPYT* , are all significant and negative. In terms of magnitude, the government payment variables had a small impact on hours supplied. For example, for every $1,000 in payments, operator hours supplied were decreased by about 1% of the total work hours. Or, in absolute hour terms, for every $1,000 in payments, an operator supplied from 12 to 20 hours less of off-farm work hours per year. In the 1999B model, there was a difference in the size of the coefficient among the categories of government program payments. *TRANSPYT*, had a smaller coefficient than the other two program payments, *LOANDPYT* and *DISASTPYT*. When operators received payments that were less coupled, those payments caused operators to reduce their supply of off-farm work less than other payments. For example, the results of the 1999B model showed that for every $1,000 of PFC payments, off-farm hours were reduced by almost 10 hours per year. This compared to a reduction of 15 hours per year for emergency assistance payments.

Summary and Implications

Economic theory suggests two avenues by which government farm program payments may affect the off-farm supply of farm operators: (1) by increasing the marginal value product of time spent farming and (2) by increasing nonlabor income. If a payment is coupled to production decisions it will increase the marginal value of time spent farming. If a payment is decoupled from production decisions it will not. The 1996 FAIR Act established a payment program viewed as less coupled, and more like nonlabor income, the production flexibility contract payments. After 6 years of operation, there is an interest in measuring the impact of these payments on the decisions of farmers and farmland owners regarding the allocation of farm resources. The off-farm labor supply of farm operators is but one of the resources expected to be affected by a transition from a coupled to a decoupled payment program. Simple descriptive statistics of labor allocations, for those that receive payments and those that don't, and for both operators and spouses, tell the same story over the decade of the 1990s. Leisure has not declined, but the hours of time allocated to off-farm employment increased relative to farm hours, especially in the later part of the decade. The contribution of this study is to examine the factors affecting off-farm labor participation and supply in a multivariate framework.

National research results (El-Osta and Ahearn (1996) using 1988 data) and research results for Kansas (Mishra and Goodwin (1997) using 1992 data) indicated that transfer payments had a negative impact on the participation and/or labor supply of farm operators in the off-farm labor market. In this study, estimated regression coefficients in the participation equation obtained using 1991 data were not greatly different from those obtained using 1996 data. This despite the fact that, in the eyes of many economists, the 1996 payments were relatively more decoupled from production than those for 1991. We did find a smaller impact of government payments on off-farm participation using the 1999 data, when both PFC and other payments were transferred to farmers. We investigated whether this smaller impact in 1999 was the result of the PFC payments being in the payment mix by examining the effects separately for the production flexibility contract payments and the other payments (emergency assistance payments and loan deficiency payments). We did not find a difference in the impact of the various programs in 1999 for the decision to participate off the farm, and believe this is our strongest conclusion of the paper. The smaller impact in 1999 is likely due to the significantly greater transfer in that year, thereby lessening the per $1000 impact of payments on off-farm participation. We did find a small difference in the impact between payment types on the hours of off-farm labor supplied by the farm operator. This suggests that there could be no difference among payment types insofar as they affect the decision to work off the farm but there may be differences among payment types on decisions about how many hours to allocate to off-farm work.

Our results clearly point to the need to rigorously estimate an on-farm labor supply model, as was done in Huffman and El-Osta (1997). They did not include government payments in their model, but they found that for operators that did not work any hours off the farm, nonlabor income had the expected negative impact on labor hours worked on the farm. Hence, leisure was found to be a normal good for farmers. Extending the on-farm labor hours model to account for different payment types as we did in this study for off-farm labor hours, in combination with the nonlabor income, will yield a great deal more insight into the ultimate question about policy implications. We would also argue for additional analysis on improving the national perspective on the role of local area labor markets. The research that has addressed the issue using national databases have generally found weaker results for this category of variables than have small area studies. Given the greater allocation of time to off-farm employment during the decade at the same time that the general economy was very strong, we expect there to be more of a story yet to be told in this area.

Undoubtedly, when the proposed on-farm labor supply work is completed, other complications will remain in addressing the policy question. Some of these complications can be addressed by refinements to the standard agricultural household model such as extending the model to account for: the capital gains to landowner-operators that are associated with payments, the lack of substitutability of hired and own labor, the desire of many farmers to pass their farm on to future generations, and the “nonpecuniary” returns from farming. Moreover, subtle differences in the farmer population contribute to the difficulty in modeling choices about labor allocation adjustments, such as personal goals and lifestyle preference. Another set of challenges relevant to the time allocation decisions are those associated with the rigidities of off-farm employment requirements in concert with the variability and time-sensitivity associated with the biological process of agricultural production.

Moreover, the agricultural household model is incomplete for addressing long-run, dynamic issues such as the impact of subsidies on agricultural structure and technology adoption. Changing farm structure may in turn lead to more efficient farm production, and hence, affect agricultural supply. Many economists have offered a variety of conceptual models of structural change in agriculture (see Harrington and Reinsel, 1995, for a review). Moreover, a satisfactory model of the issues involved will involve recognition of the heterogeneity in the farmer population. Future research will be needed to determine the characteristics of farm households that are linked to their choices of reducing farm and off-farm hours.

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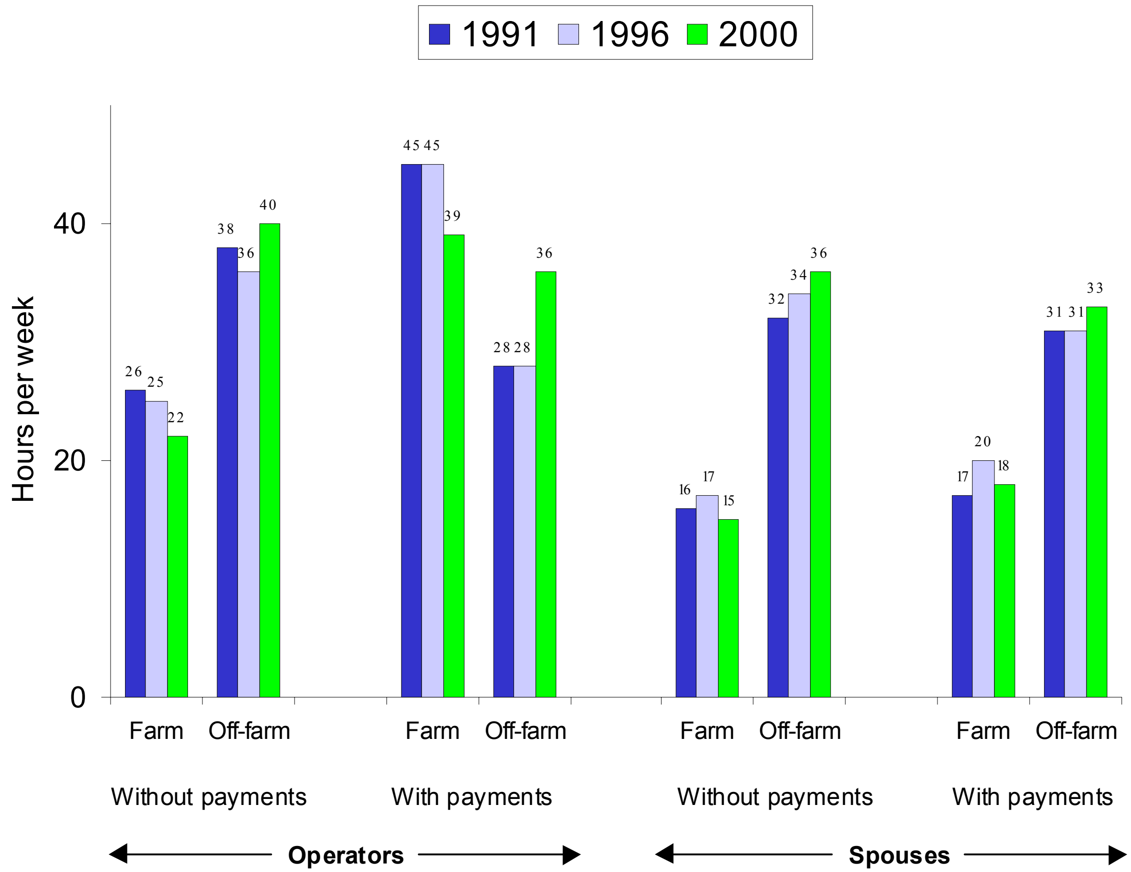
Figure 1. Hours of farm and off-farm work for operators and spouses, by receipt of commodity program payments, 1991, 1996, and 2000

Operators' average hours of farm work dropped between 1996 and 2000, regardless of receipt of government payments



Source: 1991 FCRS, 1996 ARMS, and 2000 ARMS.

Figure 2. Labor-Leisure Trade-Off with Substitution Effect Dominating Wealth Effect

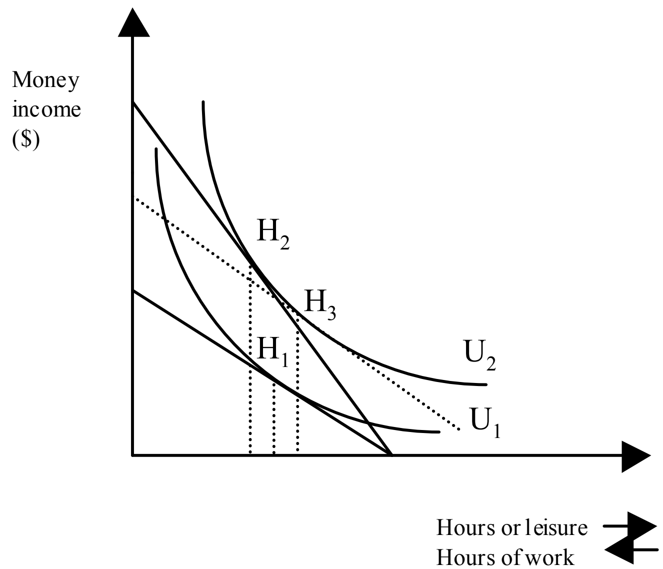
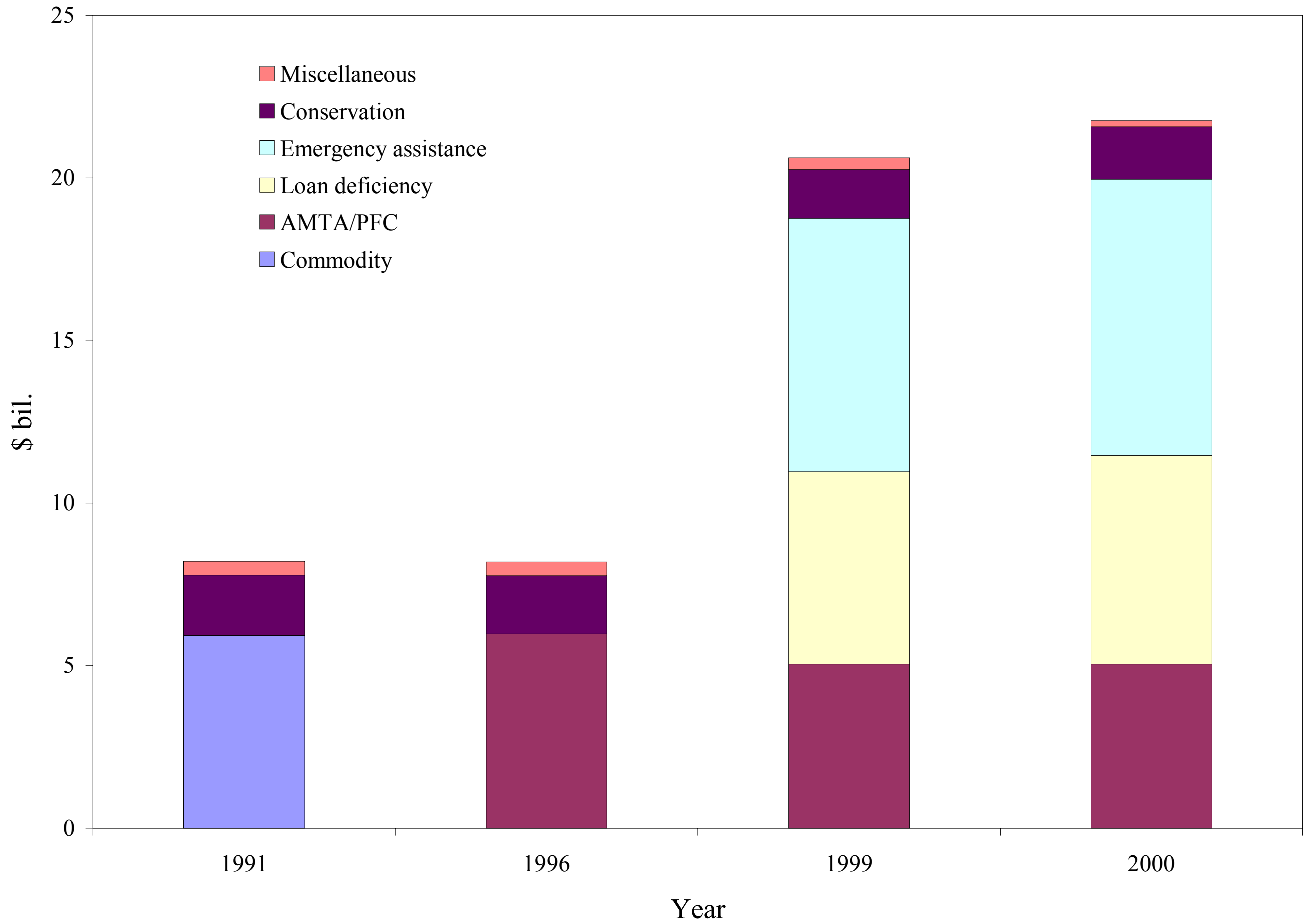


Figure 3. Government payments, selected years



Source: http://www.ers.usda.gov/data/FarmIncome/finfidmu.htm.

Figure 4: Regions as defined by the U.S. Bureau of the Census

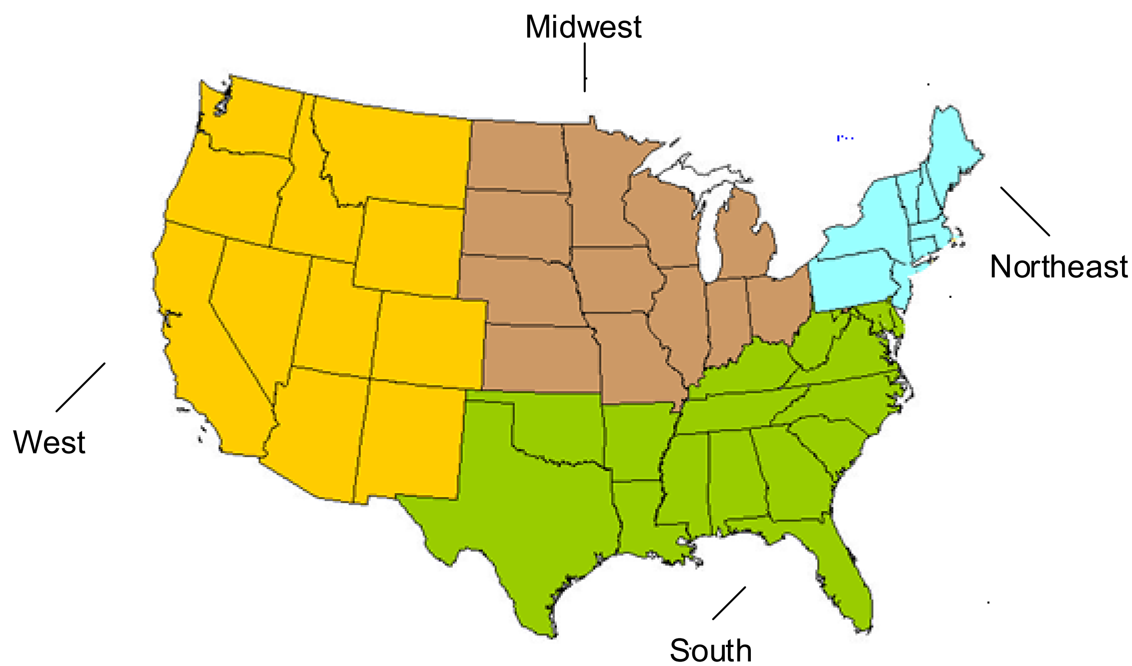


Figure 5: Impact of government payments on the probability of off-farm work by farm operators (1991, 1996, and 1999)

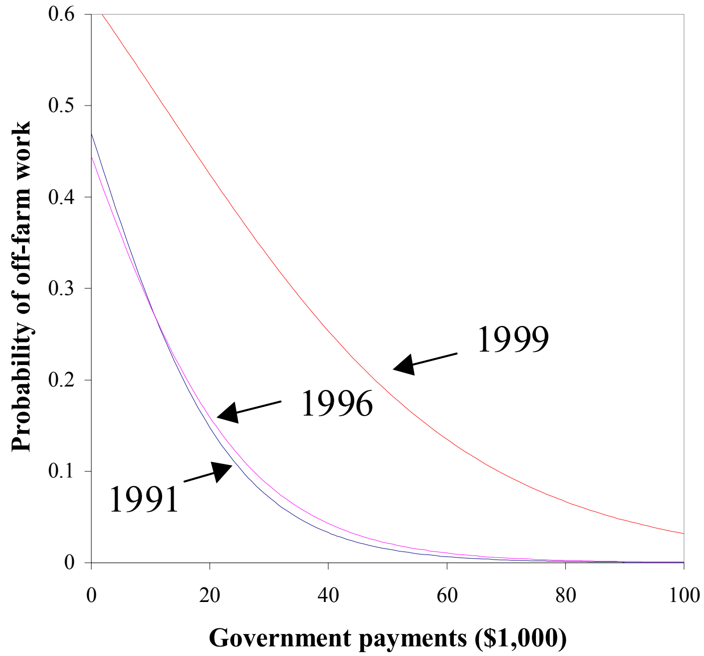


Figure 6: Impact of various government payments on the probability of off-farm work by farm operators, 1999

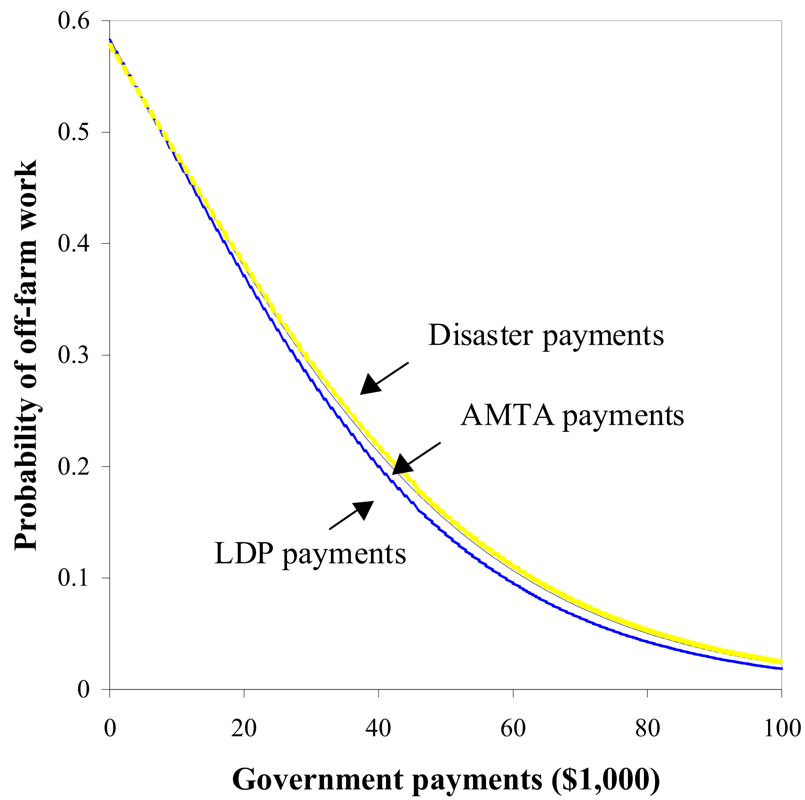


Table 1. Names, definition, and sample means of variables used in the off-farm labor participation model: 1991, 1996, and 1999[1]

Variables	Definition	1991	1996	1999
OPAGE	Age of farm operator (years)	53.45	56.33	54.78
OPEDUC	Education of farm operator (years)	12.64	12.80	13.15
SPOFFW	1 if operator's spouse worked off-farm for a wage or salary; 0 otherwise	0.53	0.49	0.47
HHSIZE	Number of persons who live in the household	2.88	2.78	2.75
OFFINT	Interest and dividends (gross income) earned by the household, $1,000	2.73	2.72	4.27
VALMACH	Per acre value of farm machinery and equipment, January 1, $1,000 (computed as the market value of the farm share of all trucks, cars, tractors, machinery, tools, equipment and implements owned by the operation less the value of what was bought of these items during the relevant production year)	0.33	0.44	0.48
GOVT	Government payments, $1,000	3.28	3.28	6.81
TRANSPYT	Transition payments (AMTA), $1,000	--	--	2.13
LOANDPYT	Loan deficiency payments (LDP), $1,000	--	--	2.24
CRPPYT	Conservation Reserve Program (CRP) payments, $1,000	--	--	0.53
DISASTPYT	Disaster payments and all other state and federal agricultural program payments, $1,000 (includes in 1999 Wetlands Reserve Program (WRP) payments and Environmental Quality Incentive Program payments)	--	--	1.90
DAIRY	1 if farm specializes in dairy production; 0 otherwise	0.07	0.06	0.04
NEREG	1 if farm is located in the Northeast Census region; 0 otherwise	0.06	0.05	0.06
MWREG	1 if farm is located in the Midwest Census region; 0 otherwise	0.41	0.37	0.38
WEREG	1 if farm is located in the West Census region; 0 other wise	0.13	0.12	0.14
SOREG	1 if farm is located in the South Census region (base); 0 other wise	0.40	0.46	0.42
UNEMP	LMA's unemployment rate (%), lagged one year	5.82	5.32	4.77
URBAN	Percent of labor market area's (LMA) population living in urban areas, based on 1990 Census of Population	31.11	30.41	31.24
AGRIN	LMA's income from agriculture (%), lagged one year	5.28	2.77	3.22
MANUF	LMA's employment in manufacturing (%), lagged one year	15.27	15.09	13.90
CONST	LMA's employment in construction (%), lagged one year	4.95	5.17	5.42
SERV	LMA's employment in services (%), lagged one year	23.21	24.36	25.97
TRADE	LMA's employment in wholesale and retail trade (%), lagged one year	20.48	20.77	20.64
OPOFFW	1 if farm operator worked off-farm for a wage or salary; 0 otherwise	0.47	0.43	0.57
Sample size		3,061	6,976	9,774
Population		2,077,789	1,961,165	2,146,421

[1] Data for the 1991 sample are from the Farm Costs and Returns Survey and for the 1996 and 1999 samples are from the Agricultural Resource Management Study survey.

Note: Coefficient of Variation = (Standard Error/Estimate)*100. All estimates have CV's that are less than 25 percent.

Table 2. Names, definition, and sample means of variables used in the off-farm labor supply model: 1991, 1996, and 1999

Variables	Definition	1991	1996	1999
OPAGE	Age of farm operator (years)	48.17	49.13	49.63
OPWAGE	Operator's off-farm wage = gross cash wages, salaries, commissions, including cash bonuses, from working off-farm divided by *OPOFFHOURS*, $ per hour	16.77	--	--
SPOFFW	1 if operator's spouse worked off-farm for a wage or salary; 0 otherwise	0.64	0.70	0.60
HHSIZE	Number of persons who live in the household	3.20	3.11	2.94
OFFINT	Interest and dividends (gross income) earned by the household, $1,000	1.76	2.22	3.70
SIZE	Size of operation, $1,000 (measured in terms of total value of production)	28.64	44.23	29.17
GOVT	Government payments, $1,000	1.62	1.66	3.52
TRANSPYT	Transition payments (AMTA), $1,000	--	--	1.05
LOANDPYT	Loan deficiency payments (LDP's), $1,000	--	--	1.08
CRPPYT	Conservation Reserve Program (CRP) payments, $1,000	--	--	0.42
DISASTPYT	Disaster payments and all other state and federal agricultural program payments, $1,000	--	--	0.96
DAIRY	1 if farm specializes in dairy production; 0 otherwise	0.02	0.03	0.01
NEREG	1 if farm is located in the Northeast Census region; 0 otherwise	0.06	0.05	0.06
MWREG	1 if farm is located in the Midwest Census region; 0 otherwise	0.37	0.39	0.38
WEREG	1 if farm is located in the West Census region; 0 other wise	0.14	0.11	0.13
SOREG	1 if farm is located in the South Census region (base); 0 other wise	0.44	0.45	0.43
UNEMP	LMA's unemployment rate (%), lagged one year	5.88	5.17	4.76
URBAN	Percent of labor market area's (LMA) population living in urban areas	31.93	29.58	31.06
AGRIN	LMA's income from agriculture (%), lagged one year	4.65	2.73	2.96
MANUF	LMA's employment in manufacturing (%), lagged one year	15.94	15.36	14.02
CONST	LMA's employment in construction (%), lagged one year	5.02	5.12	5.45
SERV	LMA's employment in services (%), lagged one year	23.03	24.17	26.06
TRADE	LMA's employment in wholesale and retail trade (%), lagged one year	20.40	20.84	20.66
OPOFFHOURS	Farm operator's annual hours of off-farm wage or salary work	1,849	1,734	1,896
Sample size		1,093	2,265	3,589
Population		973,7894	852,574	1,218,068

Note: All estimates have CV's that are less than 25 percent.

Table 3. Logit regression estimates of the off-farm labor participation model: 1991, 1996, and 1999

Variables	1991		1996		1999 A		1999 B	
	$\widehat{\beta}$	$\partial P_i / \partial x_i$	$\widehat{\beta}$	$\partial P_i / \partial x_i$	$\widehat{\beta}$	$\partial P_i / \partial x_i$	$\widehat{\beta}$	$\partial P_i / \partial x_i$
INTERCEPT	-8.4729***	-1.42585	-1.7304	-0.28931	-3.0657***	-0.48538	-3.1206**	-0.49207
OPAGE	0.3640***	0.06126	0.0430	0.00719	0.1742***	0.02757	0.1724**	0.02718
OPAGESQ	-0.0040***	-0.00068	-0.0009**	-0.00015	-0.0024***	-0.00037	-0.0023**	-0.00036
OPEDUC	0.0905***	0.01523	0.0959***	0.01603	0.0908***	0.01438	0.0901**	0.01420
SPOFFW	0.2890**	0.04944	1.2176***	0.22635	0.6490***	0.10773	0.6558**	0.10844
HHSIZE	0.1835***	0.03088	0.0912	0.01524	-0.0060	-0.00095	-0.0029	-0.00045
OFFINT	-0.0170	-0.00287	0.0012	0.00020	-0.0001	-0.00001	-0.0001	-0.00002
VALMACH	-0.2429***	-0.04087	-0.0508	-0.00849	-0.0581*	-0.00920	-0.0560*	-0.00882
GOVT	-0.0814***	-0.01371	-0.0720***	-0.01204	-0.0389***	-0.00615	--	--
TRANSPYT	--	--	--	--	--	--	-0.0408**	-0.00642
LOANDPYT	--	--	--	--	--	--	-0.0430**	-0.00677
CRPPYT	--	--	--	--	--	--	0.0033	0.00052
DISASTPYT	--	--	--	--	--	--	-0.0398**	-0.00628
DAIRY	-2.7261***	-0.40021	-1.6935***	-0.26111	-2.9185***	-0.46092	-2.9147**	-0.46197
NEREG	-0.2610	-0.04419	-0.0987	-0.01647	0.0761	0.01197	0.0663	0.01039
MWREG	-0.4382**	-0.07438	-0.0811	-0.01354	0.0692	0.01093	0.0642	0.01011
WEREG	-0.0562	-0.00946	0.1485	0.02485	-0.3048*	-0.04912	-0.3291**	-0.05290
UNEMP	0.0024	0.00041	-0.0659	-0.01101	0.0034	0.00054	0.0061	0.00096
URBAN	0.0042	0.00071	-0.0053*	-0.00088	-0.0026	-0.00040	-0.0025	-0.00039
AGRIN	0.0116	0.00196	-0.0144	-0.00240	-0.0149**	-0.00235	-0.0153**	-0.00241
MANUF	0.0243**	0.00410	0.0103	0.00173	-0.0038	-0.00059	-0.0025	-0.00040
CONST	-0.0001	-0.00001	-0.1264	-0.02113	-0.0353*	-0.00559	-0.0306	-0.00482
SERV	-0.0144	-0.00243	-0.0014	-0.00022	0.0092	0.00145	0.0107	0.00168
TRADE	-0.0161	-0.00271	0.0682**	0.01140	0.0148	0.00233	0.0157	0.00247
Log likelihood (*L*)	$-1.0478\ E^{+6}$		$-0.9861E^{+6}$		$-1.0416\ E^{+6}$		$-1.0389\ E^{+6}$	
Restricted log likelihood (L_0)	$-1.4361\ E^{+6}$		$-1.3426\ E^{+6}$		$-1.3426\ E^{+6}$		$-1.4682\ E^{+6}$	
McFadden's R^2	0.270		0.262		0.224		0.292	
Percent correct prediction[1]	76.22		77.94		78.98		78.94	
Sample size	3,061		6,976		9,774		9,774	
Population	2,077,789		1,961,165		2,146,421		2,146,421	

* Significant at 10%. ** Significant at 5%. *** Significant at 1%. Note: McFadden's $R^2 = 1 - (L / L_0)$, where L is the likelihood function of the logit model and L_0 is the likelihood function when the logit model is estimated subject to the constraint that all the regression coefficients except the intercept are zeros (see Amemiya, p. 1505).

[1] A correct prediction is one in which the estimated probability of the operator working off-farm is greater or equal to (less than) 0.5 for a participant (nonparticipant).

Table 4. Least squares regression estimates of the off-farm labor supply model: 1991, 1996, and 1999

					1999			
	1991		1996		A		B	
Variables	$\hat{\alpha}$	t-statistics	$\hat{\alpha}$	t-statistics	$\hat{\alpha}$	t-statistics	$\hat{\alpha}$	t-statistics
INTERCEPT	2895.59***	3.65	2105.18***	3.45	2421.54***	9.72	2410.02***	9.62
OPAGE	-13.65***	-3.94	-19.16***	-3.96	-9.04***	-3.63	-9.17***	-3.67
Ln(OPWAGE)[1]	289.87	1.26	--	--	--	--	--	--
SPOFFW	-3.73	-0.06	118.20	1.40	59.40	1.51	60.63	1.55
HHSIZE	-34.57*	-1.75	46.63**	2.53	23.16	1.49	23.48	1.53
OFFINT	0.75	0.15	-0.62	-0.16	0.24	0.58	0.22	0.57
SIZE	-0.52	-1.17	-0.13***	-2.86	-0.09	-0.80	-0.09	-0.85
GOVT	-15.51***	-3.10	-20.15***	-3.34	-11.64***	-12.40	--	--
TRANSPYT	--	--	--	--	--	--	-9.53***	-3.22
LOANDPYT	--	--	--	--	--	--	-13.19***	-5.39
CRPPYT	--	--	--	--	--	--	-4.85	-1.19
DISASTPYT	--	--	--	--	--	--	-13.84***	-4.08
DAIRY	-510.66**	-2.38	-524.90*	-1.91	-881.59***	-6.65	-876.59***	-6.68
NEREG	19.21	0.15	-5.78	-0.05	-111.67	-1.42	-113.57	-1.43
MWREG	26.26	0.34	15.76	0.10	-127.81***	-2.83	-130.08***	-2.86
WEREG	-152.02*	-1.81	29.62	0.15	-156.47	-1.54	-159.53	-1.56
UNEMP	-36.11*	-1.75	-4.51	-0.28	-2.85	-0.41	-2.27	-0.32
URBAN	0.59	0.41	2.14	0.75	0.00	0.00	0.01	0.01
AGRIN	-29.41*	-4.82	-6.73	-0.85	-5.41	-1.45	-5.52	-1.45
MANUF	-6.27	-1.18	-0.95	-0.11	1.00	0.28	1.11	0.31
CONST	-25.64*	-1.81	100.58***	2.43	-15.99	-1.42	-15.30	-1.37
SERV	2.62	0.30	-22.67	-1.62	-1.05	-0.18	-0.80	-0.13
TRADE	-20.08	-1.28	20.05	0.81	3.68	0.40	3.76	0.41
R^2	0.145		0.178		0.091		0.092	
Sample size	1,093		2,265		3,589		3,589	
Population	973,894		852,574		1,218,068		1,218,068	

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

[1] *Ln(OPWAGE)* is the predicted off-farm wage rate of the operator in natural logarithm based on a simple human capital model, as in:
$Ln(OPWAGE) = 1.651^{***} + 0.162^{***}\, OPEDUC$; $R^2 = 0.028$.