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Title: Determinants of Off-Farm Labor Supply Among Farm Households in the North Willamette Valley

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Financial stress in agriculture has been a concern over the past century. Agrarian values and "love of the land" seem to yield public conclusions for the support of the industry. Much of this support is in the interest of preserving a viable food producing sector in an volatile world climate. High interest rates, declining land values and highly competitive export markets have spurred renewed concern for farm survival in the past ten years.

One alternative to traditional price supports and tariffs for farm household support is off-farm income. This may take many forms including off-farm wages and salaries, rental income, interest and dividend income and, retirement or pension funds. Central to the analysis of nonfarm income generation is the allocation of time by farm households. For farmers who place a high value on the farm lifestyle, occupational choice is embedded in the time decision to such an extent that the resource allocations based on economic efficiency criteria may be altered.

Tobit techniques offer a new approach to the analysis of farm household decisions on time allocation. The procedure allows the investigator to estimate and evaluate parameters that may affect the amount of off-farm work by farm household members. The Tobit analysis is designed for censored data sets. The data in this study were censored because there were missing observations on the quantity of off-farm work for those individuals who did not work off-farm in 1986.

Results of Tobit analyses of off-farm work by farm operators and spouses in three Oregon counties indicated that high levels of gross farm income reduce the likelihood and extent of off-farm work. Middle-aged operators worked off-farm more while the presence of small children and elderly dependents in the farm household inhibited off-farm work. The allocation decisions of the spouse and the operator appeared to be independent; this supports a nonsimultaneous Tobit specification like the one used in this research.

Determinants of Off-Farm Labor Supply Among Farm Households in the North Willamette Valley

by

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CHAPTER I

INTRODUCTION

This study combines the economics of labor supply and demand in order to explain the factors surrounding farm household decisions about the use of labor resources. The purpose of the research is to create a greater level of understanding about Oregon farm households and how they combine nonfarm and farm income. To do this, recent theory on labor allocation is combined with the latest econometric procedures to develop a detailed analysis of off-farm labor supply by farm households.

One form of financial support for farm households experiencing financial problems is from nonfarm work. Government backing of this type of farm support is probably less politically charged and could be more popular with taxpayers than other farm programs such as marketing quotas and deficiency payments.

A study of the off-farm employment issue is important from several angles. It is important to understand farm household adjustments to high interest rates, declining land values and capital asset values, and relatively low farm prices (Green et al., 1986). Part of the farm adjustment has been away from farming into nonagricultural sectors. Another part of the adjustment has included continued farm efforts bolstered by off-farm earnings from farm household members. Many farm household members may already have shifted from farming to off-farm jobs to gain wages and fringe benefits. Some of these off-

farm jobs have led to permanent positions, while other work is perhaps viewed as a temporary adjustment until farming operations again become self-supporting.

Farm financial stress, described as the inability to meet debt service payments or as a cash-flow impediment, is obviously relevant to the time allocation issue. There have been several financial stress studies conducted in the United States, including Hewlett's (1987) research for Oregon agriculture. Financial stress is a timely consideration that may only be a small part of the off-farm work question.

It is also important to investigate off-farm work with respect to lifestyle preferences. It may be that many of the financially burdened farms are using off-farm employment to stay in farming despite a lack of profitability in their operations. Land values and a strong tradition of farming and agrarianism may be significantly imbedded in the decision making process for many farm households.

Finally, there are a wide range of variables which affect the marginal values of time in a household utility maximizing outlook and as such have important implications about the incidence of off-farm work. If a utility maximizing objective is relevant to household members, off-farm work may be a simple response to economic incentives that encourage farm households to reallocate their resources to nonfarm uses.

According to the Census of Agriculture for Oregon, off-farm employment increased from 1978 to 1982, indicating a definite increase in the farm household dependence on nonfarm income. Figure 1

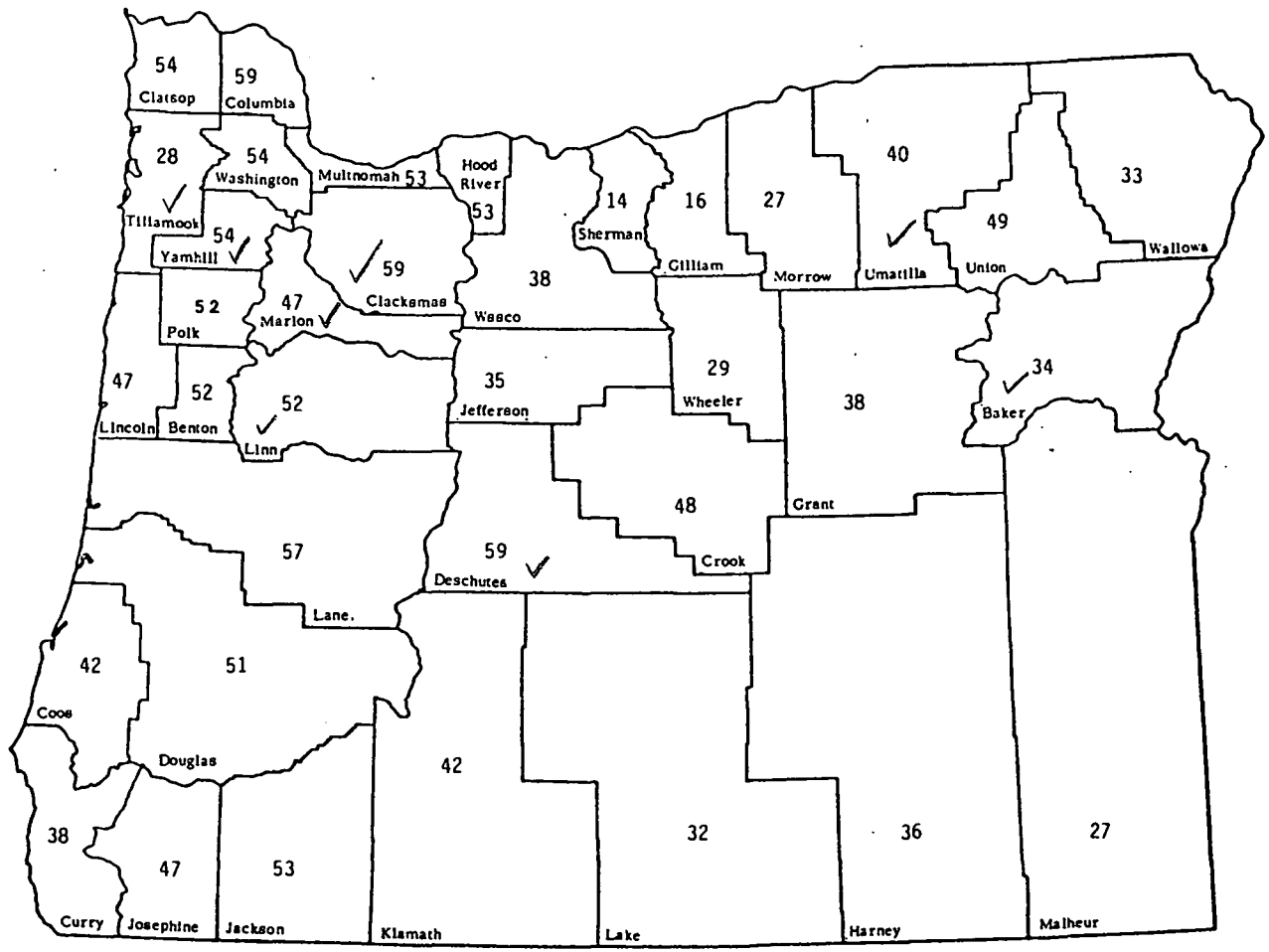


Figure 1. Census of Agriculture Profile of Oregon Off-Farm Work by County: % Operators Who Worked Off-Farm at Least 150 Days, 1982.

shows the 1982 level of off-farm employment for farm operators by Oregon counties. Note that for most of the counties in the western portion of the state, about one half of the operators worked off-farm at least 150 days. In the eastern sections of the state, it is apparent that off-farm work is not as common.

Objectives

The objectives of the thesis are to:

(1) examine the effects of human capital, farm characteristics, household characteristics, and wealth holdings on the off-farm labor allocation of Oregon farmers.

(2) examine the effects of labor market characteristics on off-farm labor allocations and off-farm wages.

(3) examine the effects of farm location, relative to identifiable labor markets, on off-farm work participation decisions of farm households.

This thesis reports findings on off-farm work activities by farm households in the northern Willamette Valley. This region was chosen because of its proximity to potential off-farm labor markets, such as Portland, Salem, and the many small towns in the area. The study area potentially has more opportunity for off-farm work than some of the less populous counties in eastern and southern Oregon. The area also offers a wide array of farm enterprises from hops and peppermint to grass seed and wheat.

Procedures

The thesis is organized in an alternative format to facilitate submission of results to an appropriate journal. Chapter II contains a review of literature of the theory and methodology relevant to the off-farm employment issue. Chapter III includes an explanation and description of the sampling frame. Chapter IV is a self-contained journal manuscript, prepared according to the format of the **American Journal of Agricultural Economics**. This format was chosen to facilitate reporting of the results and to expedite a submission to the journal for consideration of publication. The reader is encouraged to use the second chapter as a reference guide for the manuscript in Chapter IV. Appendix A contains copies of the survey instrument, follow-up letters used to encourage response, and an explanation of the criteria used to evaluate questionnaires for inclusion to the sample. Appendix B comprises two tables describing subsets of the households in the survey group, such as a comparison of households with and without farm debt and a comparison of households with an operator engaged in off-farm work and those whose operator did not work off-farm in 1986.

The Manuscript

The manuscript (Chapter IV) draws on a summary of Huffman's (1980) theoretical base for the allocation of time among competing labor activities. A formulation of the reservation wage theory described by Deaton and Muellbauer (1983) is included to increase the

explanatory power of the utility maximization paradigm for nonparticipant households.

Methodological improvements over past research include maximum likelihood estimation of Tobit labor supply functions, where the dependent variable is off-farm work hours by farm operators and spouses. This is an important improvement over maximum likelihood estimation of logit or probit labor supply specifications because it estimates the number of off-farm work hours offered, as well as the likelihood of working off-farm. It is also superior to linear probability models estimated by ordinary least squares, for reasons given by Kmenta (1986) and it allows the inclusion of observations for household members who do not work off the farm.

A two-step estimator (Heckman, 1979) is employed to test for sample selection bias and to impute missing wage observations for the farm household members not working off-farm. Sample selection bias tests indicate whether or not the probability of an observation's selection to a purportedly random sample has any explanatory power in the analyses of off-farm hours and market wage. If bias is present, coefficients estimated from the working subsample may not be imputed to the nonworking subsample. Significant sample selection bias precludes the use of wage estimates, which are predicted from the working group, for household members who do not work off-farm.

Significance

This research is important to policy makers and the general agricultural sector because it indicates the types of farm households

and communities that may be able to derive the greatest benefit from off-farm work opportunities. Part-time farming and off-farm employment have been studied in the past but the issue is still relevant in the present financial and market conditions of the industry. It is important to understand characteristics that inhibit or induce farm household involvement in alternative time allocations. Off-farm work may be an acceptable form of risk reduction in the current volatile market. It may also offer a means of self-support for the revered family farms and may reduce the public burden of support for the industry.

Chapter II

REVIEW OF THEORY AND METHODS

Introduction

This section is concerned with past research in the areas of off-farm employment and labor economics. The theory used by various authors in studying labor economics and off-farm employment is presented in the first section with the review of methodology in the following section.

The number of empirical studies addressing the determinants and incidence of off-farm employment in U.S. agriculture is relatively small. Much of the literature have noted the reallocation of farm labor to nonfarm labor markets. This has been the result of an increase in the potential for higher compensation in nonfarm markets that has occurred in the last part of this century (Huffman, 1980). Short-term financial crises have also played a part in sustaining a large off-farm labor supply. Farmers caught in the vise of declining land values and high debt loads acquired during the export growth of the 1970s have been using off-farm jobs as a temporary means of generating cash-flow.

Leistritz et al. (1985) reported that 53 percent of the farm operators who started farming in the 1970s or 1980s had debt-to-asset ratios greater than 40 percent, while over 78 percent of the farmers who started farming before 1960 had debt-to-asset ratios of 40 percent or less. The study indicated that younger farmers with

more debt were also more likely to work off-farm than their less highly leveraged, older counterparts.

Albrecht et al. (1986) pointed to the substantial trend towards part-time or "hobby-farming" as a contributor to the increase in off-farm employment. It is noted that part-time farmers may have the best of both worlds because they receive the economic benefits from farming and psychological benefits from rural living (Paarlberg, 1980).

Heffernan and Heffernan (1985) conducted a study of farm families that had recently terminated their operations. They found that young families were more likely to be forced off the farm as a result of financial stress. Their report, given as testimony at a Hearing of the Joint Economic committee of the Congress of the United States, recommended that governmental policy foster rural development through off-farm employment opportunities.

The Theory of Off-Farm Labor Allocation

General Labor Allocation Theory

In this section the relevant labor economic literature is introduced and an attempt is made in the next section to cast the off-farm labor question in this broader theory.

One portion of economic theory is concerned with labor supply by individuals and households and labor demand by firms. The objectives of this theory are to explain why individuals offer a given quantity of labor to the market, how the individual's labor allocation inter-

acts with the household living unit and what influences the demand for labor by firms.

Mansfield (1982) described labor supply and labor demand in the classical context while offering the notion that firms maximize profit and hire units of labor until the marginal cost of hiring an additional unit of labor is exactly equal to the marginal benefit derived from that same additional unit. Included in the marginal costs of hiring are wages paid, benefits given to employees and taxes, among others. The labor unit's propensity to yield benefit may be affected by human capital, performance effort, health and other limitations on work performance.

Labor supply can be viewed in a utility maximization context similar to the profit maximization theory which is in common use. In this theory, the individual foregoes the use of time with the expectation of being compensated with money income and nonmonetary benefits. The prevailing market wage is dependent on the labor supply and labor demand schedules of a labor market. As Mansfield theorized, the individual's labor supply function is dependent on the individual's demand for leisure or free time. A person with a strong demand for leisure will offer less labor time to the market at a given wage rate than a person with a weaker demand for leisure.

Off-Farm Labor Supply

Huffman (1980) modeled labor supply for farm operators to quantify the reallocation of farm labor to off-farm jobs. He postulated that the time allocation between competing activities is a result of

household utility maximization, subject to constraints on time, income, and farm production. Huffman asserted that a household's decisions about off-farm work are made simultaneously with decisions on farm inputs, including household members' farm work. In this light, the off-farm labor supply is also the labor supply function less the demand function for the members' farm labor or equivalently an excess labor supply schedule. The decisions are household decisions in this theory with associated utility interdependencies between household members.

In Huffman's model, utility is a function of leisure and a composite of all purchased goods. Income is used to acquire goods and is derived from farm sales, off-farm work wages and salaries, and other endowed income from wealth holdings. The time constraint comprises work time (farm, off-farm and household) and leisure time. Huffman was concerned mainly with educational levels and agricultural extension efforts and their effect on off-farm labor allocation and off-farm work productivity.

Sumner (1982) proposed a similar framework to Huffman's theory by imposing the condition that the marginal values of time in competing activities be equated in a time allocation decision. In this way, the marginal benefit for leisure time was set equal to the marginal benefit for farm time and off-farm work time. Under this assumption, the farm household allocates time to off-farm employment activities when the off-farm wage rate exceeds the value of marginal product from farm work. Sumner did not model spouse labor allocation. Sumner was also concerned with labor allocation off-farm as a

form of risk reduction for farming operations, which is equivalent to a target income theory.

Altering Huffman's theory slightly, Simpson and Kapitany (1983) theorized that off-farm employment decisions were based on a sequential decision order. Following Steeves (1979), they tested a theory that suggested off-farm employment decisions were based on the desire to generate sufficient capital for entering farming. In this theory the farming decision preceedes the off-farm decision. Off-farm allocation is based on a target income framework similar to Sumner's risk reduction theory.

Within Huffman's generally accepted utility maximizing framework, several important theoretical considerations must be addressed. Among these is the theoretical determination of the constraint equations for time, income and the farm operation. Huffman, Sumner, and Simpson and Kapitany considered several types of variables important to time allocation. These included human capital variables such as age, education and work experience; farm operation variables such as farm size, farm location and farm income; household constraint variables such as the presence of dependents in the farm household; and the income constraint, which in turn is affected by human capital, farm size and household characteristics. Also important to the utility maximization framework of the authors is the consumption pattern of the household. All of these considerations are further discussed in the journal manuscript section.

The benefits from off-farm work are commonly measured as a wage or salary in off-farm labor studies. Jensen and Salant (1985)

studied the role of fringe benefits in operator off-farm labor supply. Monetary valuation of fringe benefits was not explicitly analyzed. They did not address operator and spouse labor supply simultaneously despite introducing the importance of measuring all real benefits from off-farm work.

Ahearn (1986) used Huffman's general theoretical framework but noted an additional consideration; measurements on leisure time are often imprecise and leisure time is usually ill-defined. She pointed out that many studies using the simple form of the utility maximizing framework grouped home production and leisure time. This is an important consideration, yet the problem remains of measuring time spent in home production activities. Ahearn also recognized that the off-farm wage must also exceed the value of marginal product from household work in order to induce allocation to off-farm work.

An Extension of Neoclassical Labor Supply

Deaton and Muellbauer (1983) theorized that the decision to participate in a labor market is made simultaneously with the decision on how much labor to supply. They examined the concept of a reservation wage, which can be interpreted as the wage required by an individual to enter the labor market at all. Their analysis focused on the explanatory improvement of the reservation wage in determining the individual's leisure demand schedule.

Heckman (1974) modeled shadow wage rates (reservation wages) in the work participation framework. He theorized that the reason some individuals do not work is because they have reservation wages in

excess of market rates. Heckman found it possible to characterize both the interior and the corner solutions within a common theoretical framework. The corner solution in this case would also be the result of utility maximization. In essence, the marginal benefit of leisure is equated to the marginal benefit of money income at a "corner" in such a way that the individual does not offer any labor in exchange for money income. He described the shadow wage rate as a function of the hours of work, the amount of other nonwork income available, a vector of consumption good prices, wages of other household members, and constraints from household size, education levels, and household technology.

Household decision interdependency has been addressed by several labor economists. Among these, Gronau (1977) has theorized that in the case of women, labor allocation was dependent on the husband's labor supply and wage earnings. He also pointed out, similarly to Ahearn's theory, that one should distinguish between work at home and leisure. He described in some detail the allocation of time within a given household between various activities including household production and labor outside the home. Greenhalgh (1980) theorized that the spouse's income constraint includes a factor for the expected earnings of a marriage partner. This study differed theoretically from the other cases because it assumed decisions about labor allocation were sequential rather than simultaneously determined. It also includes a reservation wage to explicitly define participation decisions about off-farm work.

Literature Review of Methodology

There are numerous choices for dependent variables in an off-farm employment study. Some authors have chosen to model the number of days worked off-farm in a year, while others have used the number of hours worked in a year. Other efforts have addressed the decision to work off-farm as a binary choice dependent variable, ignoring the amount of time allocated. In the following section, the relevant measurement and estimation techniques are described. The problems with each of the techniques is described and statistical techniques are presented to combat these obstacles. A case is made for a most appropriate form of the dependent variable and a most efficient estimation technique.

Ordinary Least Squares

It could be argued that the most traditional estimation technique in econometrics is ordinary least squares (OLS) as used, for example by Leistritz (1986). Jensen and Salant (1985) also used this technique as a part of their analysis of the farm operator's labor supply off-farm. Using data from the 1981 USDA Family Farm Survey of 1,087 farm families, they estimated the hours of off-farm work, given a set of variables describing human capital attributes of the operator and spouse, farm enterprise distribution and family characteristics. Only those who worked off-farm were used in this part of their analysis. The reason was that those not working off-farm reported zero off-farm work hours; the authors thus determined that

the off-farm work estimation was conditional on the decision to participate in off-farm work. This reduction in sample size is less than desirable. If the full sample size is used, however, the dependent variable takes on qualitative choice properties reflecting the decision of the respondent to participate in the off-farm market. Further, the zero values observed on the dependent variable for nonparticipants will be highly correlated with the error term if estimated with OLS.

According to Kmenta (1986), standard OLS estimation for a binary choice or linear probability model has a few general problems. The first problem that may be encountered is heteroskedasticity of the disturbance term; this causes the calculated standard errors to be inconsistent and biased. This problem, by itself, could be solved by a weighted least square estimator. A second problem, one which does not have a practical solution, is that the predicted dependent variable may fall outside of the range of the theoretical model, i.e., outside a zero-one probability interval which might be used as the dependent variable to reflect the individual's work participation choice. A third and most important shortcoming of OLS estimation of a linear probability model is that the partial slope coefficients and the intercept will be affected by the range of the independent variables. The method of Jensen and Salant, that is, the exclusion of those respondents who did not work off-farm, is not an efficient use of the data. The nonparticipants are quite valuable to the estimation process for the very reason they are excluded; for some reason they do not work off-farm.

The second dependent variable used by Jensen and Salant (1985) was the participation decision, a yes or no choice. They used a maximum likelihood estimator described by Kmenta (1986) as more appropriate than OLS estimation for zero-one dependent variables because of the problems mentioned earlier with OLS estimators of linear probability functions. Jensen and Salant were also unable to use all the information observed on the dependent variable with their binary choice participation model; however, they avoided the problems associated with OLS by using maximum likelihood estimation. The use of full information from the dependent variable is discussed later.

The following definition of a maximum likelihood estimator is given by Kmenta (1986, p. 176):

> "...if a random variable x has a probability distribution of f(x) characterized by $\theta_1, \theta_2, \ldots, \theta_k$ and if we observe a sample $x_1, x_2, \ldots, x_k$, then the maximum likelihood estimators of $\theta_1, \theta_2, \ldots, \theta_k$ are those parameters that would generate the observed sample most often where $f(0) = 1 - \pi_i$ and $f(1) = \pi_i$."

Probit

Probit, which was used by Salant and Jensen, is the appropriate binary choice model where a normal distribution of the error term is assumed. Sumner (1982) also used this technique to avoid the problems of fitting dummy-dependent variables by OLS. His procedure was a reduced form participation equation that included all exogenous variables which affect the marginal value of time in any activity.

This method avoided the inclusion of off-farm wages as an endogenous variable.

The probit dependent variable can be interpreted as the propensity to make an affirmative decision about a given concern. The likelihood function as described by Kmenta (1986) is:

$$L = \Sigma\{Y_i \text{ Log } F(\alpha + \beta x_i) + (1-Y_i) \text{ Log } [1-F(\alpha + \beta x_i)]\} \qquad (2.0)$$

where Y_i is the zero-one dependent variable and x_i is a vector of theoretically related independent variables.

Logit

A second type of binary choice specification can also be derived from a log-linear distribution called logit. A maximum likelihood estimation technique is also employed with this type of specification. Amemiya (1985) further described the merits of logit and probit, suggesting the use of logit in cases where the distribution of the observations is heavily weighted in the tails. Kmenta also suggests that the logit coefficients as easier to interpret than probit, with an asymptotic similarity existing between the two functions. Huffman (1980) used logit to analyze a dependent variable described as the log-likelihood that an operator would work off-farm. A set of explanatory variables quite like Sumner's were used. Simpson and Kapitany (1983) also used maximum likelihood to estimate a logit function of the off-farm work decision.

Logit can be interpreted as the log-odds of making an affirmative decision about a given concern. The likelihood function

described by Kmenta (1986) is:

$$L = \Sigma[Y_i (\alpha + \beta x_i) - \text{Log}(1+e^{\alpha + \beta x_i})] \quad (2.1)$$

where, again, Y_i represents the binary participation choice and a vector of independent variables are represented by x_i.

Tobit

Using the full range of information from the dependent variable, that is, the number of hours as well as the binary choice, is highly desirable for off-farm labor supply estimation. This type of variable specification is commonly called a censored variable (Kmenta, 1986). In general, a dependent variable is censored if there are observations (such as zero) for a portion of the sample. A sample is said to be truncated if there are missing observations for one or more independent variables when the dependent variable is censored (Kmenta, 1986).

Most off-farm labor supply studies involve both participants and nonparticipants and are usually forced to analyze both censored and truncated data. This is especially true if wages are to be used to explain labor supply, because nonparticipants do not obtain a measurable wage. Tobin (1958) introduced a maximum likelihood estimator which is applicable to this problem. Tobin pointed out that some variables in household surveys, for example, yearly expenditures on consumer durables, may have a lower or upper limit which is taken

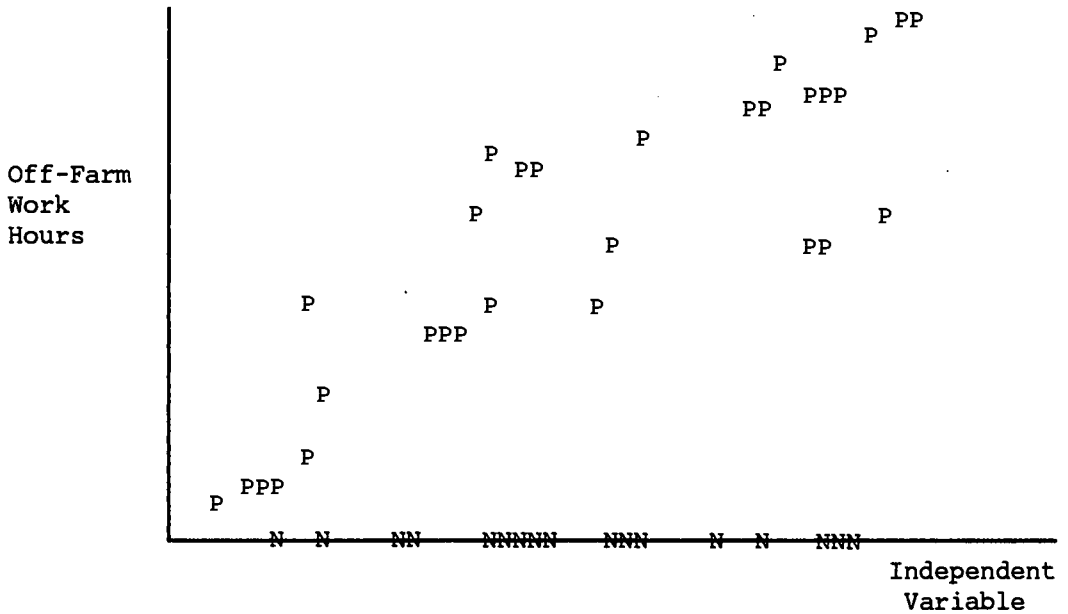
on by a substantial portion of the sample, the subsample comprising households that did not purchase consumer durables. The range of values for the dependent variable among the other households, those that did purchase consumer durables, can be quite broad (Figure 2). A single straight line fit only to the array of observations showing positive values and ignoring those at the zero-limit would incorrectly estimate the hours of work and would consequently yield biased coefficients. By converting the positive values to a one, as in the case of probit or logit, the information derived from some observations on the dependent variable is lost. Maximum likelihood estimation of a Tobit function allows for the use of the full range of the positive values as well as their zero-one participation nature. Amemiya (1985) fully described Tobit estimation and offered several cases for which the procedure could be applied. The Tobit likelihood function is as follows (Kmenta, 1986):

$$L = \Sigma\{(1-Z_i) \text{ Log } F(\frac{-\alpha-\beta x_i}{\sigma}) + Z_i[-1/2 \text{ Log}(2\pi \sigma^2)-1/2 \sigma^2 (Y_i - \alpha - \beta x_i)^2)]\} \quad (2.2)$$

where Z_i indicates whether the individual works off-farm or not, and the dependent and independent variables are represented by Y_i and X_i, respectively.

Sample Selection Bias

Deaton and Muellbauer (1983) suggest the use of Tobin's techniques and describe two other problems with truncated data sets that



* P = continuous variable observations
** N = censored observations at limit=0

Figure 2. An Example of Censored Data.

have missing observations on some independent variables for those respondents who do not work off-farm. The first can be described as a sample selection bias introduced into an analysis when functions for hours of work are estimated from cross-sectional data where only part of the sample work. The second problem involves predicting values for missing observations or developing a suitable proxy for variables with missing observations. The most common type of missing observation is the wage rate. When the operator does not work off-farm, there is a lack of reportable wage offerings.

By way of a solution of the first problem, Heckman (1979) described a two-step estimation technique using Probit and OLS to assess the degree of sample selection bias. The procedure involves estimation of a probit model for the participation decision, using the entire sample. A value for each observation is then created from the ratio (Heckman, 1979):

$$\lambda_i = Z_i \; / \; 1 - Z_i, \qquad (2.3)$$

where Z_i is the probability density function of the standard normal index variable created by the probit algorithm and $1 - Z_i$ is the cumulative density function. This procedure is followed to estimate the probability of an observation's selection into the sample. Hours worked, as a dependent variable, is then analyzed by OLS, using exactly the same independent variables, including λ_i, as in the probit. Only that portion of the sample observed working off-farm is used in the OLS. The coefficient for the probability of selection to the sample, λ_i, is tested for significance, along with the other coeffi-

cients and yields an estimate of the degree of sample selection bias. If sample selection bias is not present, the OLS coefficients are applicable to the nonparticipant subsample as well as the participant subsample (Heckman, 1979).

The second problem of missing wage observations can be solved with Heckman's procedure as well. A wage function can be estimated from the working subsample, using human capital variables, area characteristics, and other measurements of labor supply and labor demand as independent variables. If sample selection bias is not present, according to Heckman's procedure, the wage coefficients can be used to impute wage observations. This procedure is accepted by Deaton and Muellbauer as a possible solution for the missing wage problem.

Sumner used the Heckman technique to estimate wage rates but failed to use estimated wages in the participation function. The R^2 for wage rates was poor; this probably accounts for his failure to impute wage rates to nonparticipants. Jensen and Salant also attempted to impute wage rates from the participant group but failed to use them. They did this because sample selection bias was detected when Heckman's procedure was employed.

Summary

Traditional labor economic theory postulates that resource allocations are based on utility maximization. This framework has been introduced and expanded to describe off-farm labor allocations. It has been argued that the off-farm work participation decision is most

efficiently modeled in an explicit theoretical framework capable of describing corner solutions as well as interior solutions of the number of hours supplied.

It has been argued that maximum likelihood estimation of a Tobit function is most appropriate in cases where the dependent variable is observed only for a subsample of participants and when a limiting value, such as zero, is observed for non-participants. Heckman's two-step estimator can be used to assess sample selection bias in survey data. His procedure can also be followed to impute important missing observations on independent variables such as wage rates.

CHAPTER III

SURVEY DESIGN AND SAMPLING FRAME

Agricultural Stabilization and Conservation Service personnel provided lists of persons in three Oregon counties who had recently received government farm payments. The three counties were Polk, Yamhill and Washington, all in the northern Willamette Valley. The lists contained names of persons engaged in varied farm activities. The range of farming operations also included nongovernment aided enterprises; most farms had more than one type of farm product, some of which were not covered by farm programs.

There were over two thousand names in each of the three county lists provided by the ASCS. Some duplication occured within the list for the farm households with multiple family members having government payment records in separate namesakes. The Oregon Department of Motor Vehicles also provided a list of names of persons having farm vehicles registered in each of the three counties; this was used to supplement the accuracy of the names and addresses in the ASCS list.

In 1982, the Census of Agriculture for Oregon reported that there were 1,919 farmers in Washington County, 1,794 in Yamhill County, and 1,196 in Polk County. Differences in the estimates of the number of farmers between Census reports and the ASCS lists can be attributed to the fluctuation in the number of farmers from year to year and in the size definition of a farmer. In 1974, the Census of Agriculture stated that an operation must yield $1,000 in sales to be considered a farm. The Census data, however, also include

categories for farms with less than $1,000 of sales receipts for a given year.

Sampling Procedure

A systematic random sample of 467 was drawn from the combined three-county list. The desired number of responses was two hundred completed questionnaires. Mail questionnaires were sent to each of the selected households to minimize survey expenses. Development of the questionnaire was hampered by a need to limit expenses, which allowed only four pages of printing space. Many of the questions concerned financial conditions for the farm household. For this reason, a personally administered interview would have been more suitable and would have improved the response rate. With the aid of the Survey Research Center at Oregon State University, an initial cover letter was sent along with a survey questionnaire to each farm household on February 26, 1987. Additional reminders and follow-up questionnaires were sent at two week intervals to households not responding. Of the 467 households drawn from the ASCS sampling frame, 323 (70 percent) households responded in some form. Two hundred thirty-three respondents were filtered out either by their lack of farm sales (< $1,000) in 1986 or for lack of reported data on key questions within their questionnaire. The usable sample size was reduced to 90 questionnaires. Twenty were from Polk County, 38 from Washington County, and 32 from Yamhill County. Observations for both operators and spouses were obtained for all of the important variables in this subgroup.

Table 1 describes general farm characteristics, as reported by the Census of Agriculture for 1982, in each of the three counties including crops grown, tenure distributions and farm size distributions. Table 2 indicates the amount of farm sales attributable to individual farm enterprises in the 1986 off-farm work sample of ninety households. Table 3, in Chapter IV, indicates other characteristics for the farm households in our survey group. In order to assess how well the sample represented the population characteristics, standard t-tests of difference were conducted at the α=.01 significance level. A comparison of the survey group with the population as a whole indicates that those farms in the small sample had different farm sales from the various farm products than those reported in the population as a whole. The sample mean of gross farm sales for those that sold at least $1,000 of farm products in the combined three-county region, during the 1986 survey year, was $81,891 (S.E. = 154,020). The population mean, according to the 1982 Census of Agriculture, was $46,435, adjusted to only those farms selling at least $1,000 of farm products. Over 70 percent of the farm households in the survey group had grain, beef, fruit and vegetables or grass/hay enterprises, while the Census of Agriculture reported that 90 percent of the farmers in the three-county region had sales from one of those enterprises. The sample group had a higher mean acreage, 172 acres (S.E. = 280.97), compared to the population in the three-county region for 1982, which had a mean acreage of 107. The mean operator age in the sample was 54.2 years (S.E. = 12.56), while the population mean was 50 years for the entire

Table 1. 1982 Census of Agriculture: County Data.

	County			
	Washington	Polk	Yamhill	Total
Number of Farms	1,919	1,196	1,794	4,909
Average Acreage	78	150	109	112.3
Total County Sales	$71,513,000	$40,650,000	$65,167,000	$177,330,000
Average Farm Sales	$37,266	$33,989	$36,325	$35,860
Adjusted Avg. Farm Sales[a/]	$43,940	$47,567	$46,963	$46,434
Crop Enterprises[b/]				
Number Farms Selling	1,174	614	987	2,775
Avg. Farm Sales:Grain Crop	$35,803	$20,291	$27,757	$27,950
Avg. Farm Sales:Grass/Hay Crop	$8,573	$21,291	$11,647	$13,804
Avg. Farm Sales:Vegetables	$52,126	$54,347	$74,644	$60,372
Avg. Farm Sales:Fruit	$25,314	$18,845	$15,033	$19,730
Avg. Farm Sales:Nursery Products	$112,180	$15,651	$87,028	$71,619
Livestock and Poultry Enterprises[b/]				
Num. Farms Selling	1,071	787	1,097	2,955
Avg. Farm Sales:Dairy	$142,755	$134,658	$145,746	$141,053
Avg. Farm Sales:Poultry	$5,276	$46,162	$68,815	$40,084
Avg. Farm Sales:Beef Cattle/Calves	$4,378	$5,882	$6,084	$5,448
Avg. Farm Sales:Hogs	$11,720	$7,474	$23,243	$14,145
Avg. Farm Sales:Sheep	$1,577	$2,301	$1,710	$1,862

a/ Adjusted Avg. Farm Sales is based on those farms that sold at least $1,000 of farm products.
b/ Mean farm sales for each enterprise calculated only for those selling products from that enterprise.

Table 2. Crop, Livestock and Poultry Sales for the 1986 Sample (n=90).

Crop or Livestock	Num. Farms	Total Sales All Farms	Average Sales[a/]
Grain	31	$1,030,199	$ 33,232
Grass/Hay	25	$ 508,796	$ 20,351
Vegetables	13	$ 733,300	$ 56,407
Fruits	27	$ 662,688	$ 24,544
Nursery	6	$1,087,299	$181,216
Dairy	9	$1,420,831	$157,870
Poultry	3	$ 410,100	$136,700
Beef	36	$ 269,701	$ 7,491
Hogs	12	$ 567,382	$ 47,281
Sheep	7	$ 35,303	$ 5,043
Trees	4	$ 30,800	$ 7,700

[a/] Average sales per farm is calculated for that subset of farm households which grew and sold that farm product only.

area of study. These response results indicate that the 1986 sample captured significantly more farmers in the upper end of the farm size distribution than in the lower end of the distribution. The changes could also be attributed to a general increase in the farm size for the area. The mean number of years involved in farming was 18.9 (S.E. = 11.9) for the sample and only 14.14 for the population as a whole.

Types of Questions

The data obtained from the questionnaires described the household and general farming operations of each respondent, including information about the farm location, age, and level of education for the spouse and operator, the number of children, their sex and age, household income from all sources (farm and nonfarm), farm debt levels, farm sales from all crops, livestock and poultry. The questionnaire was also designed to obtain information about the off-farm work by spouses and operators including their wages, work experience, commuting distances, work locations, hours of work, fringe benefits and future expectations about off-farm work.

CHAPTER IV

OFF-FARM LABOR SUPPLY: A TOBIT ANALYSIS

A variety of approaches have been used in modeling off-farm labor supply. These include Huffman (1980), Sumner (1982), Albrecht (1986), Simpson and Kapitany (1983), Ahearn (1986), Jensen and Salant (1985), and Leistritz (1985). Huffman and Sumner both used a logistic specification to explain off-farm work by operators in their cross-sectional studies. The type of dependent variable that they considered is called a censored variable (Amemiya, 1985). This is the case, for example, when off-farm work participants have positive hours of off-farm work, while nonparticipant hours are zero. In addition, if some of the independent variables are not observed when the dependent variable is censored, the sample distribution is also truncated (Amemiya, 1985); missing off-farm wage observations is an example of a truncated distribution for an independent variable. Both censoring and truncation are likely to occur in labor economic studies.

Standard OLS estimation techniques are not prescribed for censored samples and truncated distributions (Amemiya, 1985). Past research has often modeled the dependent variable in two separate ways; the first is a dummy-dependent formulation for the participation decision and the second is an OLS labor supply function using only off-farm work participants. The first method incompletely models the decision in a binary choice formulation; the second method yields biased estimators. Instead of these methods, maximum likeli-

hood estimation of the Tobit specification should be used to model the work participation decision simultaneously with the intensity of off-farm labor allocation, thereby improving the explanation for both limit and nonlimit observations (Kmenta, 1986).

A method of imputing missing observations in truncated data sets has been provided by Heckman (1979). Sample selection bias tests can also be carried out in conjunction with Heckman's two-step estimation procedure for imputing missing variables.

The purpose of this article is to present a Tobit model of off-farm work, a censored dependent variable, where there is also truncation of the sample distribution with respect to wages received by non-participants. The Tobit model allows for tests of whether human capital, local labor market characteristics, distance, farm characteristics, and household factors are related to off-farm work by farm operators and spouses in a three county area in Oregon.

Labor Supply

Following Huffman (1980), the labor supply decisions of farm household members are the result of household utility maximization subject to constraints on time, income, and farm production. Members receive utility from leisure (L) and purchased goods (Y); consumption (C) is affected by a set of household factors, such as age, education and number of small children. Huffman's utility function is indicated by:

$$U = f(L, Y; C) , \quad (U_i = \partial U/\partial_i > 0; \; i = L, Y) \qquad (4.0)$$

which is assumed to be ordinal and strictly concave. Members allocate time to different activities until the marginal benefit of each activity is equal to the marginal benefit of leisure. Huffman's constraint equations for time, farm production and income appear as follows:

$$T = T_f + T_{of} + q_o + T_H, \tag{4.1}$$

$$Q_f = f(x_i), \text{ where } \partial Q/\partial x_i > 0, \tag{4.2}$$

$$PY = (Q_f P_i - E + V) + w_1 T_{of}, \tag{4.3}$$

where T is the time endowment; T_f is time spent farming; T_{of} is time spent in off-farm work; q_o is leisure time; T_H is time spent in home production; Q_f is a vector of farm output which is a function of farm inputs such as operator and spouse labor, x_i; PY represents household expenditures on purchased goods; $(Q_f P_i - E + V)$ is farm product sales $(Q_f P_i)$ less farm expenses (E) plus nonlabor income from wealth holdings and transfer payments (V); and $w_1 T_{of}$ is income earned off-farm. In this formulation time decisions are made simultaneously with decisions about farm inputs and outputs and consumption.

Huffman's model explains interior solutions efficiently, but without explicit explanation of the participation decision, a corner solution. It is critical that an off-farm allocation theory explain why some individuals do not work off-farm. Deaton and Muellbauer (1983), Heckman (1974), and Gronau (1974) suggest the idea of a reservation wage to improve the explanatory power of the neoclassical utility maximization framework. The reservation wage would ex-

plicitly allow the possibility of a corner solution for the off-farm work decision; market wages must exceed some threshold in order to induce participation in the off-farm labor market.

Figure 3 depicts the reservation wage required by the individual to participate (Deaton and Muellbauer, 1983). The dashed line RW_o represents this threshold and has a slope equivalent to the marginal rate of substitution between purchased goods and leisure, W^*/p. W^* is the reservation wage; p is the price vector of consumable goods. If a market wage is in excess of the reservation wage, the individual participates in the labor market. The line MW_o, which is steeper than RW_o, depicts a decision by the individual to participate and supply l_tT hours to the labor market. If the reservation wage exceeds the market wage, as the new line MW_1 exemplifies, the individual does not participate in the off-farm market. The individual is indifferent between increased leisure and more purchased goods if the market wage is exactly equal to the reservation wage. This slope would be identical to that of RW_0.

In Deaton and Muellbauer's (1983, pp. 274-277) general model of labor allocation, they portray the demand for leisure q_o as follows:

$$q_o = f(\mu + w_1T, w_1, p), \tag{4.4}$$

where nonlabor income is μ, the time endowment is T, the wage rate is w_1, and the price of purchased goods is p. The reservation wage rate w^*, is that value of w_1 which makes q_o equal T:

$$T = f(\mu + w^*T, w^*, p) \tag{4.5}$$

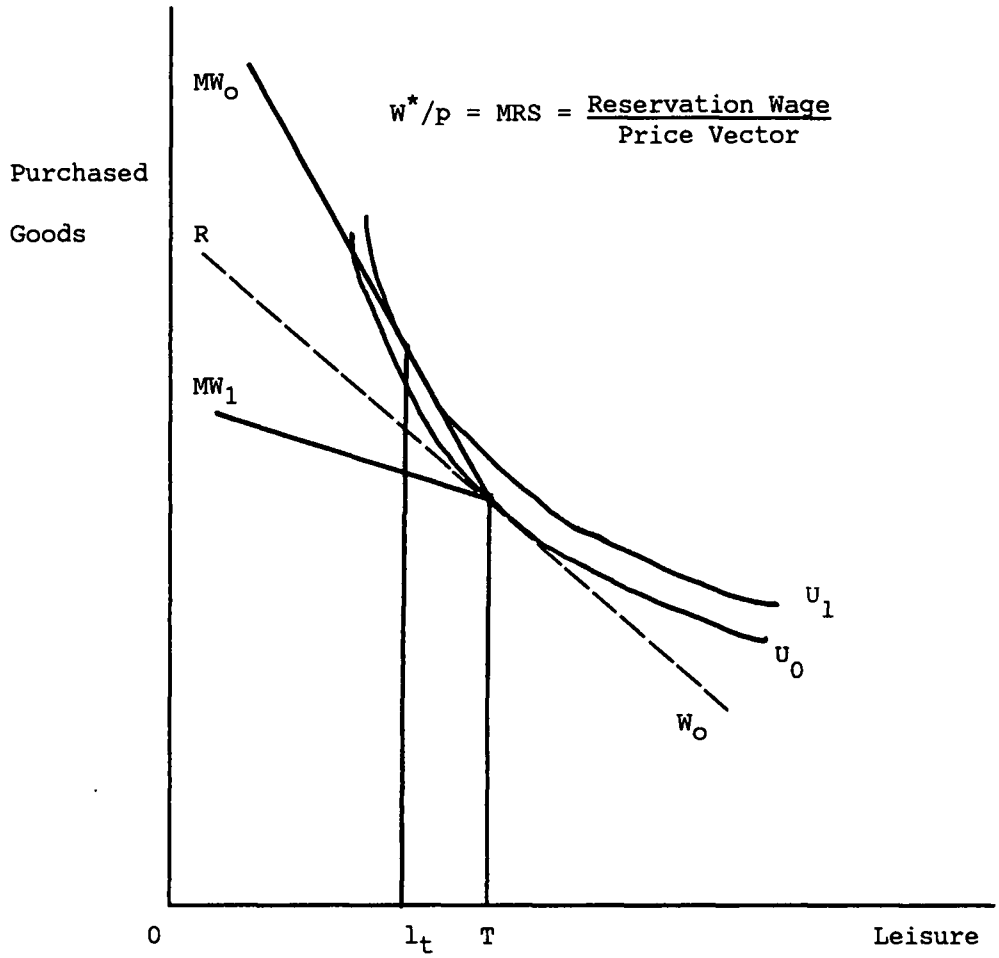


Figure 3. The Reservation Wage Mechanism.

Deaton and Muellbauer derive a labor supply function from (4.2) by allowing p and w^* to vary:

$$L = (T-\alpha_o)(1-\gamma_o) - (\alpha_o/w)(\mu-p\gamma) \qquad \text{if } w > w^* \tag{4.6}$$

$$L = 0 \quad \text{if } w < w^* \tag{4.7}$$

where γ_o is committed leisure and other factors affecting household labor demand such as the number of small children in a household. Deaton and Muellbauer then derive the reservation wage as follows:

$$w^* = \alpha_o(\mu - p\gamma)/(1 - \alpha_o(T - \gamma_o) \tag{4.8}$$

where $\partial w^*/\partial \mu > 0$, $\partial w^*/\partial p < 0$, and $\partial w^*/\partial \gamma_o > 0$. The reservation wage increases or decreases with committed leisure and nonlabor income, and declines with increases in the price of purchased goods. Note that μ can absorb earnings from other family members as part of the nonlabor income factor. Note also that γ_o is a function of household composition such as the presence of small children or elderly dependents and the time necessary for sleeping, eating and personal hygiene. T and p are constant across households.

Drawing on Deaton and Muellbauer (1983) to derive an application to off-farm work and farm production, the demand for leisure q_o may be given by:

$$q_o = f[(\mu + (Q_f P_i - E + V) + w_1 T_{of}; w_1, p, OC)] \tag{4.9}$$

where nonlabor income is μ; $(Q_f P_i - E + V)$ is net farm income and transfer payments. The off-farm market wage is w_1 and off-farm labor

is T_{of}, P is a vector of prices of purchased goods and OC is occupational preference. The threshold of off-farm work participation (reservation wage) is that value of w_1 which sets the desired amount of leisure (q_o) exactly equal to the time endowment (T). The derived off-farm labor supply function is then:

$$L_{of} = (T - \gamma_o)(1 - \alpha_o) - (\alpha_o/w_1)(\mu + Q_f P_i - p\gamma), \quad \text{if} \quad w_1 > w^* \tag{4.10}$$

$$L_{of} = 0 \quad \text{if} \quad w_1 < w^* \tag{4.11}$$

where T is the time endowment and γ_o is a composite of committed leisure and other factors which affect short-run farm and household labor demand such as the amount of fixed farm assets and the number of small children in a household. The parameter α_o is undefined in Deaton and Muellbauer (1983) but could represent a propensity for occupational choice, such as a preference for farm work over off-farm work. The off-farm reservation wage is represented by:

$$w^* = \alpha_o(\mu + Q_f P_i - p\gamma)/(1 - \alpha_o)(T - \gamma_o) \tag{4.12}$$

where the calculus is the same as in (4.8) with the addition of occupational choice and expected short-run farm income such that $\partial w^*/\partial \alpha_o > 0$ and $\partial w^*/\partial Q_f P_i > 0$.

It should be noted that the estimation of the model has a potential bias resulting from the simultaneous determination of the operator and spouse off-farm and on-farm work, off-farm wages, farm input-output decisions, and a host of other possible endogenous fac-

tors. In fact, in order to capture the entire dynamic model at least eight equations would be necessary in such a simultaneous equation system. A simultaneous Tobit specification would seem appropriate when this sophisticated computer software becomes available.

Figure 4 shows labor supply and a perfectly elastic labor demand schedule. Off-farm labor supply, the excess labor supply function in a local labor market, is derived from the total labor supply of farm households. Off-farm labor supply would shift to the right with decreases in the demand for leisure, for example, or from an increase in the price of purchased goods. Off-farm labor supply would shift to the left with increases in the demand for leisure or from a decline in the price of purchased goods. Finally, the off-farm labor supply curve would shift to the right if expected farm income were to decline due (for example) to a fall in the price of farm output.

Empirical Models

Maximum likelihood estimation of a Tobit specification is the most appropriate procedure for analysis of a censored dependent variable (Amemiya, 1985). Logit or probit specifications have also been used to model binary choice (Cain and Watts, 1973) but these zero-one specifications do not take full advantage of the information contained in the dependent variable. Tobit specification is highly adaptable to reservation wage theory and allows estimation of the participation decision simultaneously with the intensity of off-farm work. This procedure leads to estimators that are consistent and asymptotically normal and whose variances can be derived from the in-

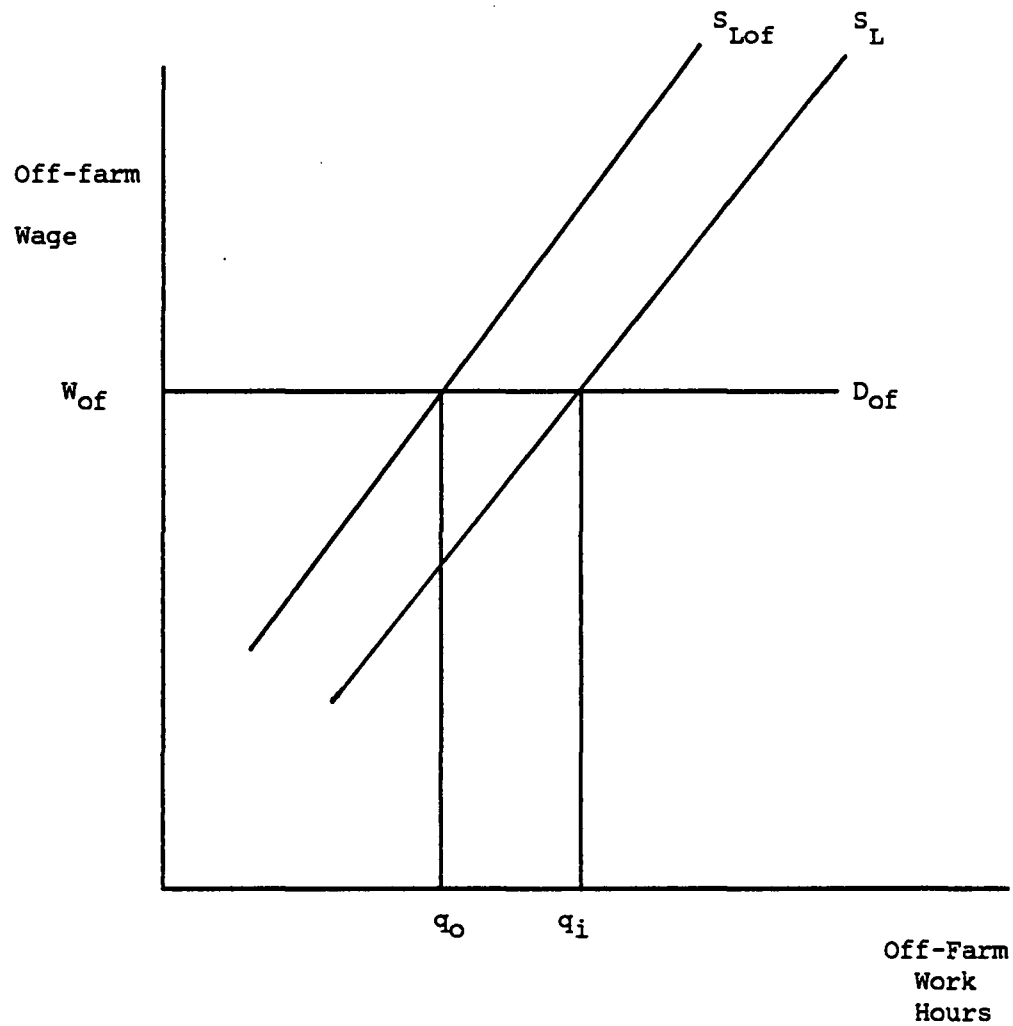


Figure 4. Labor Supply and Labor Demand Schedules.

formation matrix (Kmenta, 1986). The Tobit coefficient has a different interpretation than those from OLS and the expected value of the dependent variable is (McDonald and Moffit, 1980):

$$E(Y_i) = X_i \underline{\beta} F_i + f_i \sigma \qquad (4.13)$$

where F_i is the cumulative density function and f_i is the probability density function of a standard normal variable evaluated at $\overline{X} \beta/\sigma$. Elasticities can be interpreted as follows (McDonald and Moffit, 1980):

$$[\partial E(Y_i)] / \partial X_i = F\beta_i \qquad (4.14)$$

Labor supply is commonly depicted as a function of wages. With a truncated distribution, however, wage data are not observed for those who do not work off-farm. Missing observations can be imputed for this subsample from the participant group, however, if sample selection bias tests prove insignificant. Heckman's (1979) two-step estimation procedure offers both a test of sample selection bias and a means of predicting wages for the missing observations. This test consists of two steps. First, it is necessary to estimate a probit model of the decision to work off-farm, using all observations. A variable is then created for each observation from the ratio:

$$\lambda_i = Z_i / 1 - Z_i, \qquad (4.15)$$

where Z_i is the probability density function of the standard normal index variable created by the probit algorithm and $1 - Z_i$ is the cumulative density function. This procedure estimates the probabil-

ity of selecting a particular observation into the sample. Second, OLS is used to estimate off-farm hours, using exactly the same independent variables as in the probit, but with only that portion of the sample observed working off-farm. The coefficient for the variable, λ_i, representing the probability of selection to the sample, is then tested for significance. This yields an estimate of the degree of sample selection bias. If bias is not present, the OLS coefficients are applicable to the nonparticipant subsample as well as the participant subsample (Heckman, 1979).

The OLS coefficients are then used to compute the predicted wage, $\hat{w}$, for all observations. If observed wages are used for participants and predicted wages are used for nonparticipants, it is necessary to assume that the offered wage is independent of the off-farm work participation decision. To avoid the assumption that the predicted off-farm wages are identical to observed wages for the participant group, predicted wages are used for all observations (telephone conversation with James Heckman, 10 June 1987). Some (but not all) information about wage earners is lost with this procedure, but an undesirable assumption is thereby avoided.

Data

The data are from a 1986 farm household survey conducted in a crop/livestock area in three counties in the northern Willamette Valley of Oregon. ASCS personnel provided name lists of individuals who had received government farm payments in recent years. A brief mail questionnaire was designed to obtain information about farm opera-

tions, operators and spouses, and their off-farm work. The final usable sample for the Tobit analysis included 90 farm households. Excluded from the analysis were those with incomplete questionnaires, those for whom key responses were missing and those not meeting the Census of Agriculture farm definition of $1,000 in farm sales. The sample included somewhat larger operations than the average reported by the 1982 Census of Agriculture. Table 3 contains a summary of means and standard errors of the means for the variables used in the Tobit model. The 1982 Census differs from Table 3 regarding the average farm sales per household, not including government payments. The sample averaged $81,891, compared to the adjusted Census average of $46,434, with α = .01. Forty-four percent of the operators and 32 percent of the spouses worked off-farm in 1986.

Variable Selection

The off-farm labor supply functions for operator and spouse are as follows:

HOURS = f(LNWAGE;
AGE, AGESQR, EDUC, DHEALTH;
DEBT, ENTERP, GFINC;
SMCHILD, ELDEP, OFFINC, OTHRINC;
LNPOP, GROWTH, DIST).

The dependent variable (HOURS) was the amount of off-farm work for pay during 1986. The five types of independent variables that were considered included wage, human capital, farm characteristics,

Table 3. Sample Means and Standard Errors of Means.[a/] [b/]

	Operator	Spouse	Both
Human Capital			
AGE	54.20 (1.32)	50.33 (1.60)	---
EDUC	12.90 (0.37)	12.29 (0.39)	---
DHEALTH	0.03 (0.02)	0.04 (0.02)	---
Farm			
DEBT	---	---	$130,000[e/] (30,111)
ENTERP	---	---	2.09 (0.13)
GFINC	---	---	$85,559 (16,571)
Household			
SMCHILD	---	---	0.26 (0.07)
ELDEP	---	---	0.04 (0.03)
OFFINC	$4,359 (934)	$11,033 (1,648)	---
OTHRINC	---	---	$12,331 (2,374)
Local Labor Market			
LNPOP	9.86 (1.45)	9.75 (1.27)	---
GROWTH	13.33 (1.29)	15.66 (0.95)	---
DIST	10.76 (1.40)	9.31 (0.95)	---
WAGE	$14.16[c/] (1.41)	$7.96[d/] (0.93)	---
HOURS	1,947[c/] (130.98)	1,616[d/] (125.26)	---
Off-Farm Participation	0.44 (0.05)	0.32 (0.05)	---

[a/] n = 90 unless othewise noted.
[b/] Variables as those defined in text.
[c/] For those 40 operators who worked off-farm.
[d/] For those 29 spouses who worked off-farm.
[e/] For those 63 households with farm debt.

household characteristics, and local labor market factors. The predicted variable for hourly off-farm earnings in 1986 (LNWAGE) is obtained from a reduced form wage equation and derived as a part of the test for sample selection bias.

Among human capital attributes, AGE is a proxy for general work experience; this might be expected to increase the marginal value of an individual's time in all work activities and therefore has an indeterminate net effect on off-farm labor allocations. The length of time spent in the most recent off-farm job was obtained from the questionnaire, but this did not offer a precise measure of off-farm work experience. AGESQR was also included, considering that an individual's employability might peak at some age. Years of formal education, EDUC, indicates one form of acquired human capital. It should contribute to an individual's ability to work efficiently but the net effect on off-farm employment is also indeterminate because it may also increase marginal benefits from farm efforts. DHEALTH is a dummy variable (1 = disabled, 0 = not) indicating a physical disability that might decrease the individual's ability in some types of work.

Farm characteristics include farm debt (DEBT), gross farm income during 1986 (GFINC) and the number of farming enterprises (ENTERP). Farm debt repayment could be aided by nonfarm funds; the economic incentive to work off-farm may increase with this type of financial burden. Debt levels also indicate farm size, however, which may impose a constraint on off-farm labor allocation. GFINC could indicate both farm size and management skills; this should decrease the

amount of off-farm work although the availability of competent hired labor could allow the operator and spouse to work off-farm. (Gross income was used instead of net income because farm expense intervals on the questionnaire were too broad for precise net income determination.) ENTERP is included to capture the potential effects of diversity in the overall farm mixture. The more diverse an operation the greater the potential hedge against uncertainty; therefore, the number of farm enterprises undertaken might be negatively related to the risk level associated with mix of operations. The more risk, the greater the need to search for off-farm work, holding other variables constant.

A set of household conditions may act as constraints on work participation outside the home (Greenhalgh, 1980). The number of small children (SMCHILD) and elderly dependents (ELDEP) are expected to increase the demand for home labor. Off-farm labor income earned by the farm operator or the spouse (OFFINC) is expected to increase the off-farm reservation wage of the other because it might reduce the marginal utility from earned income. The net effect on off-farm work of the individual is unknown, however, because a spouse's off-farm earnings may be highly correlated with an operator's own set of exogenous off-farm work determinants, such as age, education and occupational preference. Finally, all other household income from nonfarm sources (OTHRINC), including retirement benefits, pensions, social security, rental income, and interest income, is expected to increase the reservation wage, thereby reducing the likelihood of off-farm work participation and the amount of off-farm work hours.

This follows directly from the non-labor income in equation (4.12).

Among local labor market characteristics, the distance (miles) to a town that might yield off-farm work (DIST) has been considered in several studies. Most have measured distance regardless of city size. The further the distance to a labor market, the greater are the commuting and information expenses. These reduce the real market wage and should reduce off-farm work. Past studies, however, have not identified other characteristics of that labor market with great precision. Here, the logarithm of the population of a town (LNPOP) is one proxy for the amount of economic activity because it indicates the off-farm demand for labor (Castle and Goldstein, 1983). The net effect of LNPOP may be indeterminate, however, because of possible increased farm profits near larger urban areas (Ruttan, 1955). The demand for food in such an area is potentially greater and reduced transportation costs may increase the productivity of farming operations. GROWTH reflects the population growth rate of the particular city the individual could work in or near from 1978 to 1985. Faster growing areas are expected to increase the number of off-farm work opportunities. These characteristics (DIST, LNPOP, GROWTH) were imputed for nonparticipants through survey questions describing the most likely location of off-farm work.

Wage Estimates

Table 4 shows the results of the wage estimation for Heckman's procedure for replacing missing observations on truncated variable distributions. The sample size was small; only 40 operator and 29

Table 4. OLS Off-Farm Wage Functions.

Variables	Operator	Spouse
n	40	29
AGE	0.0825 (0.4077)	0.0408 (0.3046)
AGESQR	-0.0008 (-0.3935)	-0.6001 (-0.0806)
EDUC	0.0462 (0.6601)	0.0304 (0.3652)
LNPOP	0.0711 (1.3954)	0.1466 (1.4884)
GROWTH	0.0047 (0.3315)	-0.0015 (-0.1825)
BIAS (λ)	0.5059 (0.3062)	-1.8221 (-1.0474)
Constant	-0.6970 (-0.1458)	-1.6172 (-0.5948)
R^2	.1548	.3593
Adjusted R^2	.0012	.1846

spouse off-farm observations were available for this part of the analysis. Independent variables in the wage function included the sample selection bias term and all demand-side variables, but not supply-side variables such as DEBT. A positive and moderately significant coefficient on LNPOP indicated that wages increased with the population of the local labor market. All other directional affects were correct as indicated by the coefficient signs, but none of the other human capital or labor market demand variables were significantly different from zero. A nonsignificant coefficient for the sample selection term was estimated in the second step of Heckman's procedure, indicating that predicted wages could be used for the Tobit labor supply estimate without sample selection bias.

Tobit Model

Results of the Tobit analysis of off-farm hours for the operator and spouse are in Table 5. The statistical basis for the results is a chi-square test for the difference in the log-likelihood between reduced and full models (Tobin, 1958). The SHAZAM econometric package was used for the analysis (White, 1978). The independent variables in the LNWAGE equation were highly correlated with those in the Tobit estimates; this introduced multicollinearity to such an extent that the matrix was not positive definite and could not be inverted. For this reason, LNWAGE could not be used in the Tobit analysis.

AGE was significant and positive and AGESQR was significant and negative for both operator and spouse. This implies that operators

Table 5. Tobit Analysis: Off-Farm Annual Hours.*

	Operators	Spouse
Human Capital		
AGE	342.34 (3.27)c/	200.97 (3.20)c/
AGESQR	-4.14 (5.22)b/	-3.03 (5.97)b/
EDUC	68.07 (0.90)	62.84 (0.29)
DHEALTH	-5277.30 (0.09)	-5335.20 (0.12)
Farm		
DEBT	-0.002 (1.36)	-.0004 (0.03)
ENTERP	45.92 (0.06)	16.39 (0.006)
GFINC	-0.007 (7.52)a/	-0.009 (5.29)b/
Household		
SMCHILD	-641.51 (1.89)d/	-705.23 (2.30)d/
ELDEP	-396.64 (0.19)	-8095.10 (1.79)
OFFINC	0.62 (0.49)	0.007 (0.20)
OTHRINC	0.01 (1.08)	-0.002 (0.01)
Nearest Town		
LNPOP	-86.23 (0.46)	-316.31 (3.41)c/
GROWTH	-22.49 (1.75)	-8.41 (0.36)
DIST	-4.55 (0.08)	10.19 (0.17)
CONSTANT	5066.60 (0.09)	243 (0.005)

* Values in parentheses are for Chi^2 (see text).

a/, b/, c/, and d/ Significantly different from zero at the .01, .05, .10, and .20 levels, respectively.

and spouses work more off-farm hours up to a peak age and then the amount of off-farm work declines. The complicated Tobit coefficients do not exhibit at what age employability peaks in the same way this could be obtained from OLS estimates.

GFINC, including farm product sales and government farm payments, was highly significant and different from zero for both operator and spouse. Increased DEBT reduced the likelihood of off-farm work for the operator but at a low level of significance. This result suggests that the financial incentive to search for nonfarm funds may not be as important for off-farm work as the effect of farm size. A measure of the farm debt/asset relationship might have been more appropriate but was not available.

The number of small children, SMCHILD, was slightly significant and reduced off-farm work by both operators and spouses. The number of elderly dependents, ELDEP, also worked in this direction for spouses. OFFINC lacked significance for either operator or spouse, thus supporting the assumption of independence between spouse and operator decisions about off-farm work. OTHRINC also lacked significance for both operator and spouse, suggesting that human capital and farm constraints were more important than nonlabor income in the off-farm work decisions.

Although growing urban areas may be important to off-farm job creation, that finding was not evident from these data. Among area characteristics, LNPOP was significant and negative in the Tobit for the spouse. This may be a result of the population dominance of Portland (379,000), relative to other cities in the region (such as

McMinnville 15,175). GROWTH was slightly significant for the operator but with a negative coefficient; those in communities with higher growth rates had a reduced likelihood of off-farm employment. The lack of significance attributed to DIST may be that operators and spouses lived too close to the towns or cities in this sample. Nearly 50 percent of the households were within seven miles of a town and only about ten percent lived more than ten miles away. This lack of variation could be avoided by better control of the geographic scope or size of the survey area.

Summary and Conclusions

This paper has sought to improve the methodology for explaining off-farm labor supply. It draws heavily on previous research but also considers the off-farm reservation wage, which is theorized to indicate at what wage an individual is indifferent between more purchased goods and increased leisure. The work participation decision yields data that are either positive, for participants, or some limiting value (zero) for nonparticipants. Past research has either used OLS to analyze the quantity of off-farm work for participants only or it has cast the dependent variable as a binary choice (zero-one). The maximum likelihood Tobit procedure has been shown to be a superior method for considering the discrete participation decision as well as the number of hours.

The empirical findings from the Tobit model showed plausible directional impacts, although estimates of off-farm wage were not used because of multicollinearity. Age and gross farm income were

significantly related to off-farm work, indicating that middle-aged individuals tended to work more off-farm hours, while greater farm income was negatively related to off-farm hours. The growth and population of the labor market surprisingly reduced off-farm work in this sample. Household care constraints such as small children imposed restrictions on the likelihood of a farm operator or spouse working off-farm. This suggests that small children and elderly dependents increase the marginal utility of time spent in work at home.

The Tobit procedure appears to be an improvement over other estimation procedures for censored and truncated data, especially OLS, and it offers flexibility in analyzing choices that also result in continuous variables, such as time allocation. An improved and larger sample could eliminate most of the problems encountered here with the estimation of off-farm wages and thus would allow the Tobit model to be viewed as a proper labor supply function in an appropriate wage-dependent form.

References

Ahearn, Mary. "Off-Farm Income and Labor Allocation of Farm Operator Households." Presented at the Annual Meeting of the Amer. Agri. Econ. Ass., Reno, NV, 1986.

Albrecht, D.E., S.H. Murdock, and K. Schifflet. "Farm Financial Stress and Level of Off-Farm Employment." Paper presented at the 49th annual Rural Soc. Society meeting, Salt Lake City, Utah, 1986.

Amemiya, Takeshi. Advanced Econometrics. Cambridge, MA: Harvard University Press, 1985.

Cain, G., and H. Watts (ed.). Income Maintenance and Labor Supply: Econometric Studies. New York: Academic Press, 1973.

Castle, E.N., and M. Goldstein. Income Distribution, Poverty, Natural Resources, and Public Policies: Conceptual and Research Issues. Presented at a Resources for the Future Workshop in Warrenton, VA, 1983.

Deaton, A., and J. Muellbauer. Economics and Consumer Behavior. New York: Cambridge University Press, 1983.

Greenhalgh, C.A. "Participation and Hours of Work for Married Women in Great Britain." Oxford Econ. Papers 32(1980):296-318.

Gronau, R. "Wage Comparisons--A Selectivity Bias." J. Pol. Econ. 82(1974):1119-1143.

_____. "Leisure, Home Production, and Work--the Theory of the Allocation of Time Revisited." J. of Pol. Econ. 85(1977):1099-1123.

Heckman, J. "Shadow Prices, Market Wages, and Labor Supply." Econometrica 42(1974):679-694.

_____. "Sample Selection Bias as a Specification Error." Econometrica 47(1979):153-161.

Heffernan, W.D., and J.B. Heffernan. Testimony prepared for a Hearing of the Joint Economic Committee of the Congress of the United States, Wash. D.C., 1985.

Huffman, W.E. "Farm and Off-Farm Work Decisions: The Role of Human Capital." Rev. Econ. and Stat. 62(1980):14-23.

Jensen, H.H., and P. Salant. "The Role of Fringe Benefits in Operator Off-Farm labor Supply: Evidence from Mississippi and Tennessee." Draft of an Unpublished Manuscript, 1985.

Kmenta, J. Elements of Econometrics, 2nd ed. New York: Macmillan Publishing Co., 1986.

Liestritz, F.L., H.G. Vreugdenhil, B.L. Ekstrom, and A.G. Leholm. "Off-Farm Income and Employment of North Dakota Farm Families." North Dakota Agri. Exp. Station Miscellaneous Report 88 (1985).

Liestritz, F.L., A.G. Leholm, H.G. Vreugdenhil, and B.L. Ekstrom. "Effect of Farm Financial Stress On Off-Farm Operators and Spouses in North Dakota." N. Central J. of Agri. Econ., 82(1986):269-282.

McDonald, J., and R. Moffit. "The Uses of Tobit Analysis." Rev. Econ. and Stat. 62(1980):318-321.

Ruttan, V.W. "The Impact of Urban-Industrial Development on Agriculture in the Tennessee Valley and the Southeast." J. Farm Econ. 37(1955):38-56.

Simpson, W., and M. Kapitany. "The Off-Farm Work Behavior of Farm Operators." Amer. J. Agr. Econ. 65(1983):801-805.

Sumner, D.A. "The Off-Farm Labor Supply of Farmers." Amer. J. Agr. Econ. 64(1982):409-509.

Tobin, J. "Estimation of Relationships for Limited Dependent Variables." Econometrica 26(1958):24-36.

U.S. Bureau of The Census. U.S. Census of Agriculture, 1982, Washington, D.C.: GPO, 1984.

White, K.J. "A General Computer Program for Econometric Methods--Shazam." Econometrica 46(1978):239-240.

CHAPTER V

SUMMARY AND CONCLUSION

This research has sought to improve the understanding of time allocations in farm households among farm work, household work, off-farm work, and leisure. An improved methodology, Tobit analysis (Tobin, 1958), has been advanced for the analysis of censored and truncated variables, specifically that exhibited in the data obtained in three Oregon counties.

First, in the interest of theoretical improvements, a reservation wage theory was adapted from that postulated by Deaton and Muellbauer (1983). The reservation wage allows discrete decisions about off-farm work at the same time that the continuous nature of the time allocation is modeled. This is equivalent to a theory that suggests corner solutions should be determined concurrently with interior solutions.

Secondly, methodological improvements center on the adaptation of Tobin's maximum likelihood estimation for censored data. The so-called Tobit model fostered the empirical analysis of both the corner and interior solutions for off-farm work. Tests for sample selection bias were undertaken in conjunction with Heckman's (1979) procedure for imputing truncated data (missing observations). In this case, wage observations were missing for those farm household members who did not work off-farm in 1986.

The data were obtained from a 1986 questionnaire distributed among 467 households. Ninety households yielded usable question-

naires. These households were generally on larger farms than those reported by the 1982 Census of Agriculture, but with similar crop/ livestock mixes.

The results from Tobit analyses of off-farm work for the operator and spouse suggested plausible directional impacts from the set of independent variables on human capital, farm, local labor market characteristics, household composition and commuting expenses. Specifically, age, and gross farm income were significantly related to off-farm work; middle-aged individuals worked more and individuals on farms with higher gross farm income worked less. The faster growth and larger populations of nearby towns surprisingly reduced the likelihood of working off-farm. Small children and elderly dependents also reduced the likelihood of working off-farm; this is the result of the time-constraints that dependents impose on farm families.

Wage estimates were obtained from a reduced form equation based on labor demand-side attributes. These results could not be used in the Tobit analysis, however, due to multicollinearity. An improved, larger sample would have possibly reduced this problem.

Further research on household time allocation might include psychometric scales for measuring occupational choice. The theory described in Chapter IV is suited to such endeavors and this would be accommodated by Tobit analysis. Development of highly sophisticated software capable of analyzing a complicated simultaneous equation system could significantly contribute to the overall analysis of time allocation. All economic decisions are interdependent, however; and

it is impossible to sort through them unless an assumption is made about past decisions which affect current situations. In this light, a sequential ordering of decisions about time allocation is probably sufficient and a single equation approach to modeling off-farm employment seems appropriate.

Bibliography

Ahearn, Mary. "Off-Farm Income and Labor Allocation of Farm Operator Households." Presented at the Annual Meeting of the Amer. Agri. Econ. Ass., Reno, NV, 1986.

Albrecht, D.E., S.H. Murdock, and K. Schifflet. "Farm Financial Stress and Level of Off-Farm Employment." Paper presented at the 49th annual Rural Soc. Society meeting, Salt Lake City, Utah, 1986.

Amemiya, Takeshi. Advanced Econometrics. Cambridge, MA: Harvard University Press, 1985.

Becker, G.S. Human Capital: A Theoretical and Empicical Analysis, with Special Reference to Education. 4th ed. New York: National Bureau of Economic Research, 1964.

Cain, G., and H. Watts (ed.). Income Maintenance and Labor Supply: Econometric Studies. New York: Academic Press, 1973.

Castle, E.N., and M. Goldstein. Income Distribution, Poverty, Natural Resources, and Public Policies: Conceptual and Research Issues. Presented at a Resources for the Future Workshop in Warrenton, VA, 1983.

Deaton, A., and J. Muellbauer. Economics and Consumer Behavior. New York: Cambridge University Press, 1983.

Green, B.L., F.K. Hines, and M.F. Petrulis. "A National Perspective on Financial Stress in Farming." Paper presented at the annual meeting of the So. Agri. Econ. Ass., Orlando, FL, 1986.

Greenhalgh, C.A. "Participation and Hours of Work for Married Women in Great Britain." Oxford Econ. Papers 32(1980):296-318.

Gronau, R. "Wage Comparisons--A Selectivity Bias." J. Pol. Econ. 82(1974):1119-1143.

_____. "Leisure, Home Production, and Work--the Theory of the Allocation of Time Revisited." J. Pol. Econ. 85(1977):1099-1123.

Heckman, J. "Shadow Prices, Market Wages, and Labor Supply." Econometrica 42(1974):679-694.

_____. "Sample Selection Bias as a Specification Error." Econometrica 47(1979):153-161.

Heffernan, W.D., and J.B. Heffernan. Testimony prepared for a Hearing of the Joint Economic Committee of the Congress of the United States, Wash. D.C., 1985.

Hewlett, J.P. "The Effect of Various Management and Policy Options on the Financial Stress Situation of Oregon Grain and Cattle Producers." Unpublished M.S. Thesis, Oregon State University, 1987.

Huffman, W.E. "Farm and Off-Farm Work Decisions: The Role of Human Capital." Rev. Econ. and Stat. 62(1980):14-23.

Jensen, H.H., and P. Salant. "The Role of Fringe Benefits in Operator Off-Farm labor Supply: Evidence from Mississippi and Tennessee." Draft of an Unpublished Manuscript, 1985.

Kmenta, J. Elements of Econometrics. 2nd ed. New York: Macmillan Publishing Co., 1986.

Leistritz, F.L., H.G. Vreugdenhil, B.L. Ekstrom, and A.G. Leholm. "Off-Farm Income and Employment of North Dakota Farm Families." North Dakota Agri. Exp. Station Miscellaneous Report 88 (1985).

Leistritz, F.L., A.G. Leholm, H.G. Vreugdenhil and B.L. Ekstrom. "Effect of Farm Financial Stress On Off-Farm Operators and Spouses in North Dakota." N. Central J. Agri. Econ. 82(1986):269-282.

Mansfield, E. Microeconomics: Theory and Applications. 4th ed., New York: W.W. Norton and Co., Inc., 1982.

McDonald, J., and R. Moffit. "The Uses of Tobit Analysis." Review of Econ. and Stat. 62(1980):318-321.

Paarlberg, D. Farm and Food Policy: Issues of the 1980's. Lincoln: University of Nebraska Press, 1980.

Ruttan, V.W. "The Impact of Urban-Industrial Development on Agriculture in the Tennessee Valley and the Southeast." J. Farm Econ. 37(1955):38-56.

Simpson, W., and M. Kapitany. "The Off-Farm Work Behavior of Farm Operators." Amer. J. Agr. Econ. 65(1983):801-805.

Steeves, A. "Mobility Into and Out of Canadian Agriculture." J. Rural Soc. 44(1979):566-583.

Sumner, D.A. "The Off-Farm Labor Supply of Farmers." Amer. J. Agr. Econ. 64(1982):409-509.

Tobin, J. "Estimation of Relationships for Limited Dependent Variables." Econometrica 26(1958):24-36.

U.S. Bureau of The Census. U.S. Census of Agriculture, 1982, Washington, D.C.: GPO, 1984.

White, K.J. "A General Computer Program for Econometric Methods--Shazam." Econometrica 46(1978):239-240.

Knaub, P.K., Draughon, P.S., et al "Employment and the Farm Impact on Life Satisfaction." Home Ec. Res. Journal 17(1), 36-46, (1988)

APPENDICES

APPENDIX A

SURVEY QUESTIONNAIRE AND FOLLOW-UP COVER LETTERS

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SURVEY QUESTIONNAIRE AND FOLLOW-UP COVER LETTERS

Questionnaire Evaluation

Several points of interest are noted as having a critical role in the evaluation of returned questionnaires. As mentioned earlier, 233 questionnaires were not used in the final analysis as the result of missing observations or because the farm operation was considered too small by Census of Agriculture standards.

Important questions for the analysis included those on income from all farming sources, including government payments; income from off-farm salary and wages, pensions, retirement funds and rental properties; human capital variables for the spouse and operator; and indications of the intensity of off-farm work, type of off-farm job and the distance to the off-farm work place of employment. Many of these were estimated for the subsample of farmers not observed working off-farm.

It was equally important, for policy and comparability, that the household fit a commonly accepted definition of a farming operation. According to the Census of Agriculture, a farm must have sales equal to or in excess of $1,000 of farm products to be described as a farm. Several of the respondents for this study were either in the process of retiring or were landlords. Many of the respondents did not consider themselves farmers if they were only involved in the ownership of the land and did not contribute to the actual farming effort.

Several respondents indicated that they were retired; they were still included in the estimation if they met the sales definition for farming. The large number of retired farmers not meeting the sales criterion, along with the small response rate is an indication of the need for a more current mailing list for sampling purposes.

OREGON'S FARMERS AND OFF-FARM WORK

▶ DID YOUR FAMILY SELL ANY FARM PRODUCTS IN 1986? (Circle one number)

1 NO ▶ Since our survey is of families who sold farm products in 1986, this questionnaire does not apply to you. Please return it in the envelope provided, and thank you very much!

2 YES, SOLD FARM PRODUCTS IN 1986 (Please continue with Question 1)

1. Do you live on the farm you operated in 1986? (Circle one number)

   1 NO
   2 YES

2. Please describe the location of this farm. (For example: 5 mi. SW of Salem)

   _____FARM LOCATION

3. How many acres, altogether, are in this farm?

   _____TOTAL NUMBER OF ACRES

4. About how many years, altogether, have you, yourself operated this farm at its current location?

   _____TOTAL YEARS OPERATED BY YOU

5. Like most other businesses, we know that farmers often need to borrow money. With this in mind, please indicate what you owned free and clear, and what you had a loan outstanding for in 1986. Please give the amount of the outstanding debt, if any.

	OWN DEBT-FREE?	LOAN OUTSTANDING?	DOLLAR AMOUNT OF DEBT
a. Livestock	1	2	$_____
b. Farm equipment . . .	1	2	$_____
c. Land and buildings .	1	2	$_____

6. Many farmers have had financial problems with recent drops in land values and commodity prices paid to farmers. During 1986, did your family experience any hardships as a result of financial conditions you experienced while farming? (Circle one number)

   1 NO, DID NOT
   2 YES, EXPERIENCED PROBLEMS/HARDSHIPS

   ▶ 6a. Would you briefly explain these problems and/or hardships?

7. Which one of the following best represents your estimate of total cash operating expenses in 1986, including such things as chemicals, hired labor, feed, taxes, and interest? (Circle one number)

01	LESS THAN $2,000	07	$20,000 TO $39,999
02	$2,000 TO $2,999	08	$40,000 TO $69,999
03	$3,000 TO $3,999	09	$70,000 TO $99,999
04	$4,000 TO $4,999	10	$100,000 TO $149,999
05	$5,000 TO $9,999	11	$150,000 TO $199,999
06	$10,000 TO $19,999	12	$200,000 OR OVER

(PLEASE TURN THE PAGE)

8. Please indicate what crops and livestock you grew and sold in 1986. Also, please give your best estimate of total cash receipts for each type you did sell.

		Grew and Sold? NO	YES	TOTAL CASH RECEIPTS
a.	Grain crops	1	2	$
b.	Grass and legume seed crops	1	2	$
c.	Vegetable crops	1	2	$
d.	Fruits, nuts or berries	1	2	$
e.	Nursery or greenhouse plants	1	2	$
f.	Peppermint or hops	1	2	$
g.	Poultry	1	2	$
h.	Dairy	1	2	$
i.	Beef	1	2	$
j.	Hogs	1	2	$
k.	Sheep	1	2	$
l.	Other (Specify_____)	1	2	$

9. Which one of the following best describes your off-farm work situation in 1986?

1 NEITHER OPERATOR NOR SPOUSE WORKED OFF-FARM (Skip to Question 10)
2 ONLY OPERATOR WORKED OFF-FARM
3 ONLY SPOUSE WORKED OFF-FARM
4 BOTH OPERATOR AND SPOUSE WORKED OFF-FARM

9a. How many off-farm jobs did you have in 1986?

a. Operator . . . . . _____NUMBER OF JOBS
b. Spouse . . . . . _____NUMBER OF JOBS

9b. Considering now only your main off-farm job in 1986, was this work seasonal or year-round? (Circle one number)

	SEASONAL	YEAR-ROUND
a. Operator	1	2
b. Spouse	1	2

9c. Did you work for others or were you self-employed in your 1986 off-farm work? (Circle one number)

	SELF-EMPLOYED	WORKED FOR OTHERS	BOTH
a. Operator	1	2	3
b. Spouse	1	2	3

9d. In the table below please indicate in or near what city or town this job was located, give the number of miles it is from your home to this job one way, and about how many minutes it took you to drive this distance.

	NAME OF CITY/TOWN	MILES ONE-WAY	MINUTES ONE-WAY
a. Operator	_____	_____Mi.	_____Min.
b. Spouse	_____	_____Mi.	_____Min.

9e. Please describe the specific type of work you did in 1986 for your off-farm employment and indicate the general type of industry (forestry, retail, etc.).

	TYPE OF WORK	INDUSTRY OR TYPE OF BUSINESS
a. Operator	_____	_____
b. Spouse	_____	_____

(PLEASE GO ON TO NEXT PAGE)

9f. In the table below, please indicate the year you began working at your main 1986 off-farm job, the average hours worked per week, and the total number of weeks worked at this job in 1986.

	YEAR JOB BEGAN	AVERAGE HOURS PER WEEK	TOTAL NUMBER OF WEEKS WORKED
a. Operator . . .	_____	_____	_____
b. Spouse . . .	_____	_____	_____

9g. Please give your hourly wage or monthly salary for this job. (Circle monthly or hourly, as appropriate)

a. Operator . . . $_____(HOURLY) (MONTHLY)
b. Spouse . . . $_____(HOURLY) (MONTHLY)

9h. In the table below are benefits some people receive when employed. Please indicate whether or not you received these benefits from your 1986 off-farm job. (Circle one number for each benefit)

	Operator?		Spouse?	
	YES	NO	YES	NO
a. Paid vacation	1	2	1	2
b. Paid sick leave	1	2	1	2
c. Employee discount	1	2	1	2
d. Life insurance	1	2	1	2
e. Retirement plan	1	2	1	2
f. Profit sharing	1	2	1	2
g. Health insurance for yourself . .	1	2	1	2
h. Health insurance for your spouse.	1	2	1	2
i. Meals	1	2	1	2
j. Other (Specify_____)	1	2	1	2

9i. In the next couple of year, do you think you will be working off the farm more, less, or about the same as you did in 1986? (Circle one number)

	MORE	LESS	SAME
a. Operator	1	2	3
b. Spouse	1	2	3

(PLEASE SKIP NOW TO QUESTION 11)

10. There are a number of reasons why some farm operators decide not to work off-farm. Please indicate whether or not each of the following was a reason for you to decide not to work off-farm in 1986. (Circle one number for each)

	Operator?		Spouse?	
	YES, A REASON	NOT A REASON	YES, A REASON	NOT A REASON
a. Poor health	1	2	1	2
b. Children too young to leave . .	1	2	1	2
c. Spouse objected	1	2	1	2
d. I looked for off-farm work but couldn't find any	1	2	1	2
e. Not many jobs in my area . . .	1	2	1	2
f. Prefer working in my home . . .	1	2	1	2
g. Prefer farm work	1	2	1	2
h. Need more training/skills . . .	1	2	1	2
i. The jobs are too far away . . .	1	2	1	2
j. I am retired	1	2	1	2
k. Other (Specify_____)	1	2	1	2

(PLEASE TURN THE PAGE)

10a. If you had decided to work off-farm in 1986, in what town or city would you most likely have worked, or looked for work? Also give the number of miles one-way from your farm residence to this town or city.

	TOWN OR CITY	MILES ONE-WAY
a. Operator	_____	_____Mi.
b. Spouse	_____	_____Mi.

11. To give us a better idea of the needs of farm families in the state, we would like to know something about the make-up of your household. In the table below, please list the relationship of family members (spouse, father, daughter, friend, etc.) who live at your farm residence. Also please give the age of each person, the highest level of education obtained and whether the individual is male or female. (Please start with the farm operator)

HOUSEHOLD MEMBER	RELATIONSHIP TO OPERATOR	AGE (In years)	EDUCATION (In years)	Sex: (Circle one) MALE	FEMALE
1	Operator	_____	_____	1	2
2	_____	_____	_____	1	2
3	_____	_____	_____	1	2
4	_____	_____	_____	1	2
5	_____	_____	_____	1	2
6	_____	_____	_____	1	2

12. Please indicate your household's income before taxes from each of the sources listed below, for 1986. If "none" for any source, please write "0". Just your best estimate is fine.

	GROSS INCOME
a. Off-farm wages and salaries	$_____
b. Off-farm self-employment income	$_____
c. Interest and dividends	$_____
d. Rental income	$_____
e. Social Security	$_____
f. Other retirement income	$_____
g. Payments from government farm programs .	$_____
h. Other (Specify_____)	$_____

13. Is there anything else you would like to say about farming in Oregon, off-farm employment, or this questionnaire?

(THANK YOU FOR YOUR COOPERATION)

About a week ago, a questionnaire seeking your participation in a survey about off-farm employment was mailed to you.

If you have already completed and returned the questionnaire to us, please accept our sincere thanks. If you have not, please do so today. Because the questionnaire has been sent to only a small, but representative, sample of Oregon households, it is extremely important that your answers be included in the study, if the results are to accurately represent the opinions and conditions of families involved in farming and off-farm employment.

If by chance you did not receive the questionnaire, or it was misplaced, please call me collect (503) 754-2942 and we will mail you another one right away.

Sincerely,

Joe B. Stevens
Study Director

Department of
Agricultural and
Resource Economics

Oregon State University

Corvallis, Oregon 97331-3601 (503) 754-2942

February 26, 1987

Dear Oregon Farmer:

In light of the concern these days about farm incomes, we are conducting a survey on the role of off-farm employment by farmers.

Along with several hundred others, your name has been selected in a sample of farmers in Washington, Yamhill and Polk counties. We would very much appreciate your assistance in filling out the enclosed questionnaire for your household. It should only take a few minutes. Your answers for your household are needed. There is no way we can substitute for the answers you provide.

Your responses will be confidential. The only reason your questionnaire is numbered is to avoid sending reminders to people who have already returned theirs. The results of the survey will be summarized for all households, not for any one household or neighborhood.

We believe that this survey will be important to Oregon farmers. The Survey Research Center at OSU is helping us collect the data. Please fill out your questionnaire and return it to them promptly in the enclosed postage-paid envelope.

If you have any questions about the survey, please feel free to contact Doug Doyle or myself at 754-2942.

Thank you for your cooperation.

Sincerely,

Dr. Joe B. Stevens
Survey Director

JBS/dd
Enclosures

Department of
Agricultural and
Resource Economics

Oregon State University

Corvallis, Oregon 97331-3601 (503) 754-2942

March 12, 1987

Dear Oregon Farmer:

I am writing to you about our study of Oregon farming and off-farm employment. If our records are correct, we have not received your completed questionnaire.

The large number of questionnaires that have been returned is very encouraging, but the success of the study depends upon you and the others who have not yet responded.

To our knowledge, this is the first study of off-farm employment by Oregon farmers, at least in recent years. Therefore, the results are of particular importance to policy makers and farm households who now make decisions about farming.

If our previous correspondence did not reach you, a replacement questionnaire is enclosed. May I urge you to complete and return it as quickly as possible? Thank you!

Sincerely,

Dr. Joe B. Stevens
Survey Director

JBS/dd
Enclosures

Department of
Agricultural and
Resource Economics

Oregon State University

Corvallis, Oregon 97331-3601 (503) 754-2942

April 2, 1987

Dear Oregon Farmer:

Last month I wrote to you seeking information about Oregon farming and off-farm jobs. As of today, we have not yet received your completed questionnaire.

Our research unit has undertaken this study because we think that reliable information is needed about opportunities for employment off the farm by Oregon's farm households.

I am writing to you again because each questionnaire is crucial to the success of this study. Your household was drawn through an equal probability sampling process. This means that only a small number of people are being asked to complete this questionnaire. In order for the survey results to be truly representative, it is essential that each household in the sample return his or her questionnaire.

In case your questionnaire was misplaced, another is enclosed. Your contribution to the success of this study is greatly appreciated. Please call Doug Doyle or myself at 754-2942 if we can answer any questions about the questionnaire or the study.

Sincerely,

Joe B. Stevens
Survey Director

JBS/dd
Enclosures

APPENDIX B

DESCRIPTIVE STATISTICS FOR THE SURVEY AREA

APPENDIX B

DESCRIPTIVE STATISTICS FOR THE SURVEY AREA

Debtors

Table B.1 indicates the differences between farm households in our sample with farm debt and those without farm debt. Sixty-three of the farm households had farm debt, while only 27 were debt-free. The farm house-holds with debt had an average number of acres (200) almost twice the average number of acres (105) of the debt-free households. Note by inspection that those farm operators and spouses with debt were typically younger and had more education than those without debt. Farm households with debt had a significantly larger percentage of both operators and spouses working off-farm than those households that were debt-free. This result is contrary to the finding from the Tobit estimation indicating that debt lacked significance as an explanatory variable in the off-farm annual hours function. This is likely the result of a correlation between debt levels and age.

Off-farm

Table B.2 indicates the differences between farm households in our sample with an operator engaged in off-farm work and those without an operator working off-farm. Note specifically that farm households with an operator off-farm were substantially different in terms of farm debt and farm sales. Also note that 53 percent of the

Table B.1. Indebted Households vs. Debt-free Households.

	Farm Indebted Households	Farm Debt-free Households
n	63	27
Acres	200.73 (326.47)	105.52 (97.351)
Operator AGE	51 (11.3)	61.66 (11.9)
Spouse AGE	46.6 (14.4)	59 (13.4)
Operator EDUCATION	13.4 (2.6)	11.6 (4.86)
Spouse EDUCATION	12.7 (3.2)	11.3 (4.6)
Farm DEBT	$130,000 (239000)	0 0
Farm SALES	$81,130 (170150)	$83,669 (110260)
% Operators work off-farm	47%	37%
% Spouses work off-farm	38%	18.5%
YEARS farming	16	25.7

* Values in parentheses are standard deviations.

Table B.2. Farms With and Without Operator Working Off-Farm.

	Operator Off-farm	Operator Farm Only
n	40	50
Acres	156.8 (263.2)	184.5 (296.5)
Operator AGE	54.9 (11.5)	53.7 (13.5)
Spouse AGE	48.6 (15.9)	51.7 (14.5)
Operator EDUCATION	13.35 (3.04)	12.5 (3.8)
Spouse EDUCATION	12.92 (3.63)	11.78 (3.68)
Farm DEBT	$106,670 (170280)	$78,460 (235270)
Farm SALES	$32,676 (88165)	$121,126 (182590)
% Spouses work off-farm	53%	16%

* Values in parentheses are standard deviations.

spouses worked off-farm when the operator did, while only 16 percent of the spouses worked off-farm if the operator did not. This suggests a certain amount of interdependence between household members. The off-farm income of an operator was not a significant variable in the determination of spouse off-farm work, however, according to the Tobit estimation. This may be the result of the explanatory power of age and education, farm sales and household composition, which were similar in households that did exhibit off-farm work.