

LABOR ALLOCATION DECISIONS

OF

VIRGINIA'S FARM FAMILIES

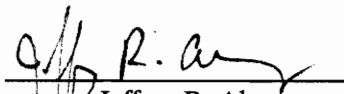
by

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(ABSTRACT)

Using data collected by the Virginia Agricultural Statistical Service in 1989, off-farm labor participation models were developed to identify factors that influence the probability that a farm operator or spouse in Virginia would choose to work off the farm. The sample indicated that a substantial proportion of Virginia farms had at least one member working off the farm. Higher total incomes were also earned by families with an operator and/or spouse working off the farm. In addition, the proportion of total income originating from off-farm sources was large regardless of whether the operator or spouse worked off the farm or not. As a result of this survey, the picture developed of farm operators and spouses in Virginia is different than a traditional view of farming would support.

Because of the dichotomous dependent variable and the different responses expected from the operator and spouse, probit analysis was selected to estimate

separate participation models for the farm operator and spouse. The empirical results reveal that human capital, labor supply and labor demand characteristics influence the off-farm employment decisions of both the operator and spouse, though not in a uniform manner. Additionally, variables found to be important to off-farm labor force participation were primarily not farm specific. Changes in the non-farm economy are expected to affect the majority of Virginia farms more than changes in the farm economy. It is also clear that the majority of farm families in Virginia have a vested interest in efforts made to develop and strengthen the local economy.

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Table of Contents

Chapter 1. Introduction	1
1.1. Labor Market Linkage	1
1.2. Farm Family Income and Its Influence	3
1.3. Problem Statement	5
1.4. Objectives	6
1.5. Operator/Spouse Distinction	6
1.6. Data and Technique	7
1.7. Thesis Organization	8
Chapter 2. Theoretical Framework	9
2.1. Theoretical Development	9
2.2. General Model Specification	21
Chapter 3. Empirical Model	23
3.1. Model Building	23
3.2. Human Capital Characteristics	25
3.2.1. Age	25

3.2.2. Education	26
3.2.3. Non-Farm Vocational Training	29
3.2.4. Sex	30
3.2.5. Off-Farm Work Experience	31
3.2.6. Farm Work Experience of the Operator	32
3.3. Labor Supply Factors	33
3.3.1. Children Under Six	34
3.3.2. Children 6 to 13	35
3.3.3. Children 14 to 18	37
3.3.4. Net Farm Income	38
3.3.5. Unearned Income	39
3.3.6. Partner's Off-Farm Income	40
3.3.7. Farm Objectives	42
3.4. Labor Market Demand Factors	44
3.4.1. Structural Variables	47
3.3. Summary	49
Chapter 4. Sample Characteristics	51
4.1. The Data	51
4.2. Farm Characteristics	58
4.2.1. Working Hours	58
4.2.2. Farm Objectives	61
4.2.3. Farm Acreage	62
4.2.4. Farm Activities	63

4.2.5. Farm Assets	66
4.2.6. Gross Farm Sales	66
4.3. Operator and Family Characteristics	67
4.3.1. Characteristics of the Operators	67
4.3.2. Number of Children	69
4.3.3. Family Income	70
4.3.4. Summary of Operator Characteristics	72
4.4. Classification of farms by spouse	73
4.4.1. Characteristics of the Spouses	74
4.4.2. Number of Children	76
4.4.3. Working Hours	77
4.4.4. Family Income	78
4.4.6. Summary of Spouse Characteristics	80
Chapter 5. Model Specification, Estimation and Analysis.	82
5.1. Model Specification	82
5.2. Farm Operators' Model Analysis	85
5.2.1. Human Capital Characteristics	89
5.2.2. Labor Supply Factors	92
5.2.3. Labor Market Demand Factors	95
5.3. Farm Spouse's Model Analysis	97
5.3.1. Human Capital Characteristics of the Spouse	101
5.3.2. Labor Supply Factors	102
5.3.3. Labor Market Demand Factors	105

5.4. Summary	105
Chapter 6. Policy Implications and Conclusions	111
6.1. Human Capital Characteristics	111
6.2. Labor Market Demand Factors	115
6.3. Labor Supply Factors	117
6.4. Agricultural Policy in Virginia	121
6.5. Rural Policy	123
6.6. Future Research	125
References	129

List of Tables

TABLE 1. Comparison of Gross Farm Sales, Sample and Population.	53
TABLE 2. Comparison of Acres Owned and Rented, Sample and Population.	54
TABLE 3. Comparison of the Off-Farm Employment of the Operator, Sample and Population.	55
TABLE 4. Comparison of the Farm Operator's Age, Sample and Population.	56
TABLE 5. Annual Hours Worked, On and Off the Farm.	59
TABLE 6. Farm Objective by Farm Type.	61
TABLE 7. Farm Acreage by Farm Type.	63
TABLE 8. Major Source of Income by Farm Type.	64
TABLE 9. Farm Assets and Gross Farm Sales by Farm Type.	66
TABLE 10. Average Characteristics of Operators.	68
TABLE 11. Average Characteristics of Operators, Dummy Variables.	69
TABLE 12. Average Number of Children per Family by Child Age Group.	70
TABLE 13. Average Income by Operator.	71
TABLE 14. Characteristics of Spouses.	75
TABLE 15. Average Characteristics of Spouse, Dummy Variables.	75

TABLE 16. Average Number of Children per Family by Child Age Group.	76
TABLE 17. Annual Hours Worked by the Spouse.	77
TABLE 18. Average Income by Spouse.	79
TABLE 19. Means of Variables Included in the Operator Model	86
TABLE 20. Probability that the Operator Works Off the Farm, Binomial Probit Model	
Results	87
TABLE 21. Means of the Variables Included in the Spouse Model	98
TABLE 22. Probability that the Spouse Works Off the Farm, Binomial Probit Model	
Results.	99

Chapter 1. Introduction

Since the late 1970's, a broadening stream of research has focused on the allocation of farm household labor, particularly between farm and off-farm activities. The decision of a household member to work on the farm, off the farm, or both is the result of a complex and interrelated process. While it is not surprising that research in this area has been diverse in both emphasis and approach, the importance of these labor decisions to the agricultural sector and to the rural sector have been consistently underscored.

1.1. Labor Market Linkage

Where the farm family was once linked to the rural community primarily through farm support services and social interaction, over the past several decades greater community involvement has developed through stronger ties to the labor

market. Carlin and Green show a relationship between farm structure¹ and the rural community, indicating a two-directional linkage where a change in one affects the other. Research by others support this two-way linkage as well (Shaffer, Salant and Saupe; Singh and Williamson; Henderson, Tweeten and Schriener; and Taylor and Woods).

Wimberley, looking at the structural trends in U.S. agriculture, found an increasing proportion of farm operators are employed off the farm and consider farming not to be their primary occupation. Many farm operators with off-farm jobs have not selected off-farm employment as a means of transition in or out of agriculture or as an emergency measure to provide the over-extended farm with operating capital. More often, the decision to work off the farm has been a deliberately selected, long-term choice (Stallmann; Pfeffer; Mage; Hallberg, Findeis and Lass).

Compared to the nation, Virginia has a greater proportion of small farms; over 65 percent generated an agricultural product value of less than \$10,000 annually in 1987 and 71 percent were under 180 acres (Census of Agriculture). The proportion of operators whose primary occupation was not farming was greater as well (54% vs 45%).

Over the 1974-1987 period, the number of Virginia's reporting farm operators who worked off the farm increased by only three percent (59% to 61%). Of those

¹ Farm size (by gross farm sales) and proportion of small farms (under \$40,000) in the county.

working off the farm from 1974 to 1987, however, almost 70 percent worked off the farm more than 200 days (the equivalent of a full-time job). These figures underestimate farm family involvement in the off-farm labor force, however, by considering only the employment of the operator. The spouse, whose contribution to family income and participation in the labor force is significant and increasing² is not included in Census of Agriculture data.

1.2. Farm Family Income and Its Influence

While involvement by the farm household in the off-farm labor force is on the increase, agriculture is declining as a source of rural employment and rural income (Oliveira). Between 1978 and 1987, the number of farms in Virginia declined by over 10 percent while hired farm labor expenses declined in real terms by almost 14 percent, a decline per farm of almost 4 percent (Census of Agriculture). The reduction in both the number of farms and the hired farm labor expenses per farm underscores the decline in agriculture as an employment source. Additionally, the majority of Virginia's farm families generate the majority of their annual income from off-farm sources. From 1980 to 1988, annual off-farm income (on average) equaled almost 3.6 times the net farm income (Center for Public Service).

² Huffman; Buttel; Spitze and Mahoney.

The influence of an off-farm job held by the farm operator should directly affect the operation of the farm by limiting on-farm management and work time. It should additionally affect the farm operation by reducing income variability and risk (Sumner) and providing farm operating/development capital (Coughenour and Swanson). When the spouse works off the farm, the influence on the farm operation should be similar, reducing hours and income variability while providing operating capital. No impact on the management of the farm operation, however, is expected when the spouse chooses to work off the farm.

It has been additionally noted (Bishop; Lee; Bollman) that farm families are not operating inefficient farms in terms of labor allocation and production when the operator [and/or spouse] is working off the farm.

The income structure of the farm makes the off-farm labor decisions and motives of the farm family relevant to the agricultural sector; as producers, regional suppliers of agricultural products, agricultural input consumers, and international competitors. Off-farm labor decisions also affect the rural sector where family disposable income and supply of labor affect the tax base, local business and service continuance and, in some instances, industrial location decisions (Carlin and Green; Taylor and Woods; Henderson et al.). A viable farm operation can also contribute positive economic, social and environmental benefits (as well as problems) to the local community and state at large (Gasson; Singh and Williamson).

Substantial diversity in farm and in rural communities exists between states, as well as regionally within state borders. It is not surprising that, among national, state, and county level off-farm labor studies, findings have been mixed. Additionally, not since Hummel and Hummel's work in the late 1930's has there been research into the off-farm labor force participation of farm operators in Virginia, and no Virginia studies have been conducted regarding the labor force participation of the farm spouse. An accurate picture of farm families and the factors that influence their participation in the off-farm labor market is necessary for the realistic design and implementation of both farm and rural policy.

1.3. Problem Statement

The traditional commitment to long-term off-farm employment by Virginia's farm operators and the consistently high proportion of operators working off the farm full-time, compared to national data, make the usefulness of off-farm labor results from other states of dubious value when applied to Virginia. Research to determine which factors influence off-farm employment of the farm operator in Virginia is therefore necessary. In addition, because comparatively less research has been done on the farm spouse than the operator, and because of the increasing contribution the spouse makes to family income, factors influencing the off-farm employment choice of the spouse in Virginia is also of importance.

1.4. Objectives

The primary objective of this research is to identify factors that influence the probability that a farm operator or spouse in Virginia would choose to work off the farm. Individual off-farm labor participation models will be developed for the farm operator and farm spouse. The effect that a change in these factors will have on the probability that the operator and spouse work off the farm will also be evaluated.

1.5. Operator/Spouse Distinction

The farm spouse, whose contribution to family income has already been noted, was generally neglected in studies modeling farm labor prior to the 1980's. Since that time, the farm spouse has been modeled as a factor in the operator's off-farm participation decision (Huffman; Sumner, 1982; Van Kooten and Arthur), as an independent decision maker (Furtan, Van Kooten and Thompson; Reddy and Findeis; Leistritz et al.), and as a part of a joint or simultaneous decision process (Smith; Huffman and Lange; Lass, Findeis and Hallberg, 1989).

In most studies, Furtan, Van Kooten and Thompson being the exception, the farm operator is either explicitly or implicitly assumed to be male. While not always the case, the assumption that the majority of farm operators are male is consistent with Virginia's Census of Agricultural data. In 1978, 1982, and 1987, the percentage

of female farm operators recorded as being female were 7.4, 7.8, and 8.5 percent respectively. The female farm spouse/operator is typically offered a lower off-farm wage and traditionally has both a greater responsibility for child rearing and a different set of labor and social expectations than does the male farm operator/spouse (Coughenour and Swanson; Spitze and Mahoney). For the reasons stated above, the farm spouse's participation in the off-farm labor market is expected to be influenced differently, by a similar set of factors, than the farm operator.

1.6. Data and Technique

A randomly selected sample of Virginia farms was contacted by the Virginia Agricultural Statistical Service in the fall of 1989. Telephone interviews were conducted with the operator or spouse, and 785 complete responses were obtained. This primary data will comprise the major portion of the project data set.

In the participation probability model, because of the dichotomous dependent variable, a probit model will be estimated. The significance of factors expected to influence the farm operator's and spouse's decision to participate in the off-farm labor market will be estimated.

1.7. Thesis Organization

The remaining portion of this thesis is divided into five sections. Chapter 2 builds the theoretical framework of this study with a review of appropriate literature. Chapter 3 presents the empirical model, and defines the relevant variables. Chapter 4 describes the data and data collection. Chapter 5 discusses the model specification and the empirical results. The final section, Chapter 6, summarizes the results and discusses their policy implications.

Chapter 2. Theoretical Framework

The primary objective of this research is to identify factors which influence the probability the farm operator or farm spouse will choose to work off the farm. Individual off-farm labor participation models for the operator and the spouse will be developed to that end.

2.1. Theoretical Development

In the building of a general model, how an individual (a farm operator or farm spouse) chooses among work activities and leisure to gain the highest level of satisfaction needs to be specified and basic assumptions about choice and preference need to be made. The assumptions, while purposely simplifying conditions existing in the world, will provide a manageable way of better understanding decision-based labor relationships.

Underlying consumer theory is the postulate that the individual makes choices based on self interest. The individual is additionally assumed to have a set of

preferences for any given set of choice alternatives. These choice sets, or consumption bundles, can be ranked in order of preference by the individual.

Utility (the level of satisfaction) is an ordinal ranking of preferences, and the individual is assumed to make choices that will maximize his/her utility. Utility is typically derived from the consumption of goods and services and the allocation of time to leisure. An indifference curve, a map of all consumption and leisure bundle combinations among which the individual is indifferent, shows the rate of substitution between consumption and leisure when a fixed level of individual utility is maintained.

A formal utility maximization model can be specified by:

$$\text{Max}U=U(C_i,L_i;H_i,V) \quad (1)$$

Where C is the consumption of (j) goods and services and L is the leisure time consumed by (i) individuals. Two exogenous factors, human capital (H_i) and household characteristics (V), are also expected to affect utility through tastes, preferences and goals.

Chayanov, looking at Russian peasant households prior to 1920 was one of the earliest to use marginal utility to evaluate farm household labor allocation. Becker (p.163) summarizes Chayanov's work, ". . . each rural farm household assigned labor to activities until the household's subjective evaluation of the disutility of work

equalled its estimate of the marginal utility of goods gained." Leisure and consumption were adjusted until equal at the margin.

Chayanov included the possibility of the farmer working off the farm and observed that off-farm opportunities (crafts and trades) appeared to influence the organization of the farm (Thorner, Kerblay and Smith). Rozman (p.105), about a decade later, in a descriptive analysis of Massachusetts farms with operators who worked off the farm, concluded that time allocated to agriculture was dependent upon several factors, one of which was the "... condition [or type] of outside employment."

Lee, in 1965, approached the decision of the farm operator to allocate labor off the farm from a theoretical perspective and suggested this decision could be both income maximizing and a rational, efficient use of labor resources. Bollman, in the late 1970's, similarly concluded that the allocation of labor off the farm does not necessarily indicate labor resources are being allocated inefficiently.

Lee applied utility maximization from consumer theory, subject to income and time constraints, in conjunction with a leisure-income farm transformation function to illustrate labor allocation in a static framework. He assumed the farm had diminishing marginal returns to labor, and constant marginal returns were assumed off the farm. Bollman, looking at the supply and demand side of farm labor allocation, illustrated a "kinked demand for labor curve" facing the farm operator concluding that this single (kinked) demand curve was a product of both diminishing

marginal returns to labor on the farm and a constant off-farm wage. In both cases, an equilibrium allocation of labor was defined where the marginal return to labor on the farm was equal to the marginal return to labor off the farm (the off-farm wage rate).

Certain restrictions are imposed on the individual's choice of bundle alternatives when maximizing utility is the goal. A budget constraint restricts the bundle choices available to the individual to affordability. Prices can be attached to the good or goods in each consumption bundle, and the maximum affordable combination of goods can be described by a budget line. The budget line shows the rate of trade, good for good (or bundle for bundle) in the market at given prices. The individual will choose to consume a combination of goods that provides the highest possible level of utility subject to the individual's budget constraint and desire for leisure. Maximization of utility can be described graphically when the slope of the budget line (the income constraint) is equal or tangent to the slope of the indifference curve.

Income, which with prices, defines the budget constraint, is generated by off-farm employment, farm production activities and unearned income (dividends, interest, pensions). The off-farm (or market) wage can be specified by:

$$\text{Market Wage} \qquad w_i = w(H_i, E) \qquad (2)$$

Where the market wage (w_i) is a function of the individual's human capital (H_i) (a composite of the level of education completed, job skills, job experience, sex and age) and labor market demand (E) (including factors that affect employment opportunities such as the unemployment rate, and the number and type of available jobs).

Net farm income is earned as a result of farm production activities, and is specified by:

Net Farm Income

$$N = \sum_{h=1}^m q_h Q_h - \sum_{k=1}^n x_k X_k \quad (3)$$

Net farm income (N) is equal to the sum of total farm output (Q_h) times the price of that output (q_h) where $h = 1, \dots, m$, less the sum of variable production inputs (X_k) times the cost of those inputs (x_k), where $k = 1, \dots, n$.

The operator and spouse choose to allocate their labor resources between income earning (farm/off-farm) and non-income earning (housework/leisure) activities. Total family income constrains the present and future purchase of consumption goods and services.

A constraint to net farm income, the farm production function, is specified by:

Production Function

$$Q_h = Q(F_i, X_k; H_i, Z) \quad (4)$$

Where total farm output (Q) is a function of the operator and spouse's farm labor input (F_i), and all other variable inputs (X_k) (including hired labor). The productivity of these variable inputs are dependent upon the individual's managerial and physical abilities (H_i) (components of human capital) as well as production technology and environmental factors (Z), each considered fixed over the short run.

The budget (or income) constraint to utility maximization, where the production function has been incorporated for simplicity (see Huffman and Lange), is specified by:

Budget Constraint

$$\sum_{j=1}^p c_j C_j \leq \sum_{h=1}^m q_h Q(F_i, X_k; H_i, Z) - \sum_{k=1}^n x_k X_k + \sum_{i=1}^2 w_i W_i + D \quad (5)$$

The costs (c_j) of consuming purchased goods and services (C_j) are less than or equal to the value of net farm income (Σq_hQ (F_i, X_k; H_i, Z) - Σx_kX_k) plus off-farm income (Σ w_iW_i) and unearned income (D).

Time also acts as a constraint, as Lee observed, limiting the hours an individual can work and the hours that can be allocated to housework and leisure. In this study, it is the operator and spouse whose housework/leisure is assumed to determine the housework/leisure portion of the family's utility level (Lass, Findeis and Hallberg, 1989; Smith).

The time constraint can be specified as follows:

Time Constraint

$$\begin{aligned} T_i &= W_i + F_i + L_i, \\ \text{where } W_i &\geq 0, F_i > 0, L_i \geq 0, \\ i &= 1, 2 (\text{operator, spouse}) \end{aligned} \quad (6)$$

Total time (T) for family member (i) is equal to the hours worked off the farm (W_i) plus the hours worked on the farm (F_i) plus the hours of housework and leisure (L_i). Off-farm labor is allowed to equal zero for the operator or spouse, or both. The operator must allocate some labor to farm production activities, but the spouse has the option to do so or not.

While not addressing farm labor directly, Shisko and Rostker (1976) examined the labor supply function of individuals working two wage jobs. They used utility maximization subject to time and income constraints (as did Lee), but assumed constant marginal returns to labor for all work (because all work was wage work). They showed graphically and mathematically how a second wage-job supply function for labor responds to changes in both the primary and secondary wage rates. One of their hypotheses was that an "individual's willingness to take a second job depends on whether the individual can work enough hours at the prevailing primary wage rate to satisfy their income goals" (p.298). In other words, a second job will be taken if its marginal value product (the wage rate, for constant returns) is above the marginal value of leisure.

Leisure is assumed to be chosen over work until the individual is offered a wage above his/her reservation wage. This reservation wage is the individual's

marginal value of leisure. The decision to work depends on the level of the reservation wage, which varies between individuals and is a function of unearned income, other family income and both family and human capital characteristics. When the offered wage exceeds the reservation wage the individual chooses to work, and the decision of which type of work to engage in then depends on the marginal value product of labor (MVP_i). Where no off-farm work is observed but the individual allocates some time to farm work, the reservation wage should be equal to the marginal value of farm work. For the individual allocating time to housework/leisure, on farm work and off-farm work, the reservation wage and the marginal value of farm work should equal the observed off-farm wage rate (net of commuting costs). This can be expressed as $MVP_i^L = MVP_i^F = MVP_i^W$.

When the marginal value product of labor for one income earning activity is greater than that of the other (subject to time and flexibility constraints), the individual (operator or spouse) will shift labor resources to the activity that returns the highest marginal value product of labor. This is based on the idea that the individual is motivated to maximize income per labor unit expended and that time allocated to one income-earning activity (farming or working off the farm) reduces the time available to engage in the other (Leistritz, et al.; Sumner, 1982). While the adjustment of leisure and household work between family members may influence the labor shift between farm and off-farm activities (Sumner, 1982), the difficulty and cost of measurement usually preclude their examination outside of theory.

When the hours allocated to the choice activities (housework/leisure, on-farm work and off-farm work) are all positive and non-zero for the individual, the optimal utility maximizing solution is an interior solution. This simply means that the individual chooses to invest some time in each of the three choice activities; no activities have a negative or zero value at the optimum. The interior solution can be determined by taking the first order conditions (FOC) of equation (1), subject to equations, (5) and (6) (Huffman and Lange; Furtan, Van Kooten and Thompson) as summarized in equation (7).

$$\begin{aligned} \text{Max} U = & U(C_p, L_i; H_i, V) + \lambda(T_i - W_i - F_i - L_i) \\ & + \phi \left[\sum_{h=1}^m q_h Q(F_i, X_k; H_i, Z) - \sum_{k=1}^n x_k X_k + \sum_{i=1}^2 w_i W_i + D - \sum_{j=1}^p c_j C_j \right] \end{aligned} \quad (7)$$

The lagrangian multipliers, λ and ϕ , in equation (7) represent the marginal utility of time and the marginal utility of income, respectively. They measure the rate at which utility changes in response to a change in the respective constraint, here shown as T_i (for time) and $c_j C_j$ (for consumption), when utility is maximized (Chiang, Henderson and Quant).

The pertinent first order conditions for equation (7) are:

Marginal utility of leisure

$$\partial U / \partial L_i = U'(L) - \lambda = 0 \quad (8)$$

Marginal utility of off-farm work

$$\partial U/\partial W_i = \phi w_i - \lambda = 0 \quad (9)$$

Marginal utility of farm work

$$\partial U/\partial F_i = \phi q Q_{Fi} - \lambda = 0 \quad (10)$$

Equation (8) states that the marginal utility of leisure is equal to the marginal utility of time ($U'(L) = \lambda$). The off-farm wage rate is equal to the marginal value of time in equation (9) ($w_i = \lambda/\phi$) (Huffman and Lange), and equation (10) shows the marginal value product of farm labor equal to the marginal value of time

$$(qQ_{Fi} = \lambda/\phi) \quad (11)$$

At the optimal solution, the marginal utility of time (λ) is equal among all three choice activities, leisure, off-farm work and farm work;

$$U'(L) = \phi w_i = \phi q Q_{Fi} = \lambda \quad (12)$$

Additionally, the marginal value of time λ/ϕ is equal between off-farm and farm work, and can then be implied equal to the reservation wage; the marginal value of leisure. It is in this equality that the off-farm wage determines the marginal value of time for the i th individual (Huffman and Lange).

If the operator and/or spouse does not work off the farm, equation (9) becomes an inequality where $\phi w_i - \lambda < 0$ and the optimal solution changes from

an interior to a corner solution. In the instance of a corner solution, the Kuhn-Tucker conditions provide a rule of participation (Gebauer; Lass, Findeis and Hallberg). This rule states that if the first order condition is less than zero under the constraint, then the constrained maximum solution occurs where the particular choice activity equals zero (Binger and Hoffman). This is applied as follows:

if d_i is a participation dummy variable and

$$w_i^* = (w_i - qQ_{Fi}) | W_i = 0 \quad (13)$$

where the residual off-farm wage (w_i^*) is equal to the offered off-farm wage (w_i) minus the marginal value product of labor on the farm (qQ_{Fi}), evaluated when off-farm hours are equal to zero (Lass, Findeis and Hallberg), then it can be said that,

$$d_i = 1 \text{ if } w_i^* > 0 \text{ (operator/spouse work off-farm), or}$$

$$d_i = 0 \text{ if } w_i^* \leq 0 \text{ (operator/spouse does not work off-farm).}$$

The corner solution applies also to the spouse in the case that no farm work is preformed, where equation (10) becomes an inequality $\phi qQ_{F2} - \lambda < 0$. Because the marginal value of the spouse's time in leisure/household work is greater than the marginal value product of the spouse's on-farm labor, no participation in farm work occurs. The appropriate Kuhn-Tucker solution applies as follows:

considering e_i a participation dummy variable and

$$qQ_{F2}^* = (qQ_{F2} - w_2^r) | F_2 = 0 \quad (14)$$

where the expression w_2^r is the spouse's reservation wage, and by equation (12), the residual farm wage (qQ_{F2}^*) is equal to the marginal value product of farm labor (qQ_{F2}) minus the reservation wage (w_2^r), the result is,

$$e_i = 1 \text{ if } qQ_{F2}^* > 0 \text{ (spouse works on the farm), or}$$

$$e_i = 0 \text{ if } qQ_{F2}^* \leq 0 \text{ (spouse does not work on the farm)}$$

Sumner (1982, p.500) found that "... off-farm work is quite sensitive to both wage opportunities and other factors affecting the marginal value of time in each activity" [leisure and on farm work]. The off-farm wage has consistently been shown to influence the probability that a farm operator or spouse will work off the farm.

When available off-farm wage rates increase above the marginal value of labor in farm production, resulting in a shift to increased off-farm hours (assuming leisure is a normal good) the substitution effect would suggest a decrease in time allocated to leisure and/or on farm work (Furtan, Van Kooten and Thompson). The effect of increased income, however, should increase the demand for leisure and so may cause a greater relative reduction in the hours worked on the farm. Huffman showed a strong substitution effect among farm operators when wages increased and there was a shift to a positive amount of off-farm work. Sumner states, further, that a number of cross-sectional studies have shown relatively small income effects when labor supply was estimated.

2.2. General Model Specification

The specification of a labor participation model with a dependent variable that is constrained to fall between a zero and one choice option is not amenable to a standard linear function (Aldrich and Nelson). The most commonly used forms for this kind of model are the probit and logit equations, which graphically are shown to define Sigmoid curves. The tails of these curves approach slowly but never intersect the range maximum or minimum values. The general probit equation (the one of interest here) is taken from Aldrich and Nelson and given as:

$$P(Y=1|X) = \Phi\left(\sum_{k=1}^n b_k X_k\right) = \int_{-\infty}^{\sum b_k X_k} \exp(-u^2/2) \sqrt{2\pi} du \quad (15)$$

Where the probability (P) that the dependent variable (Y) is equal to 1 (the event will occur), given k independent and observable variables (X), is measured by the area of the standard normal curve from $-\infty$ to $\sum b_k X_k$ where u is a standardized normal variable (Gujarati).

Participation models with dichotomous dependent variables are often used as the first part of a two part estimation procedure for labor supply models (Sumner, 1982; Furtan, Van Kooten and Thompson; Lass, Findeis and Hallberg; Van Kooten and Arthur; Gunter and McNamara). In the first step, or probit portion, "... an index related to the conditional probability an individual will work off the farm..." is developed (Furtan, Van Kooten and Thompson, pg. 215). This index is then used

as an independent variable in a second equation to check for sample selection bias (see Heckman). The objective of the present study is to estimate the first step.

Chapter 3. Empirical Model

To meet the objectives of this research project, an off-farm labor participation model will be estimated to examine the factors affecting the probability that a farm operator or farm spouse will choose to work off the farm. Separate participation models will be constructed for the farm operator and the spouse.

3.1. Model Building

To facilitate the building of these models, variables drawn from theory and expected to influence labor allocation decisions are segregated into general groups and defined. Three general categories that are important because of their effects on off-farm labor force participation are human capital, labor supply, and labor market demand. Specific factors within each of these general categories are thought to explain a portion of the operator and spouse's labor supply decisions. The farm operator and spouse have an available endowment of time and are faced with a

demand for that time by two income earning activities, farm work and off-farm work, and one, non-income earning activity, housework/leisure.

For convenience, the three categories are listed below with their respective variables. A discussion of individual variables follows.

Human Capital Characteristics

- Age (years)
- Age squared (years squared)
- Education (years)
- Vocational/Job training (1=yes)
- Operator's Sex (1=male)/Spouse's Sex (1=female)
- Years of off-farm experience (years)
- Years of operator farm experience (years)

Labor Supply Factors

- Children under 6 (number)
- Children between 6-13 (number)
- Children between 14-18 (number)
- Net farm income (annual \$1000)
- Unearned income (annual \$1000)
- Off-farm income from partner (annual \$1000)
- The farm objective (3 dummy variables)

Labor Market Demand Factors

- Construction employment (as a % of total employment)
- Transportation employment (as a % of total employment)
- Manufacturing employment (as a % of total employment)
- Retail trade employment (as a % of total employment)
- Service employment (as a % of total employment)
- Government employment (as a % of total employment)

3.2. Human Capital Characteristics

Human capital characteristics affect the individual's reservation wage (Sumner, 1982; Hallberg, Findeis, and Lass). The reservation wage (the opportunity cost of leisure/household activities) is affected by human capital characteristics, in terms of establishing at what wage level leisure/household activities will be relinquished. The offered off-farm wage is influenced by the level of formal education, skill level, sex, work experience, mobility and health of the individual (Huffman; Sumner,1982). The marginal value of farm work (the farm wage), while influenced by the same set of human capital characteristics as the off-farm wage, may not be influenced in exactly the same way. Because of the entrepreneurial nature of farm management and the physical nature of many farm activities, the marginal value of farm work may be influenced more by entrepreneurial ability and physical stamina than might the offered off-farm wage (Reddy and Findeis).

3.2.1. Age

The age of the individual is expected to encourage off-farm participation for the early and into the middle part of life (Sumner, 1982; Jensen and Salant; Lass, Findeis and Hallberg, 1989). Somewhere within this middle segment, it is hypothesized that because of the effect the demands dual employment make on time

and physical stamina, the effect of an individual's age changes from exercising a positive to a negative effect on off-farm employment. This would culminate with retirement and the cessation of off-farm employment. Older operators may also have had fewer opportunities to work off the farm when young, thereby having fewer off-farm skills with which to compete for off-farm jobs.

Oliveira, Sumner (1982), and Lass, Findeis and Hallberg (1989) have indicated that the probability of off-farm labor force participation follows a quadratic age pattern. This pattern was shown to peak (reach the highest level of probability) for the operator at 36 (Oliveira), at 43 (Sumner, 1982; Reddy and Findeis), at 44 (Gunter and McNamara) and at 48 (Lass, Findeis, and Hallberg, 1989); and for the spouse at 44 (Lass, Findeis, and Hallberg, 1989). Reddy and Findeis, while finding the expected signs, did not find the age pattern to be significant for spouses. To model the expected quadratic pattern of age, the variables age and age squared will be used. A positive sign is anticipated for the age variable and a negative sign for age squared, implying that younger operators and spouses are more likely to work off the farm.

3.2.2. Education

Formal education is expected to both increase the productivity of labor on the farm while at the same time increasing the individual's employment potential off the

farm (Sumner, 1982). Lass, Findeis and Hallberg (1989), however, hypothesized that the positive effect of higher levels of education on the market wage facing the individual outweighed its effect on the marginal productivity of labor on the farm.

Higher off-farm wages are generally associated with higher levels of education. Higher offered wages are expected to either draw individuals off the farm or encourage those having an off-farm job to maintain it, as the opportunity costs associated with remaining on the farm are increased.

Education is not always modeled in the same way. Reddy and Findeis, for example, included in their probability model a series of dummy variables; did not complete high school, completed high school (in the intercept term), 1-4 years of college and more than four years of college. They showed that operators with less than a high school education were less likely to work off the farm than those that had a high school education or better.

More typically, education is measured as a continuous variable. With some consistency, the education of the farm operator has been shown to positively affect the probability the operator will hold an off-farm job (Huffman; Jensen and Salant; Smith; Lass, Findeis and Hallberg, 1989; Oliveira; Huffman and Lange). Simpson and Kapitany, in their 1977 Saskatchewan survey, found the impact of education to vary. For married operators farming less than 15 years, education positively affected the probability of off-farm work. Married operators farming more than 15 years, as

well as all unmarried operators, were not significantly influenced to participate in the off-farm labor market by higher levels of education.

Gould and Saupe found the operator's level of education to positively affect the operator's off-farm work probability, but it was significant in only one of the two periods they examined. Furtan, Van Kooten and Thompson, in an analysis of males in Saskatchewan farm households, found the effect of education to be positive but not significant. They suggested that the employment of men in rural Saskatchewan may be influenced by heavy hiring in the areas of transportation, mechanics and municipal maintenance; jobs in which formal education is not particularly important. A low formal educational requirement may also be associated with natural resource based (mining, forestry), retail, and some service industries. In areas where these industries make up a large proportion of off-farm job opportunities, the education variable may not influence the probability of off-farm work as expected. This possibility will be controlled for through labor demand variables discussed later in the paper.

The spouse's education has been generally found to have a positive effect on the spouse's probability of working off the farm (Furtan, Van Kooten and Thompson; Smith; Gould and Saupe; Huffman and Lange). In the work by Reddy and Findeis, the probability of off-farm work by the spouse, was positively influenced by education when the spouse had one year or more of college.

Education is measured as the years of formal education completed with a value from 0 to 22. This variable is expected to have a positive influence on the probability of off-farm work for both the operator and the spouse.

3.2.3. Non-Farm Vocational Training

Non-farm vocational training, by enhancing the individual's skill level, and hence the offered off-farm wage, is expected to increase the probability of off-farm employment.

Sumner (1982) as well as Jensen and Salant used a dummy variable for vocational training and found it to positively influence the operator's off-farm work participation. Gould and Saupe also used a dummy variable for vocational training received within the four years preceding their survey periods. Their findings showed that this training had no significant effect on the operator's participation for either the 1982 or 1986 period, however vocational training within the past four years had a positive effect on the farm spouse's probability of working off the farm in both periods.

A dummy variable will be used to capture the influence of vocational training on the probability of off-farm work by the operator and spouse. It is expected that vocational job training will have a positive influence on the probability that the individual will work off the farm.

3.2.4. Sex

The sex of an individual is anticipated to affect the probability of off-farm labor force participation, chiefly through the off-farm wage rate. Higher off-farm wages increase the opportunity cost of farm work and leisure by increasing the marginal value product of labor off the farm. Bokemeier and Tickamyer (p.52) observe that employment opportunities for females in non-metropolitan Kentucky are typically in the "...unstable, low paying, but growing secondary sectors.." Deseran, Falk and Jenkins (p.225), in an aggregate U.S. study, concluded that "...rural women are more likely to be employed in peripheral jobs [low-skill jobs with employment instability], to be employed part-time and to receive lower pay than their male counterparts." The higher wages off the farm typically offered the male would be expected to more strongly draw the male operator into an off-farm job, or keep him there, than the female operator.

Lass, Findeis and Hallberg (1989) as well as Gunter and McNamara found the probability operators would work off the farm was positively associated with being male. Oliveira noted that the traditional responsibility of household work, when coupled with on farm work, should reduce the time the female farm operator has to work off the farm. His research, however, found the operator's sex did not significantly affect off-farm participation.

The variable indicating the operator's sex will be a dummy variable, where male = 1, and will only be included in the operator's equation. A male operator is expected to be more likely to work off the farm.

Traditionally, the female has put in more hours of household activity than her male counterpart, and when coupled with the generally lower off-farm wages offered women than men, the probability of the spouse working off the farm is expected to be negatively influenced by the spouse being a woman.

The spouse's sex will be indicated by a dummy variable, where female = 1, and will only be included in the spouse's equation. This variable's effect on the probability of the spouse working off the farm is expected to be negative.

3.2.5. Off-Farm Work Experience

Off-farm work experience is expected to increase the probability of working off the farm by increasing the market wage rate facing the individual (Sumner, 1982; Hallberg, Findeis, and Lass). In general, labor market experience is expected to reflect a greater level of marketable skills and hence, a higher offered off-farm wage. The marginal value of time spent working off the farm is consequently increased relative to that of leisure and on farm work.

The years of an individual's off-farm work experience, used in labor supply models, have been shown to be positively related to the number of hours worked off

the farm by both the operator and the spouse (Lass, Findeis and Hallberg, 1989). Leistriz, et al. found the years of off-farm work experience to have a positive influence on the number of days worked off the farm by the operator.

Off-farm work experience will be defined in terms of an individual's years and is anticipated to have a positive affect on the probability that the operator and spouse work off the farm.

3.2.6. Farm Work Experience of the Operator

Experience on the farm is also a component of human capital, and while expected to positively effect the supply of labor to the farm through the production function, should in turn have a negative affect on off-farm work participation (Lass, Findeis and Hallberg, 1989) by increasing the marginal value product of time on the farm relative to off-farm work.

The number of years an operator has been farming has been found to be negatively related to participation off the farm (Oliveira; Van Kooten and Arthur; Furtan, Van Kooten and Thompson). Sumner (1982) found the same negative effect on the operator's off-farm employment probability using a dummy variable indicating five or more years of farming experience in his Illinois study. Lass, Findeis and Hallberg (1989), however, found the operator's farming experience had no significant

influence on the probability the operator would work off the farm in a recent study of Massachusetts farm families.

This finding by Lass, Findeis and Hallberg may be a consequence of the location of their study. Overall smaller farms in terms of acreage and the greater proportion of off-farm employment opportunities in the Northeast as compared to studies in Illinois, Canada and the aggregate U.S., may lessen the effect of farm experience on the probability of off-farm work.

In this model, the operator's experience in farming is measured in the number of years on the farm. While a negative sign is expected, the similarity of Virginia to Massachusetts in terms of employment opportunities and farm size may reduce the strength of this sign.

3.3. Labor Supply Factors

Family, farm and income characteristics affect both the operator's and spouse's probability of working off the farm by influencing the marginal value of leisure and marginal value product of labor. A set of factors that reflect these characteristics and their influence include the number of children in various age groups, the farm objective, net farm income, unearned income and the off-farm employment income of the other partner.

3.3.1. Children Under Six

Children under six in the household are expected to have different impacts on the operator and on the spouse. In general, as the number of children in the household increase, the family's demand for income should increase as well. This income demand may result in increasing the operator's probability of off-farm participation. The presence of children may also result, however, in an expansion of current farm activities and/or the addition of production activities, decreasing the probability of the operator's participation off the farm. The overall influence of children under six on the operator's off-farm participation is consequently unclear.

Lass, Findeis and Hallberg (1989) found the number of children under six positively influenced the probability that the operator would work off the farm in their Massachusetts study. In contrast, Huffman and Lange showed that the number of children under six negatively affected the operator's probability of working off the farm in Iowa. Smith, and later, Gould and Saupe found the number of children under six did not significantly influence the operator's probability of working off the farm.

The number of children under six may effect the labor of the spouse somewhat differently than the operator, as 94 percent of the spouses are female in this study. An increase in the marginal value product of the spouse's time in household (childbearing and child-rearing) activities should draw her labor to the

household, which in turn should reduce the time allocated to off-farm work by raising her reservation wage relative to the marginal value product of labor off the farm. The number of children under six has been found to negatively affect the probability of the spouse holding an off-farm job in a number of studies (Furtan, Van Kooten and Thompson; Gould and Saupe; Smith; Huffman and Lange). Reddy and Findeis, indicating the presence of children under six with a dummy variable, found similar results.

The number of children under six is expected to negatively affect the probability of off-farm work by the spouse, while the direction of influence is unclear for the operator.

3.3.2. Children 6 to 13

Previous studies that have evaluated the effect of children above preschool age have not been consistent in their choice of age categories. Lass, Findeis and Hallberg (1989) evaluated the effects of children between 5 and 18 on the probability the operator and spouse would work off the farm; Jensen and Salant, between 6 and 17 on the operator's probability alone; Huffman and Lange, between 6 and 11 and 12 and 18 on the operator and spouse's off-farm job probability and Furtan, Van Kooten and Thompson, between 6 and 12 on the probability the farm wife would work off the farm.

It is obvious that these authors expected children above preschool age to affect the probability that the individual would work off the farm in a different manner than children under six. In this study, children between 6 and 13 were categorized separately primarily because children under six generally demand a greater level of supervisory care while those older (above 13) may provide a significant level of substitute labor on the farm. Deseran, Falk and Jenkins additionally suggest that younger children under six place greater demands on time but smaller demands on income than do older children.

The operator with children in the 6-13 range may be faced with a choice between expanding farm activities, finding an off-farm job, or both, to meet changing family income demands. The direction of influence children between 6 and 13 have on the operator's probability of working off the farm is, consequently, unclear. Huffman and Lange found the number of children between 6 and 11 to have no significant effect on the operator's probability of off-farm work.

At primary school age (between 6 and 13), however, the constraint of children to the spouse's allocation of labor on or off the farm may relax somewhat, though not be eliminated. The spouse faces a trade-off between demands for income (current and future) and an increasing reservation wage as the number of children increase.

Furtan, Van Kooten and Thompson found that children between the ages of 6 and 12 had no significant effect on the participation of women in Saskatchewan. In a later study, Huffman and Lange found that children between the ages of 6 and

11 had a negative influence on the probability the spouse would have an off-farm job in Iowa.

The number of children present in the household between the ages of 6 and 13 will be modeled, but the direction of influence on both the operator and spouse is ambiguous.

3.3.3. Children 14 to 18

Children between 14 and 18, while placing considerable demands on income, may be a source of labor to the farm, providing an additional unit of labor or substituting for labor input on the farm by a parent. This does not imply perfect labor substitution, as the diversity of demands inherent in farm production allows for considerable latitude in labor and skill level. Children between the ages of 14 and 18 may also supplement family income by earning income off the farm. As in the discussion concerning children between 6 and 13, where income demands are increased, the general options are to increase farm activity or work off the farm. The option chosen by the farm operator will largely depend upon the opportunities most readily available.

Children above 14 need generally less supervision than do those between 6 and 13, and considerably less than those under six. As child supervision is traditionally the female spouse's responsibility, the spouse's reservation wage should

decline relative to her marginal value product of labor on as well as off the farm as the demand for her time in child care activities declines and demand for income increases.

In the Iowa study of Huffman and Lange, no significant influence on off-farm participation was found to result from the number of children between 12 and 18 for either the operator or spouse.

For both the operator and the spouse, the influence of the number of children between 14 and 18 on the probability of off-farm work is unclear.

3.3.4. Net Farm Income

The farm's production function coupled with market prices determine net farm income. Net farm income is expected to be inversely related to the probability that the operator (spouse) will work off the farm. As net farm income increases above some minimum level, the income effect should cause a reduction in the hours of labor allocated to work activities in general, and increase the time spent at leisure. In addition, Napier and Carter (p.103) suggest that operators who are able to ". . . secure higher levels of living from agriculture tend to devote more time to farming." In the work of Reddy and Findeis, net farm income had a negative effect on the off-farm participation of both the operator and spouse for both the 1978 and

1984 periods of their study. Smith found similar results for the operator and spouse in both Texas and California.

Net farm income was given in the survey as a percentage of the family's total income, and total family income was one of nine equal increments of \$10,000 with the top category being \$80,000 or more. The variable used for net farm income is the product of the mid-point value of total family income and the percentage of family income from the farm, giving an estimated dollar value. A negative influence is expected from this variable for both the operator and spouse's probability of working off the farm.

3.3.5. Unearned Income

Unearned income can have a direct influence on both farm and off-farm labor allocation. It differs from sources of earned income in that it is not influenced by labor time constraints.

Unearned income should have a negative impact on the supply of labor to income earning activities in general, on or off the farm, resulting from raising the marginal utility of leisure and therefore the reservation wage (Smith). Binger and Hoffman observed that as unearned income increases (with leisure and consumption considered to be normal goods), the tendency of the farm operator/spouse would be to shift away from income earning activities, revealing a preference for leisure.

Sumner (1982), Jensen and Salant, and Lass, Findeis and Hallberg (1989) found unearned income to have a negative effect on the operator's probability of working off the farm, as theory suggests.

Smith showed unearned income to negatively influence the spouse's probability of off-farm work in her two Texas models, but while negative in sign, unearned income in her two California models was not significant. Reddy and Findeis found similarly that, while negative in sign, unearned income did not influence the probability of either the operator or spouse working off the farm.

Unearned income was given, as was net farm income, as a percentage of total family income. Its use in this model will follow the formula shown for net farm income, and have an estimated dollar value. It's effect on the probability either the operator or spouse will work off the farm is expected to be negative.

3.3.6. Partner's Off-Farm Income

While the term "spouse" does not imply gender, it is used in the present research to designate non-operator. The choice to use "partner" rather than "spouse" when specifying the individual who is not the focus of the model was made to avoid confusion, as "partner" can refer to the operator (when the spouse is being modeled) or to the spouse (when the operator is the model focus).

The level of off-farm earned income of the partner affects the total family income, and assuming a preference for leisure, is expected to decrease the probability of the other partner working off the farm by increasing their reservation wage. A negative influence on the probability of off-farm work would therefore be expected.

A decision to work off the farm, however, may itself encourage the other partner to do the same (Leistritz, et al.; Napier and Carter). Reddy and Findeis found, using a binary variable for whether or not the other partner received off-farm income, a positive effect on the probability of off-farm work for both the operator and spouse. They suggest (p.99) that "When one spouse works off-farm, the idea of working off-farm often becomes more acceptable to the other spouse."

The departure from theory in the study of Reddy and Findeis may have resulted from family income, social and/or risk management goals not being satisfied with only one family member working off the farm. Additionally, it may have been a consequence of those electing to farm after having established, and chosen to maintain, an off-farm career.

The particular issue of one partner influencing the attitude of the other toward off-farm work, however, has been partially controlled for by including the objective of the farm in the variable set, to be discussed next. The farm objective is thought to reflect family attitudes that would encourage one partner's off-farm work decision to influence the other partner's decision. Proxies for income and risk management goals, however, unless specifically stated, are not easily found and their

affect on how the partner's off-farm income influences the probability of off-farm work is unclear.

The off-farm income of the partner is measured in 1000's of annual dollars, and is expected to affect the probability of off-farm work negatively. For single operators, the partner's income was set to zero. A discussion of the single operator issue regarding partner's income follows in Chapter 5.

3.3.7. Farm Objectives

The probability that the operator or spouse will work off the farm is largely dependent upon the family's objective for farming. Carlin, as well as Heffernan et al. have suggested the need for further study in the area of farm objectives and goals.

When the farm is viewed as a business that must make a profit, a commitment to farming is implied which should negatively affect participation in the off-farm labor market by both the operator and spouse. If the farm is viewed as a secondary income source, it is obvious that the primary income source originates either in the off-farm labor market, or through unearned income. For the family looking to its farm as a secondary income source, the family member with the lowest marginal value product of labor on the farm and/or the highest earning potential off the farm would be the most likely to hold off-farm employment, compared to other family members. This second income objective could be the result of either a transitory

condition, (into or out of farming) or a long-term family choice (Pfeffer), but it is expected to affect both the farm operator and spouse positively in terms of off-farm labor participation.

When farm objectives are primarily non-monetary (the farm operating on a break-even basis or as a past-time), a much stronger probability of off-farm employment might be expected because farm income itself is not explicitly considered critical to the family's well being (see Heffernan, et al.; Henry). Non-monetary farm objectives are hypothesized to positively affect the probability of off-farm labor force participation of both the farm operator and spouse.

Farm objectives have been defined so as to include each of four major options facing the farm family; the farm as a business, a second income, a break-even operation or a past-time. These objectives are used in the model as dummy variables, with the business option included in the intercept term. Expectations are, therefore, that farm families choosing the remaining three categories will have higher probabilities of working off the farm than those whose farms are specifically considered businesses. The probability of off-farm work by both the operator or spouse should become increasingly stronger as one moves from a second income objective toward a past-time objective.

3.4. Labor Market Demand Factors

Labor market demand factors are important in determining the participation of farm family members in the off-farm labor market as the location of the farm largely determines the type, number and accessibility of off-farm employment opportunities (Hallberg, Findeis, and Lass, ch.15).

Bertrand's summary of U.S. part-time farming research (from the 1930's to the mid-1960's) indicated that different patterns of part-time farming resulted from different off-farm work opportunities. Others have subsequently found the same to be true, although the variables selected as proxies for labor markets and/or geographical access to non-farm employment opportunities have varied widely.

Dummy variables and labor structural variables are two types of commonly used proxies for employment opportunities. Dummy variables have been used to capture regional differentiation which is expected to affect access to off-farm employment. Reddy and Findeis used regions to divide the U.S., Furtan, Van Kooten and Thompson used divisions on a provincial level in Canada, Huffman and Lange used an east/west state division, and Van Kooten and Arthur used a division by crop district in their Saskatchewan study. Various measures indicating the proximity of the farm to metropolitan areas have also been used: metropolitan/non-metropolitan (Oliveira; Reddy and Findeis), and urban/non-urban (Gould and Saupe). Results from the use of these location dummy variables have been generally

split between showing a positive effect on the probability the operator will work off the farm and showing no significance at all.

Structural variables have also taken a variety of forms to reflect employment opportunities. The unemployment rate of the county was used by Gould and Saupe and of the town by Lass, Findeis and Hallberg (1989) as a proxy for demand conditions, which were expected to affect offered wages. In neither probability study, however, was significance found.

Findeis, Lass and Hallberg utilized employment density as well as the percentage change in employment (1980-1986) in both service and manufacturing industries, by county of residence, to account for labor market structural conditions. For the farm operator in their Pennsylvania study, all three structural variables had a positive influence on off-farm participation. Only the change in the service sector had a significant affect on the participation decision of the spouse.

What each of these proxies for employment opportunities have neglected, however, as have others that have used similar measures, is that work force and commuting patterns have developed along a combination of geographic, metropolitan and population lines (Tolbert and Killian). If largely politically defined units (i.e., counties, states) are the only representatives of off-farm job opportunities, there follow two implicit assumptions;

1. that geographic features pose no constraint to opportunities, and

2. there is no, or an insignificant volume of, labor commuting beyond political borders.

In other words, historically defined political borders successfully contain and define available off-farm employment opportunities. This assumption has been shown to be inconsistent with labor force patterns in Virginia (Spar; Knapp).

Using 1980 census data on labor force commuting patterns along with population and geographic characteristics, Tolbert and Killian identified 382 labor market areas (LMA's) in the United States, 18 of which include at least one Virginia county. LMA's were defined (p.2) as "Specific locales in which interactions between buyers and sellers of labor take place." Each LMA was constrained to have a minimum of 100,000 inhabitants and counties with less than 100,000 were grouped with adjacent counties until the minimum was met or exceeded.

Tickamyer and Bokemeier (p.183), looking at Kentucky LMA's, concluded that LMA's "...differ in job opportunity, wage rates, worker's characteristics and economic bases", which they suggest form an opportunity structure. They found considerable variation in the opportunity structure of Kentucky's rural LMA's.

Gunter and McNamara used LMA structural variables in their probability analysis and found the unemployment rate negatively influenced, while the percentage of manufacturing and professional employment positively influenced, the operator's off-farm work probability.

The use of LMA's rather than political jurisdictions like counties provides a better approximation of employment opportunities, as an LMA reflects a greater number of available opportunities than does an individual county. It is additionally expected that some industries will be more compatible with dual (farm/off-farm) job holding than others, and more jobs in these industries should increase the probability of off-farm work.

3.4.1. Structural Variables

In an interview with Christine Erb, Hallberg and Findeis suggested that many farm operators choose construction and similar short-term, high paying jobs that are generally more flexible in hours and can be adjusted more readily to farm demands. Both the survey and Virginia census data indicates that the majority of operators working off the farm are employed full-time (200 or more days annually). This implies that, for Virginia at least, that a part-time or a seasonal job is not necessarily important for off-farm work. On the other hand, a full-time job which offers flexible hours may increase the probability of off-farm work. Data are not available on the flexibility of off-farm employment hours, and so that direction was not pursued.

Also of concern to the farm operator in Virginia may be the compatibility of skills. Salant observed that the construction and transportation industries (among others) provide opportunities for off-farm employment that use skills often developed

on the farm. As not all farm operators working off the farm farmed as their first occupation, however, (Stallmann and Nelson) compatible skill levels need not be exclusively those tied to the operation of a farm.

In addition to the criteria of skill compatibility, the presence of the more traditional rural employers like manufacturing and government, and the expanding service sector may influence the probability of off-farm work. Dellenbarger and Deseran found the service and manufacturing industries were the primary employers of farm operators in Louisiana's labor market areas. As mentioned earlier, Findeis, Lass and Hallberg found that growth in manufacturing and service employment positively influenced the off-farm employment of farm operators in Pennsylvania, and Gunter and McNamara found employment in manufacturing to do the same in their Georgia study.

Four industries, construction, manufacturing, service and government, were thought to cover the wide range of operator's skills as well as the opportunities facing the farm operator, and were selected as structural variables. Manufacturing, service industries and government were also selected for the farm spouse, but the retail trade industry was used in place of the construction industry. These five industries employed almost 85% of the labor force in Virginia in 1988 (Virginia Employment Commission).

The proportion of total LMA employment made up by these industries, which offer a variety of opportunities, is expected to increase the probability of off-farm

work by both the farm operator and spouse. The percentage of total LMA employment represented by each of these industries will be used in the model, and are expected to positively influence the probability of off-farm work.

Labor market area average wages by industry, and by sub-industry where a pronounced difference occurs within an industry, would be preferred measures of labor market area demand, but the difficulty obtaining wages prevented their use in this study.

3.3. Summary

The participation models to be estimated and the theoretical justification for model variables were presented in this chapter. Human capital characteristics, labor supply factors and labor market demand factors were chosen because of their expected effects on off-farm labor force participation. It was from these three general areas that explanatory variables were drawn; variables that are expected to influence the labor allocation decisions of the farm operator and the farm spouse. The influence these explanatory variables have on the probability of working off the farm is chiefly through their effect on the individual's marginal value product of labor on the farm, off the farm, and in leisure/household activities. The direction of influence these variables are expected to have on the probability of off-farm work has

been stated, and the next step is to describe the data to be used in estimating the participation model.

Chapter 4. Sample Characteristics

With the general model theoretically specified and justified (Chapters 2 and 3), this chapter presents the data which the model will be used to estimate. A general description of Virginia farms follows, with a discussion of the data sub-sets used in the models developed for the farm operator and farm spouse.

4.1. The Data

The Census of Agriculture definition of a farm was used in this study: a place where agricultural production activities generate at least (or normally would generate) \$1,000 of gross sales annually.

Randomly selected Virginia farms were contacted by telephone in the fall of 1989 by the Virginia Agricultural Statistics Service (VASS). The farms were drawn from VASS files, and were drawn proportionately to the number of farms per county on their lists. Out of 1357 families contacted, three hundred ninety-four were no longer farming, 125 chose not to respond, and 48 were reached and were farming,

but neither the operator nor spouse was available to answer questions. Of the sample's 790 completed interviews, two were discarded because of missing data, and three were discarded because the landowner was not operating the farm.

While survey questions focused on the 1988 calendar year, the sample's remaining 785 observations were compared to the 1987 Virginia Census of Agriculture to see how well the sample farms reflected the farm population. Some degree of variability in production, sales, and income is expected from year to year as a result of changing economic and weather conditions. The drought Virginia experienced during the 1987 census year may have exaggerated differences in this 1987/1988 cross-year comparison for some variables, particularly gross farm sales.

Farms with less than \$2,500 in gross farm sales were under-represented in the sample and farms earning between \$10,000 and \$250,000 were over-represented (Table 1). Farms with fewer than 50 acres were also under-represented while farms with more than 180 acres were over-represented, contributing to the a significantly larger average acreage in the sample than in the Census (294 vs 194) as seen on Table 2.

A smaller proportion of sample operators work off the farm compared with the Census (41% vs 58%), as shown on Table 3. While the average age of the operators in the sample and Census are not statistically different (56.0 vs 54.5), the distribution of ages was. The sample has a smaller proportion of operators under 50

and a larger share over 50 (Table 4). Sumner (1982), and Lass, Findeis and Hallberg (1989) have shown that older farm operators are less likely to work off the farm.

TABLE 1. Comparison of Gross Farm Sales, Sample and Population.

Gross Farm Sales	Sample (785)	Population (44799)
	Percent	
Under \$2,500	14.6	30.4
\$2,500 - 9,999	30.3	34.8
\$10,000 - 39,999	28.7	20.2
\$40,000 - 99,999	12.7	6.6
\$100,000 - 249,999	8.4	4.8
\$250,000 - 499,999	2.2	2.2
\$500,000 +	1.0	1.0
Unknown	2.0	0.0
Average Sales	\$49651	\$35464
Chi-Square = 178.22		
P = 0.005		

TABLE 2. Comparison of Acres Owned and Rented, Sample and Population.

Acres Owned & Rented	Sample	Population
	Percent	
1 - 9	1.7	7.6
10 - 49	11.5	24.0
50 - 179	37.8	39.1
180 - 499	32.5	20.7
500 - 999	10.7	5.9
1000 - 1999	5.1	2.6
2000 +	0.8	0.6
Unknown	0.0	0.0
Average Acres	294.47	193.67
Chi-Square = 204.97		
P = 0.005		

TABLE 3. Comparison of the Off-Farm Employment of the Operator, Sample and Population.

Off-Farm Employment of the Operator	Sample	Population
	Percent	
Any	40.9	57.7
None	59.1	36.3
1-99 Days	6.4	8.34
100-199 Days	5.5	8.48
200+ Days	29.0	40.8
Unknown	0.0	6.0
Chi-Square = 198.10		
P = 0.005		

TABLE 4. Comparison of the Farm Operator's Age, Sample and Population.

Age of Farm Operator	Sample	Population
	Percent	
<24	1.1	1.0
25-34	5.2	8.4
35-44	15.3	17.5
45-49	9.4	10.7
50-54	12.1	11.4
55-59	14.8	11.8
60-64	13.2	12.1
65-69	13.2	10.4
70+	15.5	16.8
Unknown	0.0	0.0
Average Age	56.0	54.5
Chi-Square = 27.78		
P = 0.005		

Overall, the sample includes a somewhat older group of operators who, on average, have a higher level of gross farm income, farm a larger acreage and participate less in off-farm employment than Virginia's 1987 Census of Agriculture reports. While the degree to which the sample reflects the population is statistically relevant when predicting or forecasting an aggregate outcome, its importance is not as critical when the objective is to estimate an individual, probability outcome. The

comparison of the sample to the population is included here to provide a general overview of the data.

The objective of this research project is to identify factors which influence the probability of off-farm labor force participation among farm operators and farm spouses. Single operators over 65 or operators and spouses both over 65 years of age who were both not working off the farm in 1988 (128 of the sample's 785 observations) are considered to be in a retired category. Because of limitations on outside income by social security, and the consequences of advancing age on health, this group is expected to be influenced differently in their labor allocation choices than those under 65 and/or currently working off the farm. For this reason, the retired category of survey respondents has been eliminated from the working data set.

Two individual models will be estimated, one for the operator and one for the spouse. When cases with missing variables were eliminated from the data set, 527 observations remained usable for an operator's model and 414 observations for a spouse's model. Only these cases will be included in any further discussion.

Because farm operators are expected to differ from farm spouses in their labor allocation response to supply and demand factors, their characteristics will be discussed separately. The description begins with farms, and then moves to personal characteristics of operators and then spouses.

4.2. Farm Characteristics

Off-farm employment is expected to affect farm characteristics, primarily because the hours worked off the farm are fairly inflexible and reduce the time available to farm (Kada). To the point, 70 percent of the sample's operators who worked off the farm worked full-time (over 200 working days in 1988). To test expectations about the impact of off-farm employment on farm and income characteristics, two categories of farms were defined: farms where the operator did not work off the farm and farms where the operator worked off the farm. A breakdown of off-farm operators, separating those that worked off the farm full-time from those that worked part-time, was also considered. When evaluated using a Chow Test, however, the additional breakdown of operators who work off the farm was not found to significantly reduce the sum of squared errors for various farm and income characteristics compared to the on-farm/off-farm dichotomy. As a result, the two categories were used. The total number of operators was 527, with 275 working some time in 1988 off the farm and 252 recording no off-farm work.

4.2.1. Working Hours

Off-farm work reduces the time available for farm production activities. Not surprisingly, operators who do not work off the farm spend, on average, more time

on the farm than do the operators with off-farm jobs (Table 5). It is of interest, however, that when the hours an operator works off the farm are added to those worked on the farm, the total hours worked annually average over 20 percent more for operators with off-farm work compared to operators working only on the farm (3104 vs 2582).

TABLE 5. Annual Hours Worked, On and Off the Farm.

Hours Worked	Operator does not work off the farm	Operator works off the farm	F-Statistic	p=
	Average Hours			
Hours Worked On the Farm by the Operator	2581.85	1379.45	212.96	0.0001
Hours Worked Off the Farm by the Operator	0.00	1783.19	1348.25	0.0001
Total Hours Worked by the Operator	2581.85	3104.29	36.89	0.0001
Family On-Farm Hours*	1065.00	734.36	11.49	0.0008
Hired Labor Hours	2432.39	733.84	12.64	0.0004
All On-Farm Labor Hours	5986.26	2804.93	37.53	0.0001

* Spouse and family members other than operator.

The annual hours other family members devote to farm work are, on average, greater when the operator works only on the farm. Buttel and Gillespie have noted

that men tend to give lower estimates of the number of hours their spouses work on the farm than the spouses themselves do. This pattern appears evident in the sample data set as well. When the operator was interviewed, the hours of farm work estimated for the spouse were significantly less than the hours estimated when the spouse was the one interviewed. No significant difference (at the 5% level) was found, however, between the operators's and spouse's estimation of the operator's farm work hours.

Similar to family hours, annual hours of hired labor are greatest when the operator does not work off the farm. Overall, the hours allocated to farm production activities by the operator, family and hired labor significantly decrease when the operator works off the farm.

Kada found that some Wisconsin farm families adjusted to the operator's off-farm employment by increasing family involvement on the farm and/or contracting custom labor. This, however, does not seem to be the case in Virginia. The contrast with Kada's findings may be the result of differences in production activities and the smaller average acreage among Wisconsin farms than in the Virginia sample. The twelve year difference (1976-77 vs 1988) between surveys may also contribute to this contrast.

4.2.2. Farm Objectives

The selection of farm acreage, production activities and labor time is largely dependent upon the family's objective for the farm. The farm objective is also important in determining how the farm may respond to future economic conditions (Stallmann).

As expected, differences do exist in objectives between farms (Table 6).

TABLE 6. Farm Objective by Farm Type.

Farm Objective	Operator does not work off the farm	Operator works off the farm
	Average Percent	
The farm is a business that must make a profit.	54.76	12.00
The farm provides a second income to the family.	10.32	34.91
The farm should at least break-even/pay for itself.	29.76	41.45
The Farm is a pastime and does not have to break-even.	5.16	11.64
Total	100.00	100.00
Chi-Square = 119.932		
p= 0.0001		

Operators who work only on the farm are most likely to consider the farm a business, while relatively few of the operators working off the farm do. Substantially more operators working off the farm consider their farms to be a second income than do those not working off the farm. Both the business and second income objectives are clearly profit oriented, and it is interesting to note that almost half (47%) of those with off-farm jobs consider their farms as such. Stallmann brings out the importance of this profit orientation among operators who have off-farm jobs, but are often characterized as merely hobby farmers. An understanding of what motivates the farm operator, she concludes, has direct application to realistic policy and program development.

The percentage of farms with a breakeven objective, which at a minimum reflects cost awareness, indicates a significant portion of both farm groups (30% and 41%) are farming for reasons other than profit. Farms with this objective may be holding land for other purposes, but are not merely farming as a past-time (hobby). In fact, relatively few of either operator group consider the farm to be a past time.

4.2.3. Farm Acreage

On one hand, because the hours available to spend on farm work can be constrained by the number of hours worked off the farm, farms can be expected to vary in acreage. On the other hand, it is possible that acreage owned and/or

available to rent motivates off- and on-farm work decisions. In either case, average acreage owned and rented is over twice that of acreage in production (Table 7). Operators who do not work off the farm own and produce on significantly more

TABLE 7. Farm Acreage by Farm Type.

Acreage	Operator does not work off the farm	Operator works off the farm	F-Statistic	p=
Acres Owned and Rented	422.23	227.04	31.65	0.0001
Acres in Production	231.90	100.84	31.87	0.0001

acreage than operators who do work off the farm. The average acreage in production on farms with an operator not working off the farm is more than twice that of farms with the operator working off the farm, and over 85 percent greater in average acres owned and rented. These differences suggest that a significant scaling down occurs when the operator works off the farm.

4.2.4. Farm Activities

In addition to acreage, production activities place differing demands on the operator's time. The proportion of farms involved in particular production activities

vary by whether the operator works off the farm or not, in part because of time constraints facing the operator with an off-farm job (Table 8).

TABLE 8. Major Source of Income by Farm Type.

Income Source	Operator does not work off the farm	Operator works off the farm
	Average Percent	
Beef	43.03	58.65
Dairy	18.33	2.26
Field Crops*	13.15	9.02
Tobacco	9.56	16.54
Other Livestock**	7.57	10.15
Other***	8.36	3.38
Total	100.00	100.00
Chi-Square = 52.60		
p= 0.0001		

*Field Crops: grain (including corn, soybeans, wheat), hay and peanuts.

**Other Livestock: poultry, sheep, hogs, horses and turkeys.

***Other: forest products, fruit, nursery, vegetables and other.

For both operator groups, raising beef was the major source of farm income. Forty-three percent of the farms where the operator did not work off the farm and almost 60 percent of the farms where the operator worked off the farm listed income from beef sales as their major income source. Bollman observed that the relatively

low labor requirements of cattle operations can be easily fitted around an off-farm job. Kada also observed that some farmers with off-farm jobs had changed from dairy to beef operations to accommodate off-farm labor demands in his Wisconsin study.

While a major income source, beef production in Virginia is on a relatively small scale. When the operator works off the farm, the average number of head sold is less than half that of the farms where the operator works only on the farm (21 vs 48).

Dairy production is the second major source of income when the operator works only on the farm, and last when the operator holds an off-farm job. Because of the intensive and relatively inflexible labor demands, dairy operations are not well suited to an off-farm work schedule.

Both tobacco and field crop production have highly seasonal labor requirements and, depending on scale, can be adapted to the time constraints imposed by an off-farm job. While tobacco production ranks fourth as a major sales activity among operators who do not work off the farm, (9.56%), it accounts for a greater percentage of operators working off the farm and ranks second among them (16.54%). The production of tobacco is particularly labor intensive at certain times of the year, but small acreage can yield relatively substantial dollar returns.

4.2.5. Farm Assets

Farm assets, in terms of the 1988 market value of all farm equipment, buildings, structures and land, are considerably less when the operator works off the farm than when the operator does not (Table 9). For farms with an operator not working off the farm, farm assets average 85 percent more than those with an operator who has an off-farm job. higher when the operator did not work off the farm than when the operator did (47% vs 15%).

TABLE 9. Farm Assets and Gross Farm Sales by Farm Type.

	Operator does not work off the farm	Operator works off the farm	F-Statistic	p=
	Averages			
Assets (\$)	539451	291569	6.86	0.0091
Gross Farm Sales (\$)	94428	27408	52.76	0.0001

4.2.6. Gross Farm Sales

Smaller average acreage, smaller herd size, a greater proportion of low labor demanding farm activities, and fewer hours worked on the farm occur when the

operator works off the farm compared to farms with operators who do not. It is not surprising that average gross farm sales are greater (over three times) when the operator does not work off the farm (Table 9). This is in agreement with Oliveira's findings, that gross farm sales were negatively related to the farm operator working off the farm.

A substantially higher percentage of farms grossed less than \$10,000 when the operator worked off the farm (55%) than when the operator did not (23%). Conversely, the percentage of farms with a gross farm sales of over \$40,000 was much

4.3. Operator and Family Characteristics

The characteristics of the operator and family are expected to affect the operator's decision to work off the farm. Off-farm employment decisions are influenced by the operator's human capital (age, formal education, job experience on and off the farm, sex, and non-farm vocational training), the number of family members and age structure, and income structure.

4.3.1. Characteristics of the Operators

Operators working off the farm, on average, are younger, have more formal education and more off-farm job experience than those who do not work off the farm

(Table 10). Huffman and Lange, using a sample of Iowa Farms, and Lass, Findeis and Hallberg (1989), with a Massachusetts sample, found similar results.

TABLE 10. Average Characteristics of Operators.

	Operator does not work off the farm	Operator works off the farm	F-Statistic	p=
	Averages			
Age	53.04	51.15	3.61	0.0581
Education (years)	11.38	12.46	13.82	0.0002
Years of On-Farm Experience	28.46	26.35	3.42	0.0650
Years of Off-Farm Experience	10.87	24.45	155.82	0.0001

When the operator works off the farm, the average years of experience in both on-farm and off-farm activities are relatively close (26 and 24). When the operators' average age (51) is taken into consideration, the indication is that those with off-farm jobs have worked both on and off the farm for a considerable period. This is consistent with Virginia's Census of Agriculture data over the past 18 years, which reports a high proportion (averaging over 60%) of dual farm/off-farm employment among farm operators. It is interesting to note as well, that even for the operators

not currently employed off the farm, off-farm experience averaged almost 11 years. This emphasizes the importance of off-farm employment to the farm household over time, even for those not currently working off the farm.

Over 90 percent of the sample’s farm operators are male (Table 11). The proportion of operators with non-farm vocational training, when the operator has an off-farm job, is almost double that of those working only on the farm.

TABLE 11. Average Characteristics of Operators, Dummy Variables.

	Operator does not work off the farm	Operator works off the farm
	Averages	
Percent Male	92.46	94.55
Chi-Square =	0.974	
p =	0.330	
Percent with Vocational Training	25.40	49.09
Chi-Square =	31.41	
p =	0.0001	

4.3.2. Number of Children

Table 12 shows the average number of children per family in the under six, 6 to 13 and 14 to 18 age categories. Average numbers remain similar between the

two operator groups, varying by less than .09 for any one category. The off-farm status of the operator does not appear to be related to the number of young children in the family.

TABLE 12. Average Number of Children per Family by Child Age Group.

Age Group	Operator does not work off the farm	Operator works off the farm	F-Statistic	p=
	Average Number			
Children Under Six	0.099	0.069	1.08	0.3001
Children 6-13	0.242	0.327	2.21	0.138
Children 14-18	0.190	0.262	2.09	0.149

4.3.3. Family Income

Farm families are expected to allocate their labor to maximize family satisfaction. Family income, defined as the sum of off-farm earned income, net farm income and unearned income, has a major role in achieving this satisfaction. The level of family income, therefore, can be an important factor of change in the farm operation. It can cause a re-allocation of family labor on or off the farm as well as adjustments in farm objective, farm acreage and/or production activities.

Significant differences in average net farm income between families with operators not working off the farm and those with operators working off the farm were found (\$21,608 vs \$6,947) (Table 13). This difference was anticipated, as those not working off the farm are more likely to consider farm income as a primary income source than do those working at an off-farm job, as is illustrated by their choice of farm objectives.

TABLE 13. Average Income by Operator.

Income	Operator does not work off the farm	Operator works off the farm	F-Statistic	p =
	Average \$			
Net Farm Income	21608	6497	93.71	0.0001
Total Off-Farm Income	5877	32319	317.02	0.0001
Unearned Income	6681	2875	16.79	0.0001
Total Family Income	34167	42036	15.01	0.0001

When the operator does not work off the farm, unearned income (in average dollars) is over twice the amount accrued on farms where the operator has an off-farm job (\$6,681 vs \$2,875). Unearned income also accounts for a significantly larger share of total income when the operator does not work off the farm (20% vs 7%).

As unearned income increases, Sumner (1982), and Jensen and Salant have found it to decrease the probability of off-farm work.

When the operator works off the farm, 84 percent of the total family income comes from off-farm sources. This reinforces what the farm objective suggested, that for this group, farm income is a secondary income and is supplemental to off-farm income rather than the other way around, as is commonly thought. Even when the operator does not work off the farm, earnings from sources other than the farm (spouse's off-farm income and/or unearned income) account for over 37 percent of total family income.

4.3.4. Summary of Operator Characteristics

Over 70 percent of the sample's off-farm working operators work off the farm full-time (over 200 working days in 1988). Of all operators working off the farm, an average of 223 days were worked annually.

Operators who worked off the farm had generally smaller farms and fewer acres in production than operators who did not work off the farm. When the operator works off the farm, fewer hours were worked on the farm by the operator, the family, and by hired labor. In addition, lower labor intensity farm activities (more small volume beef, fewer dairy) were pursued. Many off-farm-working operators are willing to engage in seasonally labor intensive farm activities, such as

tobacco and field crop production. Additionally, almost half of the operators working off the farm are clearly not "hobby farmers", but have a definite profit orientation for farming.

Gross farm sales and net farm income were generally low when the operator worked off the farm, but total family income was significantly higher. For families with operators working off the farm, farm income was clearly a supplement to income generated off the farm.

From this description, there is a clear distinction between farm families whose operator does not work off the farm, and those whose operators work off the farm, across a variety of farm, labor, and income characteristics. As a result of the differences between farms, those with jobs off the farm can be expected to respond differently to economic and social changes than operators who work only on the farm. To realistically design and implement agricultural and rural programs, farm operators need to be first considered according to whether they work off the farm or not.

4.4. Classification of farms by spouse

As was done for the farm operator, expectations about the impact of farm characteristics on off-farm employment were tested by creating two categories of farms: farms where the spouse did not work off the farm and farms where the spouse

did work off the farm. Off-farm work was defined as one or more hours annually worked at either a wage/salary job or a non-farm self employment occupation. Almost seventy percent of the spouses working off the farm (an equal percentage to that found for the operators) worked over 200 days annually. The total number of spouse's was 414, with 207 working some time in 1988 off the farm and 207 recording no off-farm work. Among spouse's who do not work off the farm, 66 (32%) also do not work on the farm. It is likely that these spouse's allocate their time to household and child-care duties.

4.4.1. Characteristics of the Spouses

Spouses working off the farm, on average, are younger, have more formal education and more off-farm job experience than those who do not work off the farm (Table 14). For spouses not working off the farm in 1988, average off-farm experience was almost eight years. As it did for the operators, this indicates that off-farm work, in terms of its income, labor allocation, and effects on farm structure, has had a direct impact on the farm family in Virginia, whether the operator or spouse works off the farm currently or not.

The proportion of spouses having some kind of non-farm vocational training was twice as high for the group working off the farm as for those with no off-farm

TABLE 14. Characteristics of Spouses.

	Spouse does not work off the farm	Spouse works off the farm	F-Statistic	p=
	Averages			
Age	51.96	46.20	33.93	0.0001
Education (years)	12.13	13.42	27.51	0.0001
Years of Off-Farm Experience	7.53	18.18	133.03	0.0001

job (Table 15). As might be expected, the great majority of farm spouses (almost 95%) are female.

TABLE 15. Average Characteristics of Spouse, Dummy Variables.

	Spouse does not work off the farm	Spouse works off the farm
	Averages	
Percent Female	94.20	94.20
Chi-Square =	0.000	
p =	1.000	
Percent with Vocational Training	25.12	50.24
Chi-Square =	28.222	
p =	0.0001	

4.4.2. Number of Children

Table 16 shows the average number of children per family, by selected age category. Little difference in the number of children under six and those 14 to 18 was found. For these two age groups, the number of children in the household average about the same regardless of whether the spouse works off the farm or not. There are, however, significantly more children between the ages of six and thirteen in the household when the spouse works off the farm than when not. The off-farm employment of the spouse, in this case, may be a response to increased family income demands.

TABLE 16. Average Number of Children per Family by Child Age Group.

Age Group	Spouse does not work off the farm	Spouse works off the farm	F-Statistic	p=
	Average Number			
Children Under Six	0.116	0.092	0.43	0.5146
Children 6-13	0.280	0.406	3.12	0.0781
Children 14-18	0.217	0.271	0.87	0.3509

4.4.3. Working Hours

Off-farm work by the spouse reduces a source of family labor available for farm production activities. Spouses who do not work off the farm spend, on average, more than twice the time working on the farm than do spouses with off-farm jobs (Table 17). When the hours a spouse works off the farm are added to those worked on the farm, the total hours worked average almost 150 percent more for the spouse with off-farm work compared to the spouse not working off the farm (2115 vs 851).

TABLE 17. Annual Hours Worked by the Spouse.

Hours Worked	Spouse does not work off the farm	Spouse works off the farm	F-Statistic	p=
	Average Hours			
Hours Worked On the Farm	851.09	367.03	38.85	0.0001
Hours Worked Off the Farm	0.00	1747.58	1828.91	0.0001
Total Hours On and Off the Farm	851.09	2114.61	175.56	0.0001
Household Hours*	1668	1377	8.13	0.0046

*Daily average multiplied by 365.

As noted earlier, Buttel and Gillespie mention that men tend to give lower estimates of the number of hours their spouses work on the farm than the spouses themselves do. Since 87 percent of those interviewed were male, the on farm hourly figures for the spouse are likely to be underestimated, for both spouse groups. Tasks generally preformed by the spouse and not usually considered farm production activities, such as vegetable gardening, canning and food processing (to name a few) act as indirect sources of income (through income saving) and demand a significant allocation of time. Child care and housework place considerable demands on time as well. The table shows that when the spouse did not work off the farm, household hours, on average, were over 20 percent greater than when the spouse had an off-farm job. While the survey questionnaire asked for an aggregate total of household hours from all family members, it can be reasonably assumed that the majority of household labor was by the spouse. When household hours are added to hours of farm and off-farm work, the spouse with an off-farm job has considerably less time for leisure activities than does the spouse with no off-farm job.

4.4.4. Family Income

Total family income was highest when the spouse worked off the farm (Table 18). Of total family income, income from off-farm sources accounted for almost half

(49%) when the spouse did not work off the farm and over 75 percent when the spouse did. This again restates the dependence of Virginia's farm families on sources other than the farm for their family income. Significant differences in average net farm income between families with spouses not working off the farm and those with spouses working off the farm were found (\$17,910 vs \$9,676).

TABLE 18. Average Income by Spouse.

Income	Spouse does not work off the farm	Spouse works off the farm	F-Statistic	p=
	Average \$			
Net Farm Income	17910	9676	21.63	0.0001
Total Off-Farm Income	10747	30165	317.02	0.0001
Operator's Off-Farm Income*	9553	14678	10.66	0.0001
Unearned Income	6149	2743	10.27	0.0002
Total Family Income	34807	42585	12.49	0.0005

*Operator's portion of total off-farm income.

4.4.6. Summary of Spouse Characteristics

Fifty percent of the farm spouses worked off the farm some time during 1988 and of these, 70 percent worked off the farm full-time. Until recently, the farm spouse was generally neglected in data collection, analysis and policy development. What is shown here is that a considerable difference exists between spouses who choose to work off the farm and those that do not.

Spouses who work off the farm were, on average, younger, had more formal education, were more likely to have non-farm vocational training and had more years of off-farm work experience than those without off-farm jobs. This pattern among farm spouses is similar to that found for farm operators.

There are, on average, more children in the household between the ages of 6 and 13 when the spouse works off the farm than when the spouse does not. The average number of children under six in the household, as well as between the ages of 14 and 18, are about the same whether the spouse works or does not work off the farm.

The spouse working off the farm works significantly more hours in total than does the spouse with no off-farm job, even when household activities are included. While total family income was highest in families where the spouse worked off the farm, income from off-farm sources accounted for a significant portion of the total for both groups (49% and 75% respectively).

While the farm operator is generally the chief focus of farm policy initiatives, the farm spouse contributes a significant amount of both labor and income to the agricultural and rural communities. It is because of this contribution, and its expected increase in the future, that studying this group is important.

To apply the theoretical model (chapters 2 and 3) to the empirical data presented in this chapter, a model linking the two needs to be specified. The next chapter specifies this link (the binomial probit) and estimates models for both operators and spouses.

Chapter 5. Model Specification, Estimation and Analysis.

To examine how certain human capital, labor supply and labor demand characteristics affect the probability that a farm operator (or farm spouse) will work off the farm, a set of binomial probit models (one for the operator and one for the spouse) will be developed and estimated.

5.1. Model Specification

The specification of a binomial probit model was based on two primary factors. First, several key assumptions underlying the ordinary least squares (OLS) are violated when the dependent variable is dichotomous (Aldrich and Nelson, Gujarati). Secondly, a probit analysis can be the first step in the development of a labor supply model (Heckman, Lass, Findeis and Hallberg., Gunter and McNamara), which is the topic of future research.

When specifying a probability model where the dependent variable is dichotomous, 0 or 1 in this case, several important assumptions about the behavior

of the error term and the functional form specified in the standard OLS format are violated.

The error term in the OLS model is assumed to have constant variance, to be homoscedastic. That is, the variation of the error term, (which corresponds to the conditional variance of the dependent variable) stays the same as the value of the given independent variable changes. With a dichotomous dependent variable, however, the error term is not constant but varies according to the conditional expectation of the dependent variable. Because the conditional expectation of the dependent variable is a function of the values taken by the independent variable (Gujarati, Aldrich and Nelson), the variance of the error term is influenced by the independent variable. This relationship between the error term and the independent variable results in heteroscedasticity, which in an OLS format, would prevent minimum variance from being achieved (Spector and Mazzeo). When the sum of squared error terms are not minimized, confidence intervals cannot be set with accuracy and both the t and F tests, used to determine variable significance, will be unreliable (Aldrich and Nelson).

To avoid this pitfall, while utilizing a dichotomous dependent variable, the probit specification substitutes the probability of obtaining a discrete response for the discrete response itself (Spector and Mazzeo). This, in effect, transforms the discrete response to a continuous one, with a lower boundary of zero and an upper boundary

of one. The probability of the event occurring cannot exceed one, nor fall below zero.

This brings up another difficulty with regard to the OLS estimation of a dichotomous dependent variable model. Because the object of this research is to examine the probability of an event taking place (a farm operator or spouse working off the farm), the lower and upper bounds of probability should confine the regression to that interval. The assumption of linearity made by the OLS estimation procedure does not constrain the dependent variable to abide within a specific range of values. Consequently, as the independent variables are allowed to vary freely, values are likely to be generated both above and below the range of probability (0,1) for the dependent variable (Aldrich and Nelson, Spector and Mazzeo).

The probit specification adopts a functional form from a cumulative normal distribution function, which translates into the shape of a sigmoid curve with tails approaching but never reaching the zero/one probability limits.

The procedure used to estimate the parameters in a probit model is maximum likelihood estimation (MLE). This method operates similarly to the least squares method of OLS, with the important exception of its primary objective. Where least squares to minimizes the sum of squared errors in selecting parameter estimates, the MLE focuses on maximizing the probability of the observed dependent variable occurring (Aldrich and Nelson). The MLE procedure, particularly in larger sample

sizes, exhibits the properties of unbiasedness, efficiency and normality (Aldrich and Nelson, Gujarati). These properties provide the basis for hypothesis testing.

5.2. Farm Operator's Model Analysis

To estimate the operator's model, a dependent variable, composed of two categories was created; 0 = the operator did not work off the farm in 1988, and 1 = the operator worked off the farm in 1988. With five exceptions, all farm operators worked at least some time during the 1988 calendar year on the farm. Three of the five exceptions recording no hours of farm work were disabled, and the other two recorded zero hours of farm work with no explanation. All five, however, were listed as the operator of the farm and so were included in the data set.

Table 19. presents the independent variables, their mean values, and respective standard deviations. Using the Pearson's product moment procedure, none of the human capital and labor supply variables were found to be correlated above the .50 level, with the exception of age and the years of farm experience at .68.

The probit model assumes a non-linear specification following a sigmoid curve, where the curve's tails approach but never attain the zero and one limits, respectively. As a result, when measuring the change in probability corresponding

TABLE 19. Means of Variables Included in the Operator Model

Variable	Mean	Standard Deviation
Age	52.05	11.42
Age Squared	2839.50	1172.00
Education	11.94	3.38
Non-Farm Vocational Training(Yes)	0.38	0.49
Operator's Sex (Male)	0.94	0.25
Off-Farm Job Experience (Years)	17.95	14.20
Farm Experience (Years)	27.36	13.08
Children Under 6	0.08	0.33
Children 6-13	0.29	0.66
Children 14-18	0.23	0.57
Second Income Objective	0.23	0.42
Break-even Objective	0.36	0.48
Past-time Objective	0.09	0.28
Net Farm Income (\$)	13957.50	18836.51
Unearned Income (\$)	4694.97	10811.11
Spouse's Off-Farm Income (\$)	5860.30	10156.43
Construction (%)	6.38	1.24
Manufacturing (%)	19.93	8.87
Services (%)	21.37	3.85
Government (%)	16.35	5.83

Number of observations = 527

to a one unit change in the independent variable (*ceteris paribus*), an evaluation at the mean using partial derivatives is generally done instead of relying on the maximum likelihood derived coefficient which assumes a linear specification. The t-statistics correspond to the maximum likelihood coefficient estimates, with accompanying significance levels. Table 20 presents maximum likelihood estimated coefficients, t-ratios, marginal probabilities, and accompanying levels of significance.

TABLE 20. Probability that the Operator Works Off the Farm, Binomial Probit Model Results

Variable	Maximum Likelihood Coefficient	t-Ratio	Marginal Probability
Constant	1.6754	0.999	0.6680
Age	-0.0329	-0.660	-0.0131
Age Squared	-0.0003	-0.557	-0.0001
Education	0.1044	4.074 *	0.0416
Non-Farm Vocational Training (Yes)	0.3398	2.141**	0.1355
Operator's Sex (Male)	-0.5925	-2.076**	-0.2362
Off-Farm Job Experience (Years)	0.0572	8.244 *	0.0228
On-Farm Experience (Years)	0.0376	4.350 *	0.0150
Children Under 6	-0.4104	-1.673***	-0.1636
Children 6 to 13	0.2405	1.796***	0.0959
Children 14 to 18	0.0182	0.120	0.0073

Continued on next page.

TABLE 20. Probability that the Operator Works Off the Farm, Binomial Probit Model Results, Continued.

Variable	Maximum Likelihood Coefficient	t-Ratio	Marginal Probability
Second Income Objective	1.1413	5.211*	0.4551
Break-even Objective	0.7601	4.081*	0.3031
Past-time Objective	1.0654	3.298*	0.4248
Net Farm Income (1000's)	-0.0232	-3.990 *	-0.0092
Unearned Income (1000's)	-0.0495	-5.952 *	-0.0197
Spouse's Off-Farm Income (1000's)	-0.0029	-0.395	-0.0011
Construction (%)	0.0158	0.229	0.0063
Manufacturing (%)	-0.0356	-2.413**	-0.0148
Services (%)	-0.0538	-1.804***	-0.0215
Government (%)	-0.0234	-1.351	-0.0093

- * Significant at the 1% level
- ** Significant at the 5% level
- *** Significant at the 10% level

Correctly Predicted: 81.97%

Chi-Square = 332.11

Log-Likelihood = -198.73

The model correctly predicted 81.97 percent of the outcomes overall- 80 percent of the operators with no off-farm work and 84 percent of those with off-farm work.

5.2.1. Human Capital Characteristics

Neither age nor the age squared variable significantly influenced the off-farm participation of the operator. Huffman and Lange in their Iowa study, Gould and Saupe (in their 1982 Wisconsin model) and Reddy and Findeis (in their 1984 U.S. model) found similar results. Several studies estimating off-farm labor participation using similar models, however, have shown a quadratic age pattern to be significant (Oliveira (U.S.), Sumner (Illinois), Reddy and Findeis (1978 U.S. model), Gunter and McNamara (Georgia), and Lass, Findeis and Hallberg, 1989. (Massachusetts)).

In all past studies with significant results, younger operators are more likely to work off the farm than older operators. Contrary to expectations, however, results in Virginia indicate (*ceteris paribus*) that age is not a factor in determining whether the farm operator works off the farm or not, and a quadratic age pattern is not evident. The long history of off-farm employment among farm operators in Virginia, documented in the Census of Agriculture, may have contributed to the insignificance of the age variables.

As expected, the operator's level of education positively influences the decision to work off the farm. An additional year of education above the mean will increase the probability the operator will work off the farm by 4.16 percent. This indicates the operator's education has a stronger affect on the marginal value of labor off the farm than it does on the marginal value of labor on the farm. An

increase in the level of education was found to increase the probability of working off the farm in the great majority of probability studies (Sumner (1982), Oliveira, Reddy and Findeis, Jensen and Salant, Gunter and McNamara, Lass, Findeis and Hallberg (1989), Huffman and Lange).

Two dummy variables reflecting individual characteristics were evaluated, the operator's non-farm vocational training and the operator's sex. Non-farm vocational training, as expected, positively influences the operator's off-farm work decision. Sumner, 1982 (Illinois), and Jensen and Salant (Mississippi and Tennessee), two of the few to include a dummy variable for non-farm training, had significant and positive results as well. It makes sense that this investment in human capital would increase the marginal productivity of labor off the farm. When evaluated at the mean, an operator with non-farm vocational training is almost 14 percent more likely to work off the farm than the operator with no non-farm training.

The sex of the operator was found to have a negative effect on the probability of the operator choosing off-farm employment. When the farm operator is male, the likelihood of working off the farm is over 23 percent less than when the operator is a female. In other words, female operators are more likely to work off the farm than their male counterparts.

As expected, the years of off-farm work experience had a positive effect on the operator's choice to work off the farm. For an additional year of off-farm work experience, there was a 2.28 percent increase in the probability that the operator

would work off the farm (when evaluated at the mean). Among all operators, the average off-farm work experience was almost 18 years and underscores the importance of off-farm employment to the farm family in Virginia, whether the operator currently works off the farm or not.

Contrary to expectations, as discussed in Chapter 3, the number of years of on-farm work experience also positively influences the probability the operator will work off the farm. While Van Kooten and Arthur showed a strongly negative effect in their Canadian work, Findeis, Lass and Hallberg found this variable to have no significant influence on the probability the operator would work off the farm in their Pennsylvania study. Among Virginia farm operators, a consistent and relatively long history of dual farm/off-farm work has been established, and the positive influence of farm experience found in this analysis may reflect this historic work pattern. This pattern of dual employment is reflected in the sample data. When the operator works off the farm, the average years of work experience both on and off the farm are relatively close. When the average age of the operator is taken into consideration, it is apparent that those with off-farm jobs have worked both on and off the farm for a considerable period. When the years of farm experience was omitted from the operator's equation because of a correlation of .68 with age, the age variable did not change in sign or significance.

5.2.2. Labor Supply Factors

The influence of children in the household under the age of six on the operator's off-farm labor choice was expected to be ambiguous, but was found to have a negative affect in Virginia. This is consistent with the findings of Huffman and Lange in their Iowa study, however others have found both a positive (Lass, Findeis and Hallberg (1989) in Massachusetts) and insignificant (Smith, in her Texas and California studies and Gould and Saupe in Wisconsin) influence on the operator's off-farm work probability. The inconsistent findings among research is not surprising, as the added demand for income following an increase family size may be met by the expansion of the farm operation or off-farm employment. The response may be highly influenced by which opportunity is most readily available in that region of the country.

A similar argument can be made regarding the number of children in the household between 6 and 13 and those between 14 and 18. Only Huffman and Lange evaluated the affect of a similar age range of children on the operator's off-farm labor force participation (ages 6 to 11 and 12 to 18), but found no significant influence in their Iowa study. The number of children between 6 and 13, in this analysis, had a positive influence on the probability the operator would work off the farm. The affect of children between 14 and 18 on the operators decision to work

off the farm was expected to be ambiguous, and in this analysis had no significant influence.

The three dummy variables reflecting the farm objective: the farm as a second income, the farm as a break-even operation, and the farm as a past-time, were compared to operators who consider the farm a business operation (included in the intercept term). Results indicate that the operator with a business objective for farming is less likely to work off the farm than the operator with any of the three other objectives.

When the farm is considered a second income, the likelihood the operator will work off the farm (when compared to an operator with a business objective) is increased by almost 45 percent. An increase in the probability of working off the farm is also found for the break-even (30%) and the past-time operations (42%).

Both net farm income and unearned income negatively affect the operator's decision to work off the farm, as expected. An annual increase of \$1,000 in net farm income results in a decrease in the probability of working off the farm of about one percent when evaluated at the mean. When unearned income is increased by \$1,000, the probability of working off the farm decreases by almost two percent.

Following theory, an increase in net farm income is expected to cause a reallocation of labor away from both farm and off-farm work and toward leisure, and is consistent with the work of Reddy and Findeis, Smith, and Gunter and McNamara. Unearned income follows the same pattern, with the expectation of reducing either

or both farm and off-farm work activities through the income effect. The participation models of Sumner (1982), Jensen and Salant, and Lass, Findeis and Hallberg (1989), showed results suggesting this shift toward leisure when unearned income is increased.

Slightly over 11 percent of the operator's are single. To see if being single had an effect on the probability the operator would work off the farm, a dummy variable was created indicating whether the operator was married or not. A probability model was run including the dummy variable for marital status along with the spouse's income variable set to zero when no spouse was present, and this was compared to a model without the marital status dummy. The dummy variable was not significant and was omitted from the model.

The spouse's off-farm income, while negative in sign as expected, does not significantly affect the probability of off-farm work by the operator. While increasing the desire for leisure through an increase in the reservation wage, the influence of the other partner's involvement in the off-farm labor force may itself encourage off-farm participation (Reddy and Findeis), thus resulting in a mixed overall affect.

5.2.3. Labor Market Demand Factors ³

Eighteen labor market areas (LMA's) were used to define a set of four structural variables, with the purpose of estimating the affect of labor demand characteristics on the probability the operator would work off the farm. Contrary to expectations, the proportion of total employment in the manufacturing and in the service sectors, in an LMA, were found to negatively influence the probability of off-farm work by the operator. The negative influence of both the manufacturing and service sectors indicates that as their respective proportion of total employment in a labor market increases, the probability the operator will work off the farm declines.

Gunter and McNamara, in a study using 1980 data for Georgia farm operators, found the manufacturing sector to positively affect the probability of off-farm work. The difference between the results for manufacturing's employment influence in this study and that of Gunter and McNamara's may in part revolve around the period the data were collected (1988 vs 1980). In Virginia, from 1980 to 1988, total non-agricultural state employment grew by 29 percent whereas employment in manufacturing grew by only three percent (Virginia Employment Commission). These data include both the urban and rural sectors, however, and

³ In preliminary analysis, several models were run to measure the influence of different labor market demand variables on the operator's off-farm work probability; 17 labor market dummy variables, the labor market area unemployment rate, and the growth (1982-1987) of the manufacturing, construction, service and government sectors. None of the three models were found to significantly influence the operator's probability of working off the farm.

since the early 1980's manufacturing employment in the rural sector has declined relative to manufacturing employment in the urban sector. The percentage of a labor market area's employment in manufacturing may reflect other factors that influence the probability the operator will work off the farm, but are not wholly a function of the manufacturing sector itself. A relatively large proportion of employment in manufacturing may be indicative of a declining, rather than vital economy.

Gunter and McNamara looked at the service sector as well, but particularly focused on the professional portion of that sector and not the sector as a whole, as was done in the present study. The difference in the influence of the service sector in the present study and that found in Gunter and McNamara's may be related to the tendency of service sector employment in rural areas to be of the low wage/non-professional type (Porterfield). The skills required for these service jobs are less than those of most farm operators.

The probability of a farm operator working off the farm does not change significantly when either the construction or government industries increase or decrease their proportion of total LMA employment. This is not to imply that few farm operators working off the farm are, say, construction workers. Many in fact, may be, but the rise or fall of the construction industry's share of total employment in a labor market area, in this sample, does not influence the likelihood of working off the farm.

Upon examination, these four industries were found to employ the majority of the sample's operators, and the industries varied significantly across LMA's in their proportion of total LMA employment. When the distribution of operators with and without off-farm work in each LMA was tested using a chi-square test, the proportion of operator's with and without off-farm work was found to be the same. This uniformity suggests that while opportunities vary among LMA's by industry, the overall number of opportunities are sufficient to provide Virginia operators with the choice to work off the farm or not.

5.3. Farm Spouse's Model Analysis

To estimate the spouse's model, a two part dependent variable was created; 0 = the farm spouse did not work off the farm in 1988, and 1 = the spouse worked off the farm in 1988. While the operator was obliged by definition to work at least some time on the farm, the spouse is not so constrained. Not working off the farm includes the option of no direct involvement in farm production activities. The presence of single operators resulted in fewer observations for the spouse's model, 414 vs 527.

Table 21. presents the independent variables used in the spouse's model, as well as their mean values and standard deviations. Following, Table 22. shows the

TABLE 21. Means of the Variables Included in the Spouse Model

Variable	Mean	Standard Deviation
Age	49.08	10.46
Age Squared	2517.95	1028.80
Education	12.77	2.57
Non-Farm Vocational Training (Yes)	0.38	0.49
Spouse's Sex (Female)	0.94	0.23
Off-Farm Job Experience (Years)	12.85	10.79
Children Under 6	0.10	0.38
Children 6-13	0.34	0.73
Children 14-18	0.24	0.58
Second Income Objective	0.24	0.43
Break-even Objective	0.35	0.48
Past-time Objective	0.08	0.28
Net Farm Income (\$)	13793.00	18457.75
Unearned Income (\$)	4446.50	10931.42
Operator's Off-Farm Income (\$)	12115.57	16156.48
Manufacturing (%)	20.42	10.13
Retail (%)	16.47	1.48
Services (%)	21.84	3.52
Government (%)	16.79	5.98

Number of observations = 414

estimated maximum likelihood coefficients, t-ratios with accompanying levels of significance and the marginal probabilities.

TABLE 22. Probability that the Spouse Works Off the Farm, Binomial Probit Model Results.

Variable	Maximum Likelihood Coefficient	t-Ratio	Marginal Probability
Constant	4.4897	1.616	1.7893
Age	-0.1062	-1.445	-0.0423
Age Squared	0.0003	0.471	0.0001
Education	0.0852	2.246**	0.0339
Non-Farm Vocational Training (Yes)	0.2766	1.621	0.1102
Spouse's Sex (Female)	-0.2473	-0.629	-0.0986
Off-Farm Job Experience (Years)	0.0822	8.978*	0.0327
Children under 6	-0.6729	-2.750*	-0.2682
Children 6-13	-0.0215	-0.182	-0.0086
Children 14-18	-0.1120	-0.819	-0.0446
Second Income Objective	0.2053	0.828	0.0818
Break-even Objective	0.1134	0.510	0.0452
Past-time Objective	-0.3279	-0.933	-0.1307

Continued on next page.

TABLE 22. Probability that the Spouse Works Off the Farm, Binomial Probit Model Results, Continued.

Variable	Maximum Likelihood Coefficient	t-Ratio	Marginal Probability
Net Farm Income (1000)	-0.0278	-4.636*	-0.0111
Unearned Income (1000)	-0.0134	-1.571	-0.0053
Operator's Off-Farm Income (1000)	-0.0046	-0.770	-0.0018
Manufacturing (%)	0.0039	0.250	0.0016
Retail (%)	-0.1083	-1.270	-0.0432
Services (%)	0.0149	0.526	0.0059
Government (%)	0.0198	0.987	0.0079

- * Significant at the 1% level
- ** Significant at the 5% level
- *** Significant at the 10% level

Correctly Predicted: 79.71%

Chi-Square = 233.12

Log-Likelihood = -170.40

The model correctly predicted 79.71 percent of the outcomes overall. Seventy-eight percent of the outcomes were correctly predicted when the spouse did not work off the farm and 81 percent when the spouse did.

5.3.1. Human Capital Characteristics of the Spouse

Similar to the operator, and contrary to expectations, neither the age nor age squared variables significantly influenced the spouse's decision to work off the farm. These findings are consistent with those of Gould and Saupe in their Wisconsin study, for both the 1982 and 1986 periods. Reddy and Findeis found no significance for the age and age squared variables in their U.S. model for 1978, and the age squared term alone was significant in their 1984 U.S. model.

The level of formal education completed by the spouse has a positive influence on the probability the spouse will work off the farm, as expected. The majority of studies evaluating the off-farm behavior of the spouse have found the same. This model shows that an additional year of schooling, above the mean of 12.77 years, should result in a 3.39 percent increase in the probability the spouse will work off the farm.

Neither of the two dummy variables used to reflect human capital characteristics, non-farm vocational training and the spouse's sex (female), were found to have an influence on the off-farm choice of the spouse. Job opportunities available to the rural female are different than those facing the rural male (Bokemeier and Tickamyer; Deseran, Falk and Jenkins; Coughenour and Swanson; Spitze and Mahoney). A different demand for human capital is suggested by the difference in off-farm job opportunities. The decreased importance of non-farm

vocational training for the farm spouse may be a reflection of opportunity differences.

The years of off-farm work experience positively affected the probability that the spouse would work off the farm, following expectations. For an increase of one year's experience, the model indicated an increase in the probability of off-farm work of 3.3 percent. A mean of almost 13 years of off-farm experience among all spouses in the model underscores, as was found for the operators, the importance of off-farm employment to the farm family.

5.3.2. Labor Supply Factors

When the number of children in the household under six years of age increases, the probability the spouse will work off the farm decreases, consistent with expectations, and the studies of Gould and Saupe, Smith, Huffman and Lange, and Furtan, Van Kooten and Thompson. This study indicated that an increase of one child under the age of six decreases the probability of the spouse choosing to work off the farm by almost 27 percent.

An ambiguous affect on the spouse's probability of off-farm employment was expected for an increase in the number of children between 6 and 13, and no significant influence was found. Furtan, Van Kooten and Thompson found the number of children in the household between 6 and 12 to have no significant

influence on the woman's decision to work off the farm in their Saskatchewan study. Huffman and Lange, however, found children between 6 and 11 to negatively affect the off-farm work decision of the spouse in Iowa. The different results for the secondary school age children on the spouse's participation off the farm may be due to the regional history of off-farm opportunities facing the spouse.

An increase in the number of children in the household between 14 and 18 was expected to have an ambiguous affect on the probability of off-farm work by the spouse, and was found to have no significant influence. Huffman and Lange found the number of children between 12 and 18 to have no significant influence on the probability the spouse would work off the farm.

When compared with spouses on farms with business objectives, those living on farms with any of the other three farm objectives were not statistically more or less likely to work off the farm. This indicates that residing on a farm with a second income, break-even or past-time farm objective does not affect the spouse's decision to work off the farm differently from those residing on farms with a business objective.

Net farm income was found to negatively influence the spouse's participation in the off-farm labor force, as expected. Theory indicates that as family income increases, above some basic level, the individual will tend to substitute toward leisure and away from labor. Reddy and Findeis as well as Smith found net farm income to decrease the probability that the spouse would work off the farm. For a \$1,000

increase in net farm income, this study found the percentage decline in probability of the spouse working off the farm is one percent.

Unearned income, while having the expected sign, did not significantly influence the off-farm decision of the spouse. This finding is similar to that of several other studies. In the Texas portion of her research, Smith found unearned income to have a negative influence on the probability of the spouse working off the farm, while in California it did not although it was negative in sign. Reddy and Findeis also found a negative sign, but not a significant influence in their national study. When the spouse's labor is not directly a factor in income generation, as is the case with unearned income, the lack of significant influence on the probability of off-farm work may be due to preferences. In other words, an increase in unearned income may not increase the spouse's desire for leisure in the present because of the influence of income or other preferences.

The influence of the partner's off-farm income on the spouse's probability of working off the farm was statistically no different than zero. As discussed earlier, while increasing the desire for leisure through an increase in the reservation wage, the other partner's off-farm employment may itself encourage off-farm participation (Reddy and Findeis; Napier and Carter), resulting in a muddled overall affect.

5.3.3. Labor Market Demand Factors

Contrary to expectations, none of the four structural variables - the percent of LMA employment in manufacturing, retail, services, and government - used to estimate the impact of off-farm labor demand on the probability the farm spouse would work off the farm had a significant influence. In other words, the rise or fall in the industry's share of total employment does not influence the spouse's likelihood of working off the farm. Findeis, Lass and Hallberg found in their Pennsylvania study that a percentage increase in employment in the manufacturing sector (from 1980 to 1986) had no influence on the spouse's probability of off-farm work, but a percentage increase in the service sector had a positive affect. As discussed earlier for the farm operator, this lack of structural variable significance does not imply that few farm spouses are employed in these industries. It may be that sufficient opportunities exist in the labor market areas to work off the farm regardless of industry mix.

5.4. Summary

From this analysis, it is evident that human capital, and labor supply characteristics influence the off-farm employment decisions of both the farm operator and spouse. The structural variables used as a proxy for labor demand

characteristics, however, had little effect. While several of the human capital and labor supply factors influence the operator and spouse similarly, a proportionately greater number of variables have different impacts.

Neither the operator's nor spouse's age significantly influenced the probability of off-farm work, nor is a quadratic age pattern evident. This is a departure from the majority of other probability studies, but is consistent with the long history of off-farm employment among farm operators in Virginia. The level of formal education and off-farm job experience significantly influenced the probability of off-farm work by both the operator and spouse. The operator was influenced by non-farm vocational training, however, but the spouse was not.

While the number of children under six negatively influenced the off-farm work decision of both the operator and spouse, children between the ages of six and thirteen had a positive affect on the probability the operator would work off the farm, but a negligible influence on the spouse. The number of children between fourteen and eighteen had no significant influence on either the operator's or spouse's off-farm employment probability.

The probability of off-farm work was negatively influenced by net farm income in both the operator and spouse models, but unearned income influenced only the operator's probability of off-farm work and not the spouse's. Income earned by the other partner did not significantly influence the off-farm work decision of either the operator or spouse.

The farm objective significantly influenced only the probability the operator would work off the farm, and the proportion of LMA employment in the manufacturing and service sectors were the only two structural variables to influence the operator's probability of off-farm work. The probability the spouse would work off the farm was not significantly affected by any of the structural variables.

While similarities do exist between the operator and spouse, it is the differences in influence by some human capital, labor supply and demand factors on the probability of off-farm employment by the operator and spouse that suggest there is more to looking at the farm family than evaluating the farm operator. The farm operator and farm spouse need to be considered individually, as well as members of a family, for policy design and development efforts.

In addition, the operator's model suggests that farm operators in Virginia react differently to some factors than do their counterparts in other states. The majority of probability studies found a quadratic age pattern for the operator, indicating that the probability of working off the farm first increases, peaks, and then decreases as the operator gets older. Results from this Virginia study indicate that age is not a factor in determining whether the farm operator works off the farm or not, and a quadratic age pattern is not evident.

The majority of previous studies found farm experience to negatively influence the probability of off-farm work. In the present study, farm work experience

positively influenced the probability of off-farm work, possibly reflecting the relatively long history of dual farm/off-farm employment by farm operators in Virginia.

While this study found the number of children under six to negatively influence the probability the operator would work off the farm, as did Huffman and Lange's Iowa study, results from other studies have ranged from not significant to positive. This study divided children over six somewhat differently than most other studies. Only one other study examined the influence of the number of children in the primary school age range on the probability the operator would work off the farm, and found the influence not significant. In this study, the influence on the probability of the operator deciding to work off the farm as the number of children in the household between 6 and 13 increased was positive.

Consistent with the majority of probability studies, both net farm and unearned income were found to have a negative influence on the probability the operator would work off the farm. Income earned by the partner, however, was not significant in the present study. This finding differs from a national study using a dummy variable to indicate whether the partner earned off-farm income. The national study found a positive influence on the probability the operator would work off the farm.

Of the many probability studies including some proxy for labor demand, only two used structural variables. A study of Georgia operators found the percentage of employees in manufacturing positively affected the probability of working off the

farm, and a study of operators in Pennsylvania found an increase in manufacturing and service employment growth (1980-1986) positively affected the probability of off-farm employment. In contrast, this Virginia study found both manufacturing and service employment to have a negative influence on the probability the farm operator would work off the farm.

Considerably fewer probability studies have been conducted for the farm spouse, and resultingly, there are fewer studies for comparison. In contrast to probability studies of the operator, the majority of studies have found the age of the spouse does not significantly affect her off-farm work decision. The results of this study also found the influence of age to be not significant.

A Wisconsin study found non-farm vocational training to positively influence the probability of off-farm work by the spouse in one of the two time periods they studied. This study found non-farm vocational training to not be significant.

The majority of studies, as did this one, found the number of children under six in the household to negatively influence the spouse's probability of off-farm work. Findings on the impact of primary-school-age children range from negative to insignificant. This study found, as did a Canadian study, that primary school age children to had no significant affect on the spouse's off-farm employment probability.

In the majority of previous studies, net farm income had a negative influence on the spouse's probability of off-farm work while unearned income has not had a significant impact. The results of this study were consistent with previous findings.

Contrary to the positive findings of a national study, this study found that the partner's income had no significant influence on the probability of off-farm work by the spouse.

A Pennsylvania study found the percentage change in service sector employment (1980-86) positively influenced the probability the spouse would work off the farm. No significant influence was found, however, for any of the structural variables in this study.

This study has shown that farm operators and spouses respond differently to some human capital, labor supply and labor demand factors. Additionally, farm operators and spouses in Virginia appear to respond differently to several of these factors than do operators and spouses in other state and national studies.

Chapter 6. Policy Implications and Conclusions

The primary objective of this research has been to identify factors that influence the probability that a farm operator or spouse in Virginia would choose to work off the farm. Two off-farm labor participation models were developed to this end. The effect of changes in the factors identified on the off-farm employment status of the operator and spouse have also been discussed. The findings of this research have application to both the agricultural and the rural sector. Policy implications, conclusions, and recommendations will be presented in this final chapter.

6.1. Human Capital Characteristics

The level of income earned off the farm has been found in the majority of farm labor studies to be influenced by human capital factors. Off-farm incomes are determined, in large, by the offered wage rate, and the wage rate is often a function of education and/or skill level. It follows, then, that the higher the educational

and/or skill level the greater should be the income earning opportunities of the individual, and the probability of off-farm employment should increase. In both the operator and spouse models, the level of formal education was found to have a positive effect on the decision to work off the farm.

Increasing the level of formal education can be considered a long term development strategy. Teixeira and Mishel have questioned rural development that leans heavily on increasing education to enhance an area's ability to grow, however. These authors suggest that the supply of an educated work force in rural areas is not the problem, rather the problem is weak demand which results in a high out-migration of the educated (see also McGranahan and Ghefi). On the other hand, an increase in the level of education should expand the individual's range of job opportunities by allowing him or her to compete for existing jobs. Farm operators and spouses with higher education may be more likely than others to remain in the community because of community ties through land ownership. For the non-farm rural community, however, the benefit of increasing the level of education depends upon how policy is directed to discourage or constrain out-migration. Overall, increasing the level of education would be best coupled with other strategies (like appropriate job creation) if the welfare of the rural/farm community at large is being considered (Stallmann, et al.).

Non-farm vocational training positively affected the operator's off-farm work decision but did not influence the decision of the spouse. Non-farm vocational

training is a short run strategy to enhance the employment opportunities of individuals. The development of this strategy demands an assessment of a region's economic prospects, in terms of what to train a given population for. The industry of growth today may not be growing in the very near future, particularly in light of increasing global competition and market flexibility. The problems associated with not considering market globalization and flexibility were recently evidenced in many rural areas with the manufacturing sector's booming arrival and subsequent decline.

While formal education's influence on the probability of off-farm work was accounted for in the model, the level of formal education completed by the farm spouse, on average, is significantly higher than the operator's. On average, the spouse has completed more than high school, whereas the operator's average is less than high school. Non-farm vocational training, therefore, may not be as relevant a human capital development strategy for the farm spouse as for the operator because the spouse already has a higher formal education.

Differences in the influence of non-farm vocational training on the off-farm employment probability of the operator and spouse have important policy implications. Job opportunities available to the rural female have been found in several studies to be considerably different than those facing the rural male; typically more unstable and lower paying (Bokemeier and Tickamyer; Deseran, Falk and Jenkins). The differences in job opportunities suggest a demand for different human capital by the off-farm labor market, and may be reflected in the decreased

importance of non-farm vocational training for the farm spouse. Where human capital development is included in a rural development effort, care must be taken to assess the needs of the farm operator and spouse individually, and as members of a family.

Neither the age of the operator nor the age of the spouse had a significant influence on the probability of off-farm work. This is a departure from the majority of off-farm participation studies, but is consistent with the long history of off-farm employment among farm operators in Virginia.

Throughout this paper attention has been called to the traditional, full-time commitment to off-farm work by farm operators in Virginia. The sample indicated that operators and spouses had considerable off-farm work experience, whether they worked off the farm in 1988 or not, which underscores the involvement of the farm family in the off-farm labor market. Both models found that off-farm experience significantly increased the probability of off-farm work. Having an off-farm job encourages continued off-farm work, which suggests that the choice of off-farm employment is clearly not a transitional measure into or out of farming.

This point is additionally supported by the model's evaluation of farm work experience. Farm work experience was found to positively influence the operator's participation in the off-farm labor market. In other words, the more experience a farm operator had on the farm (no variable was available for the spouse in terms of farm work experience), the more likely he or she would be to work off the farm. It

should be noted, however, that years worked on the farm does not imply an increase in hours worked on the farm.

With both off-farm and on-farm work experience acting to encourage off-farm participation, the picture of farm operators in Virginia takes on a different quality than a traditional view of farming would support. Policies designed to benefit the farm sector must consider the dual farm/off-farm employment of the farm operator as a permanent condition of preference, rather than a temporary measure or a measure taken by those who consider farming to be merely a past-time. A very small percentage of sample farms were considered past-time operations.

6.2. Labor Market Demand Factors

Four labor market area structural variables were included in the model to account for the influence of labor demand on the probability of off-farm work. Results from the operator model indicated that of the four industries examined, only a change in the proportion of employees in a labor market area's manufacturing and service sector's affected the operator's off-farm work decision, and the effect was negative in both instances. As the proportion of employees in either the manufacturing or service sectors increase, the probability the farm operator will work off the farm declines.

While each of the four structural variables includes a wide range of wages and job types, as well as both full-time and part-time job opportunities, it is the particular increase in proportion of low paying manufacturing and service sector jobs in rural areas since the early 1980's (Porterfield; Deavers) that distinguish the manufacturing and service sectors from the construction and government sectors. The increase in lower end wage opportunities along with poor fringe benefits may account for part of these two industry's negative influence on the probability of the operator working off the farm. The manufacturing and service sector variables may also be picking up other factors that influence the probability of off-farm work, but are not wholly a function of the sectors themselves. Since the early 1980's, the rural manufacturing sector has also fared poorly when challenged by world markets, and the negative influence found in the operator's probability model may be indicative of a declining, rather than vital, local economy.

None of four labor market area structural variables; manufacturing, retail, services and government, were found to have significant influence on the off-farm work decision of the spouse. Although job opportunities are important, the mix of jobs in a labor market area does not seem to be important in determining off-farm labor force participation of the spouse. It is possible that the structural variables used in this present analysis have not been well measured, and consequently, further discussion will follow in section 6.6.

Job creation can increase both individual and community welfare. Employment stability and wage levels in the medium to long term, however, are important features to consider in the recruitment and/or creation of jobs (Kraybill, Johnson and Deaton; Singh). Additionally, Stallmann, et al. found that an individual's decision to invest in human capital was influenced by the types of jobs available. Low wage industries recruited to create jobs and income in the short run, may work against human capital development and community welfare in the long run, as well as have a depressing long term effect on the range of job opportunities the individual (and community) can choose.⁴

Job creation, with an eye for long term effects on human capital development, employment stability and wages, needs to be thoughtfully designed to benefit both the individual's and community's future.

6.3. Labor Supply Factors

Family characteristics can affect the operator's and spouse's off-farm work decision by influencing the marginal value of household/leisure activities and the marginal value product of labor on the farm. The number of children in the household under six years old had a negative influence on the spouse's decision to work off the farm. As the number of children under six increased, the likelihood that

⁴ See the discussion in section 6.1., particularly the segment on non-farm vocational training.

the spouse would choose to work off the farm declined. The increased child-rearing demands usually placed on the spouse (94 percent of which were female in this study) suggest this outcome. The number of children in this age range also negatively affected the probability the operator would work off the farm, suggesting that expanding demands for family income and child care are likely to be met with a choice not to work off the farm.

To increase the accessibility of existing off-farm job opportunities, the development of child care facilities should be considered. For the spouse particularly, but in view of the effect on family income ultimately, child day care services that correspond to local employment hourly demands is an appropriate development strategy.

Primary school age children (6 to 13), were found to have no influence on the spouse's off-farm labor market decision but had a positive affect on that of the operator. An increase in the number of children between six and thirteen in the farm household increased the probability that the operator would work off the farm. The greater demands placed on family income by primary school age children, compared to the children under six, may account for this influence on the operator's off-farm work decision.

Both the operator's and spouse's models found the number of children between the ages of 14 and 18 to have no significant influence on the probability of

off-farm work. This age group may substitute for, or complement, labor on the farm, as well as supplement family income with off-farm work.

Both participation models found net farm income to negatively affect the probability of off-farm work. As net farm income increases, the probability that the operator or spouse will choose to work off the farm declines. Income earned from farm production activities averages less than 17 percent of total family income among farms with an off-farm working operator, and 63 percent among farms where the operator does not work off the farm. Net farm income averages almost 23 percent of total family income among farms with an off-farm working spouse, and 51 percent among farms where the spouse does not work off the farm.

Unearned income negatively affected the farm operator's off-farm labor force participation, but while negative, did not significantly affect the probability that the spouse would work off the farm. A different set of income preferences may account for the different influence of unearned income for the operator and spouse (Barlett).

Although the influence of unearned income on the probability of off-farm work differed between the operator and spouse, the proportion of total family income made up by unearned income was similar. Unearned income averaged less than seven percent of total family income on farms having an operator with an off-farm job and almost 20 percent of family income on farms where the operator did not work off the farm. When the spouse worked off the farm, unearned income averaged

less than seven percent of total family income and almost 18 percent of family income on farms where the spouse did not work off the farm.

The partner's off-farm income was found to have no significant influence on the probability that either the operator or spouse would work off the farm. Income preferences of the family, a function of family size and consumption patterns, may have left income goals unmet with one partner working off the farm and may have clouded the expected income effect. Additionally, the off-farm labor force participation by one may make it more acceptable to the other, minimizing the income effect expected from higher family incomes.

Earned off-farm income does significantly affect total farm family income in Virginia. Family incomes were found to be 23 percent higher, on average, when the farm operator worked off the farm than when the operator did not. When the spouse worked off the farm, a 22 percent increase was found in total family income compared to farms where the spouse did not. These proportions of family income are likely to be underestimated because benefits such as health insurance and retirement programs (often provided by off-farm employers) were not included. Even though off-farm wages are likely to be different for the operator and spouse, it is interesting to note that when either the operator or spouse works off the farm, family income is increased in almost the same proportion. This comparable increase in family income, regardless of who works off the farm, suggests that family decisions to work off the farm are made rationally. Because off-farm income is generally more

stable than farm income, the income distribution shown in Chapter 4 indicates that, on average, Virginia farm families are both increasing and smoothing their income flow (and reducing risk) through the off-farm labor market.

As a result of both the higher total incomes earned by families with an operator and/or spouse working off the farm, and the proportion of total income originating from off-farm sources, changes in the non-farm economy are expected to affect the majority of Virginia farms more than changes in the farm economy.

When overall model results are examined, it is clear that factors influencing the farm operator and farm spouse to work off the farm are not different from factors expected to influence the non-farm rural resident's employment choice. Variables found to be important to off-farm labor force participation in this present study are not farm specific, except for farm income, which suggests that policies aimed at rural development may be more appropriate as a means of improving farm family welfare in Virginia than is current agricultural policy.

6.4. Agricultural Policy in Virginia

If stabilizing and/or raising the income level of the farm family is an objective of federal agricultural policy, then it is reasonable to ask if this policy goal is being met in Virginia.

Agricultural policy has traditionally been tied to the production of specific commodities. The impacts of government commodity programs are highly regional in Virginia. Only about eight percent of total farm acreage was allocated to the production of commodity program crops in 1987. These crops: wheat, feed grains, cotton, peanuts, and tobacco generated approximately 12 percent of the state's total agricultural sales value (Census of Agriculture). Not all farms producing crops eligible for price supports, however, are participants in government commodity programs. In fact, from available Census data it appears that while 40 percent of Virginia's farms raise crops eligible for price support payments, less than six percent of the eligible farms participate. Additionally, in 1987 less than three percent of Virginia's farms received 70 percent of all direct government commodity payments.

The majority of Virginia farms raise livestock, particularly cattle, which, with the exception of dairy and wool, are enterprises which garner no government support. The wool industry receives a production incentive payment and the dairy industry receives price support through government purchases; however, these two industries account for less than seven percent of the farms in Virginia. Not only are most livestock production activities ineligible for government support, but they may be placed at a disadvantage through artificially maintained prices for feed grains. Over half of all agricultural sales dollars in 1987 came from beef cattle, poultry and pork, and over 66 percent of Virginia's farms were involved in their production.

Agricultural policy coming out of the federal government makes up the great proportion of agricultural policy implemented in Virginia. This policy scenario suggests that either state legislators assume federal agricultural policies are meeting the needs of farm families in Virginia, or they feel that any special needs a farm family may have are being met through other programs. Figures clearly indicate, however, that the way current agricultural policies are implemented the majority of farm families in Virginia are not being reached.

Recognizing the failure of current agricultural policies to reach the majority of Virginia's farm families constitutes no cry for an increase in or continued farm support measures. It is rather an injunction to review current programs, and if the intended objective of the federal (and state) farm program remains to increase and/or stabilize farm family income, then alternatives, at least in this state, need to be proposed.

6.5. Rural Policy

Because off-farm jobs have been shown to increase overall incomes among farm families in Virginia and can provide income stability, agricultural policy makers would do well to encourage strategies that strengthen the off-farm earning abilities of farm operators and spouses as well as the development of off-farm job opportunities. Strategies designed to include off-farm employment options, however,

need to be flexible enough to accommodate regional/local conditions, needs and resources because of the great diversity among rural areas (see Rowley and Reid). When strategies are directed to the creation of jobs, however, flexibility in off-farm job hours may allow for greater participation among farm family members (Stallmann and Alwang).

Those understanding that farm policy is not synonymous with rural policy, and who are looking to rural policies geared toward economic development, usually focus in one of two directions (Knutson and Fisher). One direction is infrastructural expansion, which includes the development of roads, bridges, industrial parks, and job training programs in hopes of attracting industry. The other direction, human capital development, looks to increase the level of education and health care, and provide leadership training to encourage industrial location. Both of these approaches stress the need for job opportunities, though the long term effects of luring certain kinds of industries into a rural area has been questioned (Stallmann, et al.). Regardless of focus, programs geared to improving the welfare of those residing in rural areas in the long run must examine both the farm and non-farm sectors of the community to assess the types of needs and contributions each can make (Shaffer, Salant and Saupe). It is clear that the majority of farm families in Virginia have a vested interest in efforts to develop and strengthen the local economy.

The importance of rural development to Virginia's farm sector is evident from this study, and it is saddening to note the disproportionate lack of emphasis on Community and Rural Development (CRD) by the extension service and the land grant community (McDowell). Because the majority of farms in Virginia are tied to the rural community through the off-farm labor market, a realignment of extension and research resources toward CRD may better meet the needs of Virginia's farm families than the current emphasis on agriculture.

6.6. Future Research

Because of the importance of off-farm income to total family income, the present study was developed as the first part of a two part off-farm labor model. The second part will examine the factors that determine the off-farm earnings of the farm operator and farm spouse. This present study, the probit portion, will be used to develop an index, which can then be used as an independent variable in the subsequent equation to check for sample selection bias. It is necessary to look for possible selection bias in the sample because no off-farm wage data are observable for those not working off the farm. Heckman's procedure for dealing with sample selection bias is the most popular method used in off-farm labor supply models (Gebauer).

Findeis, Lass and Hallberg emphasize the importance of examining labor demand factors, because of their relationship to rural development policies as well as farm family welfare. Reddy and Findeis noted, as have others, the relatively crude nature of variables used as a proxy for the influence of labor demand on the probability of off-farm work. As the variables used in the present research did not perform well in explaining the off-farm employment decisions of either the operator or spouse, alternative measures need to be considered.

The use of labor market areas to capture employment opportunities, while better than those politically defined, are nonetheless handicapped in presenting a full picture of available opportunities by their minimum population constraint of 100,000 (Tolbert and Killian; Stallmann and Nelson). Where sparsely populated counties are consigned to a labor market area solely to meet the population criteria, labor demand factors, no matter how well defined, may have their influence obscured. One measure to consider may be commuting zones, developed by Killian and Tolbert. Commuting zones define areas on the same basis as do labor market areas, however the minimum population constraint is relaxed.

Average wages in the labor market area or average wages of particular industries in the LMA (and sub-industry where there is a pronounced dichotomy in wage levels), could offer important information about the influence of both wages and industry type on why off-farm work is chosen or not.

An examination of particular industries and occupations chosen by the off-farm working operator and spouse may also provide insight for future job recruitment and development strategies.

Labor market areas, while providing general boundaries for employment opportunities, do not necessarily reflect the social and cultural boundaries that may influence off-farm employment decisions. Regional differences in tradition, along with attitudes toward the family and mobility are part of this social/cultural context. If development strategies are going to be considered on a regional or community basis in Virginia, then effectiveness would require some evaluation of an area's social and cultural characteristics, particularly in terms of labor supply.

While this research addresses the factors affecting the decision of farm operators and spouses to work off the farm, the motives for their choice to work both on and off the farm or work only on the farm remain unclear. Looking at employment decision factors without examining the motives behind them gives an incomplete picture of the decision making process. Do individuals with off-farm jobs take up farming as a function of residential choice, as a flexible second income, as a mixture of the two or for some other reasons altogether? How do income and lifestyle goals influence the off-farm work decision?⁵ Policy decisions can be more accurately focused if the motives for the off-farm/farm choices are known. This kind

⁵ Wise and Brannen as well as Patrick, Blake and Whitaker suggest that farmer goals (for farming) are not uni- but multi-dimensional.

of knowledge should have relevance for both the farm and rural sectors, as the factors found in this present study to influence off-farm employment decisions were notably not farm specific.

Additionally, it is because factors that affect the off-farm labor decisions of the farm operator and spouse are generally not farm specific, coupled with the vested interest Virginia farm families have in the development of the local economy, that research into how rural non-farm families in Virginia allocate their labor is warranted.

Off-farm jobs do not uniformly demand the same hourly commitment, and consequently, whether the off-farm job is full-time or part-time may be an important distinction. An individual with a part-time job off the farm will have more time available to farm than would be possible with a full-time, off-farm job. Additionally, fringe benefits are more likely to be offered to full-time employees than those working part time (Jensen and Salant; Porterfield). This research has not considered the variability in off-farm employment hours and how those hours may influence farm and off-farm labor decisions. An additional examination of this issue may also benefit rural job creation strategies.

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Vita

James H. Nelson was born May 6, 1947 in Frankfort, Germany. He Graduated from Franklin High School in Seattle, Washington in 1965, was drafted by the Army in August of 1966 and was honorably discharged in August of 1968 after serving a year in Viet Nam. He subsequently worked in various aspects of reinforced steel construction through 1975. On the 1st of June,1976 he made a decision to follow Jesus Christ. From that time until the end of 1983 he worked in a non-profit Christian ministry, working primarily with the homeless, but also with the elderly, those in jail and those with emotional problems. He worked on a dairy farm occasionally/part-time from 1978 through 1983, and full-time during the 1984 period. In January of 1985 he enrolled at Virginia Polytechnic Institute and State University in Blacksburg, Virginia, where he met Catherine Joan Sherwood, whom he married in November of 1987. He received a B.S. degree in Agricultural Economics in 1988. He subsequently entered the Masters program in the Department of Agricultural Economics at Virginia Tech, and completed the degree program in December of 1992.