Formulating Rural Development Programmes to Aid Low-Income Farm Families

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Abstract: Rural development programmes may facilitate the off-farm employment of low-income farm families and provide additional public support beyond traditional US farm income and price support programmes. To examine the implications of alternative rural development strategies for low-income farmers, joint off-farm labour participation models are developed for farm operators and spouses. Univariate and bivariate probit models are estimated, based on 1985 Current Population Survey farm household data. The bivariate model is applied to data on 240 farm families that qualify as low-income families. Study results indicate that age, education, number of young children, and location represent constraints to participation among differentiable segments of the low-income farm population. The implications of these results for the formulation of rural development programmes to aid farm families are examined.

Introduction

Since 1980, US farm families on average have earned over 50 percent of total farm income from off-farm sources. Income from off-farm employment of farm family members represents the principal source of off-farm income, particularly for small- and medium-sized farms. In the USA, as well as in many developed countries, the majority of farm families depend on off-farm employment of family members to provide a significant income supplement (Kada, 1980; OECD, 1977; Ahearn, 1986; Ahearn and Lee, 1988; and Fuller 1988).

Despite the trend towards greater reliance on off-farm income, a significant number of farm families continue to earn low total incomes. These families earn low net farm incomes and are either unable or unwilling to supplement their farm incomes significantly with income from off-farm work. In some cases, family members are unable or unwilling to participate in the off-farm labour market. The option of working off the farm may not be available due to lack of off-farm job opportunities or lack of human capital demand from employers recruiting for jobs geographically accessible to farm families. The time requirements of farming, household work, and child care may also constrain participation. Alternatively, farm family labour resources employed off the farm may be underemployed, due to low hours or low income.[2]

This study examines factors affecting the joint off-farm labour participation decisions of US farm operators and spouses, using 1984 farm household data from the 1985 Current Population Survey (CPS). Univariate and bivariate probit models are developed to assess the influence of selected individual, family, farm, and location characteristics on the probabilities that the farm operator, farm spouse, or both work off the farm. Unlike Reddy and Findeis (1988), the jointness of household decision making is explicitly modelled. Alternative rural development strategies to benefit low-income farm families are assessed on the basis of the study results.

Off-farm Employment Decisions

Farm households are assumed to maximize utility by choosing between purchased goods and leisure, subject to a full-income constraint and constraints imposed by farm production and time.[3] The probability that the individual works off the farm depends on the individual's reservation wage (w_i^*) relative to the market wage rate net of commuting costs (w_i^n). Participation decisions by the farm operator and farm spouse (i.e., D_o and D_s) can be expressed as follows, where jointness between decision rules *(1)* and *(2)* is assumed:

(1) $D_o = 1$ if $w_o^* < w_o^n$ and 0 if $w_o^* \geq w_o^n$; and

(2) $D_s = 1$ if $w_s^* < w_s^r$ and 0 if $w_s^* \geq w_s^r$.

Whether the farm operator, farm spouse, or both participate in off-farm work is assumed to depend on the characteristics of the individual, the farm family, the farm, and the location of the farm relative to off-farm employment opportunities. To measure the influence of these factors on the likelihood of off-farm work, the following models were specified:

(3) participation function of the farm operator—

$$P(D_o=1) = \beta_0 + \beta_1 AGE_o + \beta_2 AGESQ_o + \beta_3 NCHS_o + \beta_4 COLGE_o + \beta_5 GTCOL_o + \beta_6 ED_s + \beta_7 CHL5_f + \beta_8 CHL13_f + \beta_9 SMSA_f + \beta_{10} NE_f + \beta_{11} SOUTH_f + \beta_{12} WEST_f + \beta_{13} Y_f + \beta_{14} OT_f + \varepsilon_o;$$ and

(4) participation function of the farm spouse—

$$P(D_s=1) = \beta_0 + \beta_1 AGE_s + \beta_2 AGESQ_s + \beta_3 NCHS_s + \beta_4 COLGE_s + \beta_5 GTCOL_s + \beta_6 ED_o + \beta_7 CHL5_f + \beta_8 CHL13_f + \beta_9 SMSA_f + \beta_{10} NE_f + \beta_{11} SOUTH_f + \beta_{12} WEST_f + \beta_{13} Y_f + \beta_{14} OT_f + \varepsilon_s;$$

where, for the operator ($i=o$) and spouse ($i=s$):

$P(\bullet)$ = probability of stated outcome;
AGE_i = age of individual;
$AGESQ_i$ = square of age of individual;
$NCHS_i$ = 1 if operator/spouse has not completed high school, 0 otherwise;
$COLGE_i$ = 1 if operator/spouse has one to four years of college-level education, 0 otherwise;
$GTCOL_i$ = 1 if operator/spouse has more than four years of college level education, 0 otherwise;
ED_i = 1 if spouse of the operator has education beyond high school, 0 otherwise;
$CHL5_f$ = number of children 5 years of age or younger in the household;
$CHL13_f$ = number of children 13 years of age or older in the household;
$SMSA_f$ = 1 if farm is located in a Standard Metropolitan Statistical Area (SMSA), 0 otherwise;
NE_f = 1 if farm is located in the Northeast, 0 otherwise;
$SOUTH_f$ = 1 if farm is located in the South, 0 otherwise;
$WEST_f$ = 1 if farm is located in the West, 0 otherwise;
Y_f = net farm income of farm family in thousands of dollars; and
OT_f = other income (i.e., all income received from sources other than from the farm, off-farm wages and salaries, and self-employment income), in thousands of dollars.

Univariate probit models were first estimated for farm operators and spouses separately. A simultaneous equation bivariate probit model was then estimated using the two-stage method for estimating simultaneous binary equations suggested by Maddala (1983).[4]

Factors Affecting Participation in Off-Farm Work

The results of the univariate and bivariate probit models for farm operators and spouses are presented in Tables 1 and 2. Likelihood-ratio tests were significant for the univariate

Table 1–Estimated Coefficients of Off-Farm Labour Participation Models for US Farm Operators, 1984*

Variable	Univariate Estimate	t-statistic	Derivative†	Bivariate Estimate	t-statistic	Derivative†
Intercept	-0.3466	-0.96	--	1.7221	0.76	--
AGE_o	0.0235	1.21	0.0086	0.0362	2.08	0.0141
$AGESQ_o$	-0.0006	-1.17	-0.0002	-0.0005	-0.63	-0.0002
$NCHS_o$	-0.3274	-4.53	-0.1248	-0.2715	-2.61	-0.1039
$COLGE_o$	0.1422	1.83	0.0563	0.1521	2.20	0.0597
$GTCOL_o$	0.5289	3.07	0.2079	0.5128	6.72	0.2009
ED_o	0.3167	2.92	0.1223	0.3339	7.27	0.1296
$CHL5_r$	-0.0421	-0.85	-0.0159	-0.0382	-1.38	-0.0145
$CHL13_r$	0.0113	0.91	0.0044	0.0329	1.84	0.0127
$SMSA_r$	0.2991	2.65	0.1201	0.3670	4.70	0.1509
NE_r	0.3082	1.89	0.1228	0.2983	2.17	0.1187
$SOUTH_r$	0.3710	3.99	0.1494	0.3728	2.48	0.1496
$WEST_r$	0.0721	1.06	0.2093	0.0906	0.80	0.0369
Y_r	-0.0224	-8.22	-0.0099	-0.0275	-12.66	-0.0120
OT_r	-0.0096	-0.63	-0.0037	-0.0183	-0.92	-0.0072

*n = 1,184.
†The partial derivative measures the change in the probability of off-farm labour participation resulting from a per-unit increase in the exogenous variable.

models at the given χ^2 distribution degrees of freedom, but the correlation between the disturbance terms of the univariate operator and spouse models was statistically significant. The hypothesis of nonjointness of participation decisions by farm operators and spouses was thus rejected.[5] The bivariate model in which the jointness of decision making is implicitly considered was therefore accepted as the truer representation of the relationships between the explanatory variables and participation. This result was in contrast to the jointness tests in Hallberg, Lass, and Findeis (1988) based on 1986 Massachusetts farm household data but consistent with CPS-based models estimated by Tokle (1988) in collaboration with Huffman.

Previous studies of off-farm work participation (e.g., Huffman, 1980; Sumner, 1982; Hallberg, Lass, and Findeis, 1988; and Findeis, 1988) have incorporated age and age-squared exogenous variables to capture the hypothesized curvilinear effects of age on participation. Statistically significant relationships are found between participation and the age of the operator and age-squared of the spouse (Tables 1 and 2). However, the signs of the age and age-squared variables are consistently positive and negative, respectively. The consistency of these results with other studies suggests that age has an important (curvilinear) influence on participation in off-farm work.

Education is also important. The models estimated here measure the effects of the individual attaining alternative levels of education (not a high school graduate, one to four years of college-level training, and postgraduate college education) relative to the effect of attaining a high school degree. The education of the individual's spouse also is incorporated into the models with a variable representing the spouse's education beyond high school (ED_s).

In the bivariate model, the education estimates are (in general) statistically significant. Higher levels of education increase the likelihood that the operator will work off the farm, higher levels of education increase the opportunities for higher wage rates (i.e., w_o and w_s), and attainment of certain levels of education (e.g., graduation from high school) may qualify the individual for a greater diversity of jobs. The education level of the farm spouse also positively affects the operator's probability of off-farm employment.

For the farm spouse, education beyond high school positively affects the probability of off-farm work. However, no significant difference exists between not being a high school graduate and earning a high school degree, in terms of the likelihood of working off the farm. Similarly, education of the farm operator beyond high school is shown to have no

Table 2-Estimated Coefficients of Off-Farm Labour Participation Models for US Farm Spouses, 1984*

Variable	Univariate Estimate	t-statistic	Derivative†	Bivariate Estimate	t-statistic	Derivative†
Intercept	0.2163	0.54	--	0.5217	0.92	--
AGE_o	0.0309	1.65	0.0118	0.0482	1.49	0.0186
$AGESQ_o$	-0.0007	-3.51	-0.0003	-0.0008	-3.48	-0.0003
$NCHS_o$	-0.2089	-1.65	-0.0842	-0.2104	-1.40	-0.0840
$COLGE_o$	0.1588	2.01	0.0632	0.1575	3.82	0.0632
$GTCOL_o$	0.6533	3.67	0.2583	0.6497	6.08	0.2574
ED_o	-0.1256	-0.89	-0.0497	-0.1652	-1.10	-0.0653
$CHL5_o$	-0.4620	-5.61	-0.1781	-0.4738	-7.89	-0.1833
$CHL13_o$	-0.0763	-0.97	-0.0299	-0.0771	-0.74	-0.0301
$SMSA_o$	-0.0625	-0.70	-0.0250	-0.1088	-0.74	-0.0398
NE_o	-0.2153	-1.09	-0.0843	-0.2180	-1.32	-0.0862
$SOUTH_o$	-0.0043	-0.08	-0.0017	-0.0050	-0.21	-0.0020
$WEST_o$	-0.1284	-1.74	-0.0522	-0.1161	-1.36	-0.0473
Y_o	-0.0049	-2.17	-0.0021	-0.0032	-2.88	-0.0014
OT_o	-0.0182	-1.49	-0.0071	-0.0153	-1.33	-0.0061

*n = 1,184.
†The partial derivative measures the change in the probability of off-farm labour participation resulting from a per-unit increase in the exogenous variable.

significant effect on the probability of off-farm employment of the farm spouse. The coefficient of ED_o is in fact negative.

The number of young children in the farm household significantly influences participation by farm spouses; the estimate measuring the influence of the number of preschool children is negative and highly significant, indicating the constraint of young children on nonfarm work among farm spouses. Previous studies of US farm spouses and farm women have found similar results (e.g., Rosenfeld, 1985; and Thompson, 1985). The estimate for the effect of young children on participation among farm operators is also negative but not significant at the 5-percent level.

The effects of older children on participation in off-farm work among farm operators and spouses are not statistically significant at the 5-percent level, although a statistically weaker relationship for farm operators is demonstrated. On farms with older children in the household, the farm operator is more likely to be employed off the farm. Older children can provide labour resources to substitute for farm operator labour. At the same time, farm operators may be "pushed" into the nonfarm labour market to finance college educations (and assets) to benefit older children.

Tables 1 and 2 confirm that the farm's location has an effect on off-farm work decisions among US farm operators.[6] Operators in the Northeast and South are more likely to be employed off the farm than farmers in the North Central region, the region selected for comparison. No statistically significant difference was found for farm operators in the West, relative to the North Central region. However, the farm's location in an SMSA positively affects participation. These results probably reflect the smaller average size of farms in the Northeast and South and near urban centres and may reflect an increased availability and accessibility to nonfarm jobs in these regions. Multiple job-holding among farm operators is more prevalent in these regions, and the proportion of income earned from off-farm sources is higher. In contrast, neither regional location nor location of the farm in an SMSA appears to have an impact on the likelihood of off-farm work among farm spouses. The location estimates for farm spouses are not statistically significant in either the univariate or bivariate probit models.

Finally, net farm income is an important variable for both farm operators and spouses. The lower the net farm income, the greater the probability that farm family members work off the farm. The amount of income earned from other income sources appears to have no significant impact on work/no work decisions with respect to off-farm employment.

Participation among Low-income Farm Families

Of the 1,184 farm families in the 1985 CPS farm (couple) sample, 240 families were classified as having low income. Low-income farm families were defined as families comprised of four or fewer individuals jointly earning less than the 1980 US Census weighted average poverty threshold for four-person families, and families of five or more individuals earning less than the respective poverty thresholds for larger family sizes.

The off-farm participation models in Tables 1 and 2 showed the importance of age, education, family characteristics, location, and net farm income as factors influencing the off-farm work decisions of farm family members. Families least likely to earn income from off-farm employment are older farm couples, farm operators and spouses with less education, families operating farms in the North Central and West regions of the USA, and farms in nonmetropolitan locations. Families with higher net farm incomes are less likely to be multiple job-holding farm families.

Low-income farmers earn low net farm incomes, a factor shown to be associated with higher off-farm participation rates. Yet among the low-income families, 19 percent of the farm operators were employed off the farm compared to 47 percent for all farm operators in the CPS sample. Among low-income spouses, 41 percent had off-farm jobs, compared to 55 percent for the total sample. Clearly, low-income farm family members are less likely to have off-farm jobs providing supplementary income to the farm household.

Constraints to participation among low-income families suggest potential avenues for policy interventions to aid farm families most in need. When the bivariate participation models in Tables 1 and 2 are applied to data for low-income farm family members, several observations can be made. The low-income farm operators not working off the farm generally can be classified into one of two groups: older farm operators who in many cases had not graduated from high school and younger operators with at least a high school education (and in many cases college-level training or even postgraduate work). Among the former group, none of the farm operators was predicted to work off the farm.

Farm spouses could be similarly categorized: younger spouses who had generally graduated from high school and in many cases had acquired some college-level training, and older farm spouses with a spouse that did not work off the farm. The bivariate probability model generally predicted that spouses in the former group would be less likely to work off the farm, principally due to the presence of young children. Few of the older farm spouses were predicted to work off the farm despite the observation that most of these individuals had graduated from high school. Few older farm spouses lacked a high school degree, an unanticipated observation.

The higher proportion of low-income families in the North Central region (58 percent compared to 50 percent for the entire sample) and the observation that 90 percent of the low-income families operated farms in nonmetropolitan areas of the USA further constrain off-farm work among many low-income households. Off-farm jobs are less accessible, and job opportunities are more limited in nonmetropolitan areas, in the North Central states, and in many states in the West.

Implications for Policy

One option for farm families is to use off-farm employment as a strategy to alleviate farm financial stress, either on a permanent basis or as a temporary means of facilitating movement out of (or even into) agriculture. Low-income farm families are less likely to work off the farm, on average. One reason appears to be the higher proportion of older farm operators and spouses. These individuals are either unable or unwilling to adjust labour resources out of agriculture, even partially, into the off-farm labour market.

The lack of formal education and job-specific off-farm work experience may constrain older farm operators from seeking off-farm jobs. Older farm spouses are less likely to be constrained by education but may be negatively affected by lack of (nonhousehold) work

experience. These factors put older operators and spouses at a disadvantage in the rural nonfarm labour market and generally mean lower returns to off-farm work.

Human capital policies have been one focus of rural development policy in the USA. Such policies have typically attempted to enhance educational opportunities available to rural residents. Brown *et al.* (1987) emphasize the need for human capital policies to provide educational opportunities for displaced rural workers. Older farm family members are quasi-displaced, not willing to leave agriculture but either unable or unwilling to commit labour resources off the farm. To the extent that farm family members are willing but unable to find off-farm jobs, programmes that focus on retraining serve farm as well as rural nonfarm families. However, older farm families must be willing to take advantage of such opportunities for such programmes to be beneficial.

Younger low-income farm families are, in general, better educated and less in need of human capital development programmes. A high proportion of these farm families operate full-time farms in the North Central region. Many of these families also have children of preschool age. Thus, even though the farm spouse is generally well-educated, the presence of young children in the household may limit the spouse's participation in the off-farm labour market. Such families could benefit from additional child care programmes being established in rural communities. However, in some low-income farm families in the CPS sample, the farm spouse was employed full-time off the farm, but the family continued to be financially stressed. On these farms, the losses from the farm, probably due to high farm-debt loads, were too substantial to be offset by the off-farm income earned by the farm spouse.

Finally, policies to create, retain, and improve rural job opportunities accessible to farm families, particularly families in the North Central region, are appropriate. To the extent that rural economic development of the North Central region is considered an appropriate policy goal, programmes to create new job opportunities and maintain existing opportunities in this region will facilitate the process of adjustment for a high proportion of those farm families most in need of public aid.

Notes

[1]Pennsylvania State University.

[2]Lichter and Costanzo (1986) document higher rates of underemployment in US nonmetropolitan regions compared to urban areas. Lichter and Costanzo used a labour use framework to measure the prevalence of different types of underemployment, including the inability of workers to work as many hours as preferred (low hours) and the prevalence of the working poor (underemployed by reason of low income).

[3]For a thorough discussion of theoretical issues related to agricultural household models, see Huffman (1988). Also see Bollman (1979), Huffman (1980), and Sumner (1982).

[4]This method (also used in Hallberg, Lass, and Findeis, 1988) involves the estimation of a reduced-form probit in the first stage and use of the fitted values from the first stage as exogenous variables in the second stage. The estimates from the second stage are then used as starting values for the final estimation of the bivariate probit model.

[5]An alternative test is to jointly restrict the estimates for the predicted endogenous variables and the correlation between the models to zero and perform a likelihood-ratio test (Hallberg, Lass, and Findeis, 1988).

[6]See Findeis, Hallberg, and Lass (1987) for a comparison of estimated off-farm participation and off-farm labour supply models for farm operators and spouses. As discussed in Findeis, Hallberg, and Lass (1987), location is recognized as an important determinant but has not been effectively measured by less aggregated measures.

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DISCUSSION OPENING—*Judith I. Stallman* (Virginia Polytechnic Institute and State University)

The paper by Findeis and Reddy examines the factors that influence members of a farm family to seek employment off the farm. The model incorporates supply factors, family labour characteristics, and demand factors, particularly the region of the country and location of the farm near an urban area. In addition, the author recognizes that off-farm employment is a joint decision, even though only one member may be employed off the farm.

The model and the results are reasonable. However, two variables that could be expected to affect off-farm employment are not included in the model—wealth and type of farm. I assume that the variables are omitted from the model because they were not available in the data set that the author chose. In the future, these variables (or proxies) should be included.

The type of farming affects the number of hours that the family has available for off-farm employment. Part of this may be picked up in the region variables, but these variables were intended to reflect labour demand, not supply. Certain farm enterprises, particularly those dealing with livestock, require continual attention. Even though farm income is low, family members may not work off the farm because they cannot find a job that complements their on-farm hours. This family dilemma certainly has rural policy implications.

Income from certain types of wealth is included in the "other income" variable. However, farm families tend to have large amounts of wealth tied up in land and equipment, representing potential future income. In particular, members of older farm families may not seek off-farm employment if the low annual income is perceived as temporary and if they have a wealth "cushion." Thus, lack of off-farm work history may not be the only factor represented by the squared-age variable. These two factors have different policy implications.

The negative coefficient on age squared may also be the result of the life cycle of the farm. As a result of age, illness, or injury, some older farm families cut back the farming operation several years before retirement, causing annual income to decrease. These people have no intention of seeking a second job, since they are already unwilling or incapable of handling the original farm operation. Some measure of health might be a reasonable proxy for this life-cycle affect.

In general, discussions of rural policy need clarification. A rural transition policy seeks to ease human adjustments to market forces. A rural development policy seeks to modify market outcomes in favour of other goals valued by society, such as distribution of income. The policy objective has implications both for the model chosen and for the recommendations made as a result of the modelling exercise.

GENERAL DISCUSSION—*Jerome C. Wells, Rapporteur* (University of Pittsburgh)

The general discussion of this paper included consideration of the distinction between the concepts of "rural development" and "rural transition," and whether the definition of "farm family income" included earnings from items such as tourism, investments, and pensions. Also raised was the question of the *level* as well as the *presence* of off-farm labour-force participation, the subject of a new study by one of the authors of the paper.

Participants in the discussion included E. Asante, S. Ehui, T.E. Gina, R. Herrmann, T.N. Jenkins, D. Kirschke, H. Lee, W. Mukhebi, W. Oluoch-Kosura, and N. Traoré.