His Work, Her Work, and the Operation of the Farm:
Making Adjustments to Off-farm Employment

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Introduction

The growing prevalence of off-farm employment in the U.S. has meant that today most farm families are observed to have one or more members working at an off-farm job (OECD 2001, Mishra *et al* 2002). This is true both of those farm families that are typically thought of as living on farms as a residential lifestyle choice, as well as farm households that operate mid-size and even large farms. Comparatively few farm households in the U.S. and in many developed countries are not dependent in some way on off-farm employment (OECD 2001).

The trend toward greater involvement of farm households in off-farm work has potentially important implications for not only farm households but for the farm operation itself. Since the majority of those individuals employed in off-farm jobs are employed full-time during the week and continuously throughout the year, off-farm work has the potential to affect the practices used on the farm or ranch. That is, because of the need for off-farm work, there may be adjustments being made on U.S. farms to better accommodate off-farm work. These adjustments might include hiring farm labor, the use of less labor intensive practices, or reliance on less labor-intensive enterprises, as examples. The need for off-farm income may also influence the farm's use of what are known to be labor-intensive but more environmentally sustainable practices such as Integrated Pest Management (IPM).

Finally, this issue is taking on greater importance today given farm policy reform. It is likely that policy reform leading to the use of decoupled payments in both the U.S. and under the Common Agricultural Policy in the EU is likely to lead to an even greater proportion of farm family labor resources allocated to off-farm work. Given this, the question becomes how farm households and farms will adjust to this change, and the impacts that are likely to be observed in the farming practices that are undertaken.

This paper examines the effects of off-farm employment by either the farm man or farm woman on selected farming practices. The paper uses recent (2001) data on farm households sampled from throughout the U.S. collected by Penn State University in conjunction with the National Agricultural Statistics Service (NASS/USDA) and in collaboration with the Economic Research Service (ERS/USDA). Practices include the use of contracting, the hiring of farm labor, the use of IPM, among other practices often used on crop or livestock operations in the U.S. Very few

papers have looked at the effects of off-farm work on the farm operation itself (see, for exceptions, Phimister and Roberts, 2002; Sachs, 2002) and this paper seeks to provide evidence on the types of adjustments that are taking place.

Methodology

***Data*.** The Penn State Survey of U.S. Farm Women that provides the data for this paper was conducted in April, 2001 through a telephone survey of farm households using the sample frame used by the U.S. Department of Agriculture. A random sample was used and yielded a total of 2,661 observations. The farm woman was the unit of analysis. Each farm woman respondent was asked to answer questions about her: 1) role in farm decision-making, 2) involvement in specific farm tasks and use of sustainable agricultural practices, 3) off-farm work and involvement in nonfarm self-employment, 4) ownership and inheritance of assets such as farm land, and 5) involvement and leadership in farm and community organizations, in addition to 6) individual and household demographic characteristics and 7) characteristics of the farm. The data also include county of residence, allowing data on off-farm labor markets (external labor markets) to be appended to the data set. After the survey was completed, the data were matched by county of residence to the nine farm production regions differentiated by USDA: the Heartland, Prairie Gateway, Northern Crescent, Northern Great Plains, Eastern Uplands, Southern Seaboard, Fruitful Rim, Basin and Range, and the Mississippi Portal. A total of 2,444 farm households could be matched and comprise the data set used here.

Because several recent studies in the U.S. have found that decision-making relative to off-farm employment is a joint decision between 'the farm operator and the farm spouse' or between 'the farm man and farm woman' (e.g., Tokle and Huffman 1991, Oluwole 2001), data were also collected on the spouse/partner of the woman respondent. For the entire sample, data were collected on the work and tasks of the spouse/partner (if present) from the woman respondent. In addition, a separate survey of farm men was conducted on a subsample of the agricultural households. Hence, data are available on the work of farm men and women, both from the farm woman's perspective and from the farm spouse's/partner's point-of-view. Since the majority of U.S. farm households have a nuclear, two-adult structure, the analysis for this paper was limited to those households with both a farm woman and

spouse/partner present.

The questions on the farm operation include the size of the farm/ranch (cropland acres, and annual value of farm sales), specific farm enterprises, numbers of livestock, farm assets, and the leasing in and out of land, among other variables related to the farm or ranch operation. If crops were grown, the respondent was asked if the farm used Integrated Pest Management (IPM), genetically-modified seeds (GMS), pesticides, chemical fertilizers, no-till cropping, and other similar practices. In the case of livestock operations, questions were asked about the use of manure, purchased feed/fodder as inputs, growth hormones and rotational grazing. All farms were asked if they hired labor. Farms were also asked if they used contracts.

Estimation strategy. Following a descriptive assessment of the prevalence of off-farm work participation and the use of specific practices on crop farms and livestock farms in the U.S., off-farm work and on-farm production practice decisions were estimated in a bivariate probit framework, considering one spouse's decision to work off the farm as one decision and the use of a specific production practice being the second endogenous variable, given the potential for jointness in the off-farm work and production practice decisions. Bivariate probit models were estimated using both a common set of variables and an instrumental variable approach (see Wooldridge 2002; Ribar 1996), with the male's off-farm work decision (or the female's off-farm work decision) used to predict the production practice decision. Models were estimated first with the off-farm work decision of the farm man included in model, and then including the off-farm work decision of the farm woman instead. This provided two sets of models useful for assessing the relationships between each adult's off-farm work and the use of specific farming practices of interest. In both cases, the specific farming practices being used included the hiring of farm labor (both on crop and livestock operations), the use of growth hormones (livestock), rotational grazing (livestock), use of manure (both crop and livestock), adoption of genetically modified seeds (crop), use of IPM (crop), use of chemical fertilizers (crop), and use of insecticides (crop). The relationship between the use of contracts and the off-farm work decisions was also examined. Other variables in the estimated models included the individual characteristics of the farm woman and farm man, characteristics of the farm household and farm/ranch, and variables related to the farm's location including population density, growth in employment opportunities and other similar variables. Dummy variables reflecting the USDA farm production regions were also included in the models.

These preliminary models showed that in some cases, the off-farm work decision of the male had a relationship with the production practice, while in other cases the off-farm work decision of the female was related to the practice used. In still other cases, both the farm man's and farm woman's decisions to work off the farm were related with the production practice. Further, estimation experience with the 2001 Penn State data has shown that the off-farm work decisions of farm men and women in the U.S. are jointly determined, and consistently so. This finding is consistent with U.S. national-level findings reported by Tokle and Huffman (1991) and Oluwole (2001). Given this, the more appropriate approach of using a trivariate probit model was adopted — using the farm man's off-farm work participation decision, the farm woman's off-farm work participation decision and the decision to use a particular farming practice. The results discussed below are for the trivariate probit models.

Results

Descriptive statistics. Descriptive statistics for the 2001 Penn State survey show that over half of farm men and farm women in the U.S. were employed off the farm in the past year (see Table 1). In the 2001 survey, 52 percent of farm women in the U.S. were employed in an off-farm job in the past year, a significant increase over the 37 percent of farm women that reported working off the farm in the last major survey of farm women in the U.S. conducted by Rosenfeld in 1980 (Rosenfeld 1985). In the 2001 survey, this percentage increases even further, when the sample is restricted to working-age women — among farm women 18-64 years of age (inclusive), 62 percent reported working off the farm. Among U.S. farm men, about 52 percent were employed in an off-farm job in the year prior to the April 2001 survey, which is roughly similar percentage to that reported by Rosenfeld on the basis of the previous study. And similarly, the percentage of farm men that work off the farm is higher if the sample is restricted to the working-age population of males.

On crop farms, most (78%) reported using chemical fertilizers and 68% reported using insecticides, herbicides and/or fungicides. Among livestock operations, the most commonly observed practices were purchased feed/fodder and the rotation of livestock on pasture (76%). Lower proportions of crop farms reported using IPM (20%) or genetically-modified seeds (20%), and fewer livestock operations reported using growth hormones (9%). About half (51%) of livestock operations reported using manure on cropland. Over half of the farms hired labor during the year. Other practices that were examined included use of no-till and intercropping/strip cropping on crop farms.

Estimation results: Off-farm work and the hiring of farm labor. A trivariate probit model estimated for farm men, farm women, and hired farm labor showed that his decision to work off the farm and the farm's decision to hire labor are positively correlated — that is, when he works off the farm, the farm is less likely to hire labor to substitute for his labor in farming (see Table 2). This result is in contrast to a descriptive result from a survey of farm households also conducted in 2001 in Pennsylvania that asked what a adjustments were made to accommodate the farm man's off-farm work, and the hiring of farm labor was the most prevalent response other than the use of other family labor to substitute for his labor in farming. This difference suggests that there may be important regional differences in this result.

The relationship between the off-farm work of farm women and the use of hired farm labor was also found to be correlated, and again negatively. This result shows that the off-farm work decision of farm women is negatively related to the hiring of labor, i.e., that her off-farm work participation results in labor being less likely to be hired. It is likely the case that on farms where off-farm work of the farm woman is observed are those farms that are less labor intensive.

Finally, the correlation between the off-farm work of men and the off-farm work of women was found to be positive when estimated in a model with the hired labor decision. This is not a surprising result, because it is generally held that a spouse is more likely to work off the farm if the other spouse does, because of the possibility of sharing work-related travel costs.

Off-farm work participation of both the farm man and farm woman are found to have a life-cycle effect, with the likelihood of working off the farm increasing with age at a decreasing rate. As expected education increases the likelihood of working off the farm among both men and women, as shown in many studies. Attendance at a vocational or technical school means that she is more likely to work off the farm than if she has not graduated from high school, whereas this effect is not observed for farm men. Vocational and technical training can be agricultural in focus, reducing the impetus for off-farm employment among males. For females, this doesn't appear to the case, and vocational and technical schooling attendance enhances the probability of her off-farm work participation.

The presence of children in different age categories reduces the likelihood of both the farm woman and farm man being employed in a job off the farm. Many studies conducted in the past have reported that the presence of

young children reduces the likelihood of off-farm work among farm women, with the presence of older children increasing his likelihood of off-farm work. In the case of the male parent, the positive effect on his off-farm employment stemming from the presence of older children has at least two possible explanations.. First, older child labor and male parent labor may be substitutes, and when teenage children are present he is able to work off the farm. It may also be the case that the costs or future costs of older children — e.g., the cost of future college educations— may induce males to work off the farm as a means of providing cash income.

What is interesting about the results in Table 2 based on the 2001 Penn State survey is that men as well as women appear to be less likely to work off the farm if young children are present in the household, a result also demonstrated recently by Oluwole (2001) using Current Population Survey data that allowed a comparison of males living on U.S. farms over the past 30 years. This result was observed even when household size was controlled in the estimated models. Further, male parents also appear to be less likely to work off the farm if teenage children are present, perhaps signaling a change in the emphasis on teenage children doing extensive work on the farm. Older children on farms today may spend more time on school-related activities, such as sports and other similar uses of their time. They may also be working on other farms that need labor, especially if their male parent has a preference for farm work.

Comparing farms that are operated as sole proprietorships to those with other ownership structures shows that men on farms held as family-held corporations are less likely to work off the farm than those farms operated as sole proprietorships. Larger crop farms that include more acres of land are more likely to hire farm labor, and on these farms both the farm man and farm woman are less likely to work off the farm. On livestock farms, she is also less likely to engage in off-farm work.. When farms use contracts or computers in the farm operation they are also more likely to be hiring farm labor. And on farms with contracts, both the farm man and farm woman are less likely to work off the farm. Finally, the trivariate model shows that higher local unemployment rates are associated with the hiring of farm labor.

Estimation results: Off-farm work and other farm practices. To better understand the interrelationships between off-farm work decisions and the practices used on the farm, models were estimated for the farming practices in Table 1, for crop farms and livestock operations separately In all models, the off-farm work decisions of the farm man and farm

woman were correlated, consistent with the earlier result in the hired farm labor trivariate probit model. The correlations between the specific farming practices and the off-farm work decisions were in some cases not statistically significant for either the farm man or farm woman. This was true for no-till cropping; the use of insecticides, herbicides, and fungicides; the use of chemical fertilizers; intercropping/strip cropping; and the use of cover crops or green manure crops. This was also the case for the purchasing of feed and fodder and the rotation of livestock on pasture (these correlations were close to being statistically significant for the farm man).

The results in Table 3 show the farm practices correlated with off-farm work participation. Table 3 includes the estimates for the use of a specific practice and it should be kept in mind that these were estimated in the trivariate probit with his and her off-farm work decisions. The results for his and her off-farm work decisions were presented for the hiring of labor practice and are not included for each separate decision, although it should be noted that these results appear to be quite robust across the trivariate models. Use of IPM is found to be negatively correlated with her off-farm work decision -- if she works off the farm the farm is less likely to use IPM. Her off-farm work participation is also correlated positively with the use of hormones and the use of genetically-modified seeds. On the other hand, if he works off the farm, the farm is less likely to use manure on cropland.

Other results presented in Table 3 show that larger crop farms are more likely to use hormones and genetically-modified seed; use of IPM is not related with farm size. Use of IPM is also more prevalent in the Fruitful Rim and in the Southern Seaboard production regions, relative to the Heartland region defined by USDA, an expected result. Use of IPM is also less likely when there are young children present in the household, perhaps reflecting competing demands for farm household time.

Concluding discussion

The results of the analyses in this paper suggest that there may be interrelationships between participation in off-farm work by either the farm man, the farm woman, or both and specific practices used on the farm. The hiring in of labor represents ‘practice’ that is affected by off-farm work decisions, because of the clear interrelatedness of labor decisions across the farm household. At the same time, the use of other farm practices may be affected as well. Three practices shown to be affected in this paper by her participation in work off the farm were the use of IPM (less likely), the use of hormones in livestock (more likely) and the use of GMS (more likely). In addition, his work off the farm is

shown to affect the use of manure (less likely) on cropland, even when production region is controlled in the models.

These results are preliminary in nature, and future research will investigate further why these interrelationships exist.

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Table 1. Descriptive Statistics for Off-farm Employment and Use of Specific Farm Practices.

	%
Off-farm employment	
Farm man - all	53
Farm woman - all	52
Farm man - working-age	57
Farm woman - working-age	62

Use of practices	
Crops:	
No-till cropping	31
Integrated pest management	20
Genetically modified seeds	20
Insecticides, herbicides, fungicides	68
Chemical fertilizers	78
Intercropping/strip cropping	15
Cover crops or green manure crops	34
Livestock:	
Growth hormones	9
Purchased feed/fodder	87
Manure use on cropland	51
Rotation of livestock on pasture	76

Table 2. Trivariate Probit Results for His Off-farm Work Participation, Her Off-Work Participation, and the Decision to Hire Labor, 2001 U.S. Farm Survey.

Variables	His off-farm work	Her off-farm work	Hiring labor
Individual characteristics			
Intercept	-0.7397***	-0.2086***	-0.2011***
Age of individual	0.0649	0.1146***	
Age-squared	-0.0010**	-0.0016***	
Education attainment of individual:			
High school graduate	0.5639***	0.4792**	
Vocational or technical school	0.3540	0.9626***	
Some college	0.6844***	0.6196***	
Four-year college degree	0.7177***	0.9660***	
Post-graduate degree	1.5019***	1.3402***	
Reference category: Not a high school graduate			
Household characteristics			
Presence of children:			
Under age 6 years	-0.3332**	-0.2451**	0.0363
Children 6-11 years	-0.3325**	-0.2551***	-0.0392
Children 11-18 years	-0.3846***	-0.1109	-0.0740
Children over 18 years	-0.1944	0.0740	-0.1090
Children living away from home	-0.0261	-0.0102	0.0519
Household size	0.2273	-1.3014	0.0321
Farm-related characteristics			
Ownership structure:			
Legal partnership	0.1197	0.0294	-0.1688
Family-held corporation	-0.6583***	-0.2077	0.1232
Non-family corporation	-0.6868	0.0451	0.6892
Cooperative	-1.9878	4.5556	2.4912
Other	-0.0227	0.1389	-0.1142
Reference category: Sole proprietorship			
Acres:			
Rented in or leased in	-0.0015	-0.0011	0.0021
Rented out or leased to others	-0.0002***	-0.00005	0.0001*
Crop acres	-0.0008***	-0.0002**	0.0004***
Livestock operation (binary: 1=yes)	-0.0020	-0.0023**	-0.0013
Use of contracts (binary: 1=yes)	-0.7981***	-0.2104*	0.4554***
Use of computer (binary: 1=yes)	-0.0343	-0.0109	0.4461***

Labor market:			
Population density in county, 2000	-0.00005	-0.0002	0.0002
Unemployment rate in county, 2000	-0.0016	-0.0030	0.0791***
USDA production regions:			
Northern Crescent	-0.0898	-0.1273	-0.1714
Northern Great Plains	-0.0587	0.2049	-0.0790
Prairie Gateway	0.1477	0.1744	0.2024
Eastern Uplands	0.4038	0.0525	0.3227**
Southern Seaboard	0.2768	-0.2979	-0.1502
Fruitful Rim	0.0378	-0.1820	0.0849
Basin and Range	-0.1570	-0.1556	0.1575
Mississippi Portal	1.8202	-0.0783	-0.0034
Reference category: The Heartland	0.2258	-0.0469	0.0321

*** = statistically significant at the 0.01 level; ** = significant at 0.05 level; * = significant at 0.10 level.

Table 3. Trivariate Probit Results for Use of Specific Farm Practices, 2001 U.S. Farm Survey.

Variables	Use of Integrated Pest Management (IPM)	Use of hormones	Use of genetically-modified seed	Use of manure
Intercept	-1.5571***	-2.2100***	-1.3588***	-1.2534***
Farm-related characteristics				
Ownership structure:				
Legal partnership	0.2617	-5.5115	-0.3158	-0.1343
Family-held corporation	-0.3236	-0.1495	0.2201	-0.0744
Non-family corporation	-4.2608	-3.2249	-3.8078	-0.0476
Cooperative	3.8070	-7.2867	-2.2531	-3.2931
Other	-3.8561	-3.0228	-3.9912	-0.7421
Reference category: Sole proprietorship				
Acres:				
Rented in or leased in	-0.0009	0.0052**	-0.0041	-0.0051
Rented out or leased to others	-0.0003	0.0002	-0.0001	-0.00003
Crop acres	-0.0002	0.0003***	0.0005***	0.0003***
Livestock operation (binary 1 = yes)	-0.0065***	0.0068	-0.0080***	0.0085***
Use of contracts (binary 1 = yes)	0.0201	0.5793	0.3140	0.5408***
Use of computer (binary 1 = yes)	-0.0392	-0.3597	0.1823	0.1817
Labor market:				
Population density in county, 2000	-0.0003	0.0001	0.00004	-0.00005
Unemployment rate in county, 2000	-0.0420	-0.2631*	0.0020	-0.0929***
USDA production regions:				
Northern Crescent	0.3433	-3.4128	-0.4132	0.5327***
Northern Great Plains	0.0893	-4.3817	-5.5340	-0.8091
Prairie Gateway	0.1901	0.8246**	0.0922	-1.3648***
Eastern Uplands	0.1097	0.6758	0.2092	-0.2843
Southern Seaboard	0.7800**	-3.6149	0.3589	-0.4006
Fruitful Rim	0.5895*	-4.5673	-0.5209	-0.4179*
Basin and Range	-3.8750	-0.9307	0.1068	0.1473
Mississippi Portal	0.4143	-3.4213	0.3806	-1.0987**
Reference category: The Heartland				

Household characteristics:				
Presence of children:				
Under age 6 years	-0.4245**	0.1164	-0.2894	-0.3094**
Children 6-11 years	0.0905	-0.1815	-0.1859	-0.0330
Children 12-18 years	-0.0448	0.1292	-0.0627	-0.0407
Children over 18 years	0.0636	-0.1640	-0.1646	-0.0274
Children living away from home	-0.0285	-0.0887	0.0472	-0.0056
Household size	0.1333	0.0007	0.2868	0.1654

*** = statistically significant at the 0.01 level; ** = significant at 0.05 level; * = significant at 0.10 level.