



# An Analysis of Major Farm Characteristics and Farmers' Use of Cooperatives

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This paper examines relationships between major farm characteristics and U.S. farmers' use of cooperatives in 1986. An ordinal measure of co-op use is developed to classify farmers according to their respective use of cooperatives for marketing farm products or purchasing farm inputs. Logit regression analysis is then used to examine major farm characteristics relative to farmers' co-op use. Statistically significant relationships were found between co-op use and various farm type, size, and location groupings. No statistically significant relationship was found between co-op use and farm operator age.

Changes in the structure of farmer cooperatives are included among the many facets constituting the continuously changing structure of United States agriculture. From 1980 to 1986, the number of marketing cooperatives and farm supply cooperatives decreased by 14 and 17 percent, respectively (Richardson et al., p. 4). These decreases were due to mergers, consolidations, acquisitions, and failures. Changing farm structure has resulted in fewer farms, which in turn has increased pressure on cooperatives. The cooperatives that remain today must work to survive in an agricultural environment that includes a shrinking farm population from which to draw membership and business. Thus, it becomes increasingly important that cooperatives know as much as possible about the farmers who use their services.

Several recent studies have contributed to information on use of cooperatives by farmers. Work in this area includes Kraenzle et al. (1989a) for all farmers, Kraenzle et al. (1989b) for commercial farmers, and Gray et al. for dairy farmers. A study by Babb analyzed the buying and selling patterns of a sample of Midwest and Southeast farmers. Although these studies have increased the understanding of use of cooperatives by farmers, their conclusions are based solely on analysis of cross-tabulation of data by selected characteristics. This study takes a different approach by developing a comprehensive indicator of co-op use and using multivariate analysis to examine statistical associations between major farm characteristics and farmers' use of cooperatives.

The objective of this paper is to further the understanding of farmers' use of cooperatives by: (1) developing a measure of co-op use and (2) analyzing cross-sectional data to determine the statistical association of some major farm characteristics with relative level of farmers' co-op use.

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This paper is organized into five sections. The first section describes the data used in the study. The second and third sections present the development of four co-op use levels and the analysis procedure used to examine the statistical associations of major farm characteristics with relative level of farmers' co-op use. The fourth section contains the discussion and interpretation of the results. The final section presents a summary and implications stemming from the analysis.

### **Data**

The source of data is the June 1987 Acreage and Livestock Enumerative Survey conducted by the National Agricultural Statistics Service (NASS), U.S. Department of Agriculture for the year 1986. Information was collected by trained enumerators who personally interviewed about 17,000 farmers. The result was a sample of 13,736 usable questionnaires representing a cross-sectional data base of U.S. farmers. The sampling procedure used allowed for the generation of expansion factors whose application yields a total of 1,994,096 farm operators covered by the NASS survey.<sup>1</sup>

The particular data analyzed correspond to survey questions regarding the major characteristics of U.S. farms,<sup>2</sup> including farm type (classified by the main source of farm gross revenue), farm size (measured in terms of gross sales), region of location, and operator<sup>3</sup> age. Additional questions were asked regarding each farmer's use of cooperatives for marketing farm products and purchasing farm inputs. For marketing, farm operators were asked the percentage of their gross sales marketed through agricultural cooperatives. For purchasing, farm operators were asked whether they purchase, for use on their farms, the individual farm supply inputs of feed, fertilizer, chemicals, petroleum, and seed. If an operator answered yes to whether a particular input is purchased for use on his farm, then the operator was asked the percentage of the relevant input purchased from an agricultural cooperative.

### **Measure of Co-op Use**

To assess individual farmer's<sup>4</sup> use of cooperatives, the two functions of marketing farm products and purchasing farm input supplies constituted a basis for measurement. A specific level of co-op use was developed in accordance to farmers' use of cooperatives for marketing farm products or purchasing farm inputs. The percentage of a farm's gross sales marketed through cooperatives determined co-op use for marketing and the percentage of a farm's supply inputs purchased from cooperatives determined co-op use for purchasing. Only those inputs purchased for use on a farm's total acres operated were considered in the determination of each farmer's use of cooperatives for purchasing.

Table 1 presents the criteria used to determine level of co-op use. It is important to note that the rules governing these criteria are heuristic. The criteria emphasize marketing and purchasing use exclusive of one another for determining co-op use levels. The underlying principle of viewing marketing and purchasing use separately is that differences in regional agricultural business structures will in many cases dictate varying degrees of co-op marketing use versus co-op purchasing use. To account for such differences, the higher amount of either a farmer's marketing use or purchasing use is used to deter-

**Table 1.—Criteria for Classification of Farmers into Co-op Use Levels**

If Marketing Use <sup>a</sup> Is	Or If Purchasing Use <sup>b</sup> Is	Then Level of Co-op Use <sup>c</sup> Is
Above 75	Above 75	3 (Highest)
<b>If Not Already Classified as 3, Then:</b>		
Above 50	Above 50	2
<b>If Not Already Classified as 3, or 2, Then:</b>		
Above 25	Above 25	1
<b>If Not Already Classified as 3, 2, or 1, Then:</b>		
		0 (Lowest)

<sup>a</sup>Marketing use refers to the percentage of farm gross sales marketed through an agricultural cooperative.  
<sup>b</sup>Purchasing use refers to the percentage of farm supply inputs—that the farm purchases for use on the total acres operated—that were purchased from an agricultural cooperative.  
<sup>c</sup>Level of co-op use is developed for *i*<sup>th</sup> farm given the *i*<sup>th</sup> farmer's use of cooperatives and the presented criteria.

mine the co-op use level. Four levels of co-op use were determined. Level 3, the highest level, corresponds to a rate of use above 75 percent, level 2 corresponds to a rate of use of 51-75 percent, level 1 corresponds to a rate of use of 26-50 percent, and level 0, the lowest level, corresponds to a rate of use of 25 percent or less.

### Analysis Procedure

This section presents a model formulated to examine the statistical association of farm type, farm size, location, and operator age characteristics with farmers' relative use of cooperatives. The dependent variable is co-op use level, which, as described earlier, takes on the value three, two, one, or zero. Due to the dependent variable's ordinal nature, the familiar logistic function is used. The probability of farmer *i* being classified into co-op use level *j* or greater (*j* = 1,2,3) is given by (Judge et al.):

$$P_{ij} = 1 / (1 + \exp(-X_i\beta)),$$

where:

$$X_{i\beta} = \text{ALPHA}_i + \beta_1 \text{DAIRY}_i + \beta_2 \text{GRAIN}_i + \beta_3 \text{LIVEST}_i + \beta_4 \text{FSIZE2}_i + \beta_5 \text{FSIZE3}_i + \beta_6 \text{FSIZE4}_i + \beta_7 \text{FSIZE5}_i + \beta_8 \text{NE}_i + \beta_9 \text{SE}_i + \beta_{10} \text{LAKE}_i + \beta_{11} \text{CBELT}_i + \beta_{12} \text{NPLAIN}_i + \beta_{13} \text{SCENT}_i + \beta_{14} \text{PAC}_i + \beta_{15} \text{OPAGE2}_i + \beta_{16} \text{OPAGE3}_i.$$

DAIRY, GRAIN, and LIVEST variables correspond to the farm types of dairy, cash grain, and livestock, respectively; FSIZE2, FSIZE3, FSIZE4, and FSIZE5 variables correspond to the farm sizes of \$40,000 to \$99,999, \$100,000 to \$249,999, \$250,000 to \$499,999, and \$500,000 and over, respectively; NE, SE, LAKE, CBELT, NPLAIN, SCENT, and PAC variables correspond to the regions of location of Northeast, Southeast, Lake States, Corn Belt, Northern

Plains, South Central, and Pacific, respectively; OPAGE2 corresponds to the operator age category of 36 to 54 years; and OPAGE3 corresponds to the operator age category of 55 years and over. All independent variables included in the equation and identified above are binary dummy variables equal to one if the characteristic applies to farm  $i$  and equal to zero otherwise. To incorporate the dummy variables into the model, one category from each farm characteristic grouping is omitted. Omitted categories include the farm type of "other,"<sup>5</sup> the smallest farm size (\$1,000 to \$39,999), the Mountain region, and the youngest operator age category (under 36).

The logistic regression model is estimated by maximum likelihood methods using the LOGIST procedure in SAS (Harrell). Due to the nature of the sample, a weighted regression procedure was used where weights correspond to survey expansion factors.

Given that all the independent variables in the analysis are discrete, the marginal change in probability associated with a change in an explanatory variable is calculated by taking the difference in probability with and without the variable. This is provided by:

$$P_{ij}(X_i = 1) - P_{ij}(X_i = 0).$$

Application of logit regression to agricultural data has been extensive. Some examples include works by Batte, Jones, and Schnitkey; Garcia, Sonka, and Mozzacco; and Lines and Zulauf. Also, an application of logit analysis to data similar to those in this study is provided by Lines and Morehart.

## Results

Classifications of co-op use by major farm characteristics are presented in table 2. The greatest percentage of farmers classified in the highest co-op use level (level 3) are dairy farms, farms of size \$100,000 to \$249,999, Lake States farms, and farm operators under age 36. Twenty-nine percent of all farms are classified in the highest co-op use level and 55 percent are classified in the lowest level.

Farmers are generally either relatively large users or low users of cooperatives, in that most farmers fall into co-op use level 3 or 0. This is also true when farmers are grouped by farm characteristics, but the precise distributions of farmers in each co-op use level vary among the categories within each of the four farm characteristic groupings.

Table 3 includes estimated beta coefficients, chi-square statistics, and changes in probability of the logit analysis. The estimated beta coefficients indicate relationships between the farm characteristic variables they are associated with and relative co-op use. Significant coefficients indicate the following: positive coefficients imply a greater use of cooperatives and negative coefficients imply less use, relative to the omitted category in the same farm characteristic grouping. Magnitude differences of significant coefficients infer a greater or lesser change in co-op use.

Care must be taken when interpreting the estimated change in probability. In table 3 this is the probability of being in co-op use level 2 or greater (cooperatives used for more than 50 percent of marketing farm products, or for more

**Table 2.—Level of Co-op Use: Comparisons by Major Farm Characteristics, U.S. Farms, 1986**

Characteristic	Level of Co-op Use <sup>a</sup>			
	0 (Lowest)	1	2	3 (Highest)
	<i>Percent<sup>b</sup></i>			
Farm Type:				
Dairy	24	8	11	58
Cash Grain	45	9	10	35
Livestock	61	8	8	23
"Other"	62	6	6	25
Farm Size:				
\$ 1,000–\$ 39,999	62	7	6	25
\$ 40,000–\$ 99,999	38	10	13	39
\$100,000–\$249,999	34	11	14	42
\$250,000–\$499,999	37	11	14	38
\$500,000 and Over	44	9	11	36
Region:				
Northeast	48	9	7	36
Southeast	56	8	8	27
Lake States	39	8	8	45
Corn Belt	56	9	9	26
Northern Plains	31	12	15	42
South Central	72	6	5	17
Mountain	61	7	8	24
Pacific	66	4	4	26
Operator Age:				
Under 36	51	8	9	31
36–54	56	8	8	28
Over 55	56	8	8	29
All Farms	55	8	8	29

<sup>a</sup>Level is based on co-op use classifications (see table 1).

<sup>b</sup>Percentage of farms of farm characteristic in co-op use levels. Percentages may not add to 100 due to rounding.

than 50 percent of farm input purchasing). Since all independent variables are included in the analysis as binary dummy variables, the change in probability is relative to the omitted category. The reporting of the results that follow does not make reference to the variable names as they are explicitly included in the model (e.g., FSIZE2). Rather, the corresponding definitions of the variable names are used.

Dairy and cash grain farmers have significantly greater co-op use than "other" farmers, while livestock farmers do not significantly use cooperatives any more or less than "other" farmers. Dairy farmers have a 27 percent greater chance of being in co-op use level 2 or greater than "other" farmers. Cash grain farmers have a 9 percent greater chance. These findings support similar results reported in other research. Based on total net marketing business volume, dairy and grain products were the most important farm products marketed by cooperatives in

**Table 3.—Logit Analysis for Farmers' Co-op Use, U.S. Farms, 1986**

Variable <sup>a</sup>	Beta Coefficient	Chi-Square Statistic	Change in Probability of Being in Level $\geq 2^b$
ALPHA1	-.08*	75.81	
ALPHA2	-1.17*	158.04	
ALPHA3	-1.57*	283.69	
Farm Type: <sup>c</sup>			
DAIRY	1.11*	223.71	.27
GRAIN	.38*	48.16	.09
LIVEST	.06	1.54	.01
Farm Size: <sup>d</sup>			
FSIZE2	.51*	97.05	.12
FSIZE3	.60*	102.27	.14
FSIZE4	.57*	31.00	.13
FSIZE5	.46*	11.52	.11
Region: <sup>e</sup>			
NE	.39*	15.25	.09
SE	.34*	17.14	.08
LAKE	.61*	44.32	.15
CBELT	.04	.27	.01
NPLAIN	.83*	79.23	.20
SCENT	-.38*	18.23	-.08
PAC	-.08	.60	-.01
Operator Age: <sup>f</sup>			
OPAGE2	.01	.03	.1
OPAGE3	.12	5.36	.03
Model Statistics:			
Chi-Square with 16 d.f.	1433		
p Value	.000		

<sup>a</sup>See text for description of variables.

<sup>b</sup>Calculated at sample means. Change in probability is relative to the omitted category.

<sup>c</sup>Omitted farm type variable, OTHER (corresponds to "other").

<sup>d</sup>Omitted farm size variable, FSIZE1 (corresponds to \$1,000-\$39,000).

<sup>e</sup>Omitted region variable, MTN (corresponds to Mountain region).

<sup>f</sup>Omitted operator age variable, OPAGE1 (corresponds to under 36 years).

\*Significant at the .01 level.

\*\*Less than .01.

1986 (Richardson et al., p. 22), and Gray et al. reported that almost 90 percent of all dairy farmers had some affiliation with cooperatives. Thus, dairy and cash grain farmers would be expected to be greater users of cooperatives (for marketing) than livestock or "other" farmers. Further, the cross tab analysis by Kraenzle et al. (1989a) reported that dairy and cash grain farmers use cooperatives for purchasing most inputs in greater percentages than livestock and "other" farmers.

The coefficients associated with each of the larger farm size groupings are significant and positive, indicating that farmers with farms of these sizes have

higher probabilities of greater co-op use than farmers with farms of the smallest size (\$1,000 to \$39,999). Farmers in the size grouping of \$100,000 to \$249,999 have a 14 percent greater chance of being in co-op use level 2 or greater than farmers in the smallest size grouping. Farmers in the \$40,000 to \$99,999, \$250,000 to \$499,999, and \$500,000 or more groupings, have a 12, 13, and 11 percent greater chance, respectively. These findings are consistent with the results from cross-tab analysis by Babb and by Kraenzle et al. (1989a), which indicated that, in general, larger farmers use cooperatives to a greater degree than smaller farmers.

Farmers located in the Northern Plains, Lake States, Northeast, and Southeast exhibit significantly greater co-op use than farmers in the Mountain region. Farmers in the South Central region have significantly lower co-op use, and farmers in the Corn Belt and Pacific regions do not have significantly different co-op use, relative to farmers in the Mountain region. Farmers in the Northern Plains have a 20 percent greater chance of being in co-op use level 2 or greater than farmers in the Mountain region, while farmers in the Lake States, Northeast, and Southeast have a 15, 9, and 8 percent greater chance, respectively. Farmers in the South Central region have an 8 percent lower chance of being in co-op use level 2 or greater than farmers in the Mountain region.

No significant relationship exists between farm operator age and use of cooperatives. Therefore, younger operators exhibit neither greater nor less use of cooperatives than their older counterparts. This result is rather surprising—Kraenzle et al. (1989a) found that on a consistent basis, a higher percentage of younger farmers used cooperatives for greater percentages of their farm product marketings and purchases of inputs than older farmers.

### **Summary and Implications**

The objectives of this paper were first, to classify farmers according to their level of co-op use and second, to determine the major farm characteristics statistically associated with co-op use.

The findings provide further evidence that farmers' use of cooperatives significantly differs, dependent on farm type, size, and region of location. The probabilities of having greater co-op use are positively related to: (1) the farm types of dairy and cash grain; (2) all four larger farm size groupings; and (3) the Northern Plains, Lake States, Northeast, and Southeast regions. The probabilities of having greater co-op use are negatively related to the South Central region. Farm operator age is not a significant factor in explaining farmers' use of cooperatives.

The results have some implications that are important to farmer cooperatives. The higher probabilities of greater co-op use of dairy and cash grain farmers relative to "other" and livestock farmers imply that cooperatives need to do more in order to serve livestock and "other" farmers. Further, the relatively higher use of cooperatives by dairy farmers underscores the importance of the relationship between cooperatives and the dairy industry, implying that the applicable cooperatives should continue to develop and nurture this relationship. To better serve livestock and "other" farmers, cooperatives might begin by trying to gain a more thorough understanding of what different types of farmers expect from agribusinesses in the way of services (e.g., farmer survey).



With such additional information, cooperatives can develop strategies designed to enhance cooperative operations and services for the goal of higher co-op use by farmers, perhaps with emphasis on livestock and "other" farmers.

The greater use of cooperatives by farmers in larger farm size groupings relative to those in the smallest farm size grouping reflects positively on cooperatives. The implication is that cooperatives are having success in providing services to farmers who manage large operations. However, farmers in some of the larger size groupings did not use cooperatives relatively as much as farmers in other larger size groupings. This implies that cooperatives need to determine which larger groups of farmers they are presently serving well and then evaluate how best to derive more business from those farmers of larger farm sizes who are less committed to cooperatives. However, cooperatives face a dilemma when trying to develop strategies to target farmers of different farm sizes for additional business. If smaller farmers are targeted, as the results imply, then designing programs to attain more business from smaller farmers might well come at the expense of business from larger farmers. Therefore, it is important that cooperatives first recognize the cooperative business potential that different size farmers represent to their cooperatives and use this information to target specific size groups of farmers that can potentially bring a significant increase in business without jeopardizing existing business relationships.

Farmers located in the Northern Plains, Lake States, Northeast, and Southeast regions have higher probabilities of greater co-op use than farmers in other regions. The implication is that cooperatives located in regions where use of cooperatives by farmers is relatively lower than in other regions need to evaluate whether they are adequately serving farmers. Two regions that appear to need attention are the Corn Belt and South Central regions. These regions have the second and third most farmers of all regions with 21 and 17 percent, respectively, but farmers in the Corn Belt region use cooperatives no more (except in comparison to farmers in the South Central region), and farmers in the South Central region use cooperatives less, than farmers in other regions. Cooperatives located in these regions would benefit from comparing their operations and services to those of cooperatives located in regions where farmer co-op use is relatively higher and using the information acquired to enhance their own operations and services.

The results indicate that farm operator age has no bearing on level of co-op use. This finding basically implies that cooperatives need not be overly concerned with the specific ages of farmer patrons.

This study identified in broad scope the major farm characteristics statistically associated with higher co-op use levels of farmers. The overall implication is that cooperatives need to identify, by farm attributes, those farmers associated with certain levels of co-op use. From a research and strategic planning standpoint, cooperatives need more information in order to more effectively identify farmers who might contribute to greater use of cooperatives. Analysis of data that include a greater range and specificity of farmer attribute variables would add to the knowledge base of use of cooperatives by farmers. When farmers with specific attributes that could represent increased use (and continued greater use) are accurately identified, then strategies for increasing co-op use by farmers (and maintaining co-op use) can be properly developed. Knowledge of the various characteristics of the farmers who use cooperatives to a greater degree,

or don't use cooperatives as much, allows for the development of more targeted strategies.

### Notes

1. For detailed information on the survey design and sampling technique, see Cotter and Nealon.
2. Farms are places from which \$1,000 or more of agricultural products are sold, or normally would be sold, during the year.
3. Operator refers to the principal member of the farming enterprise. In a partnership, the operator is the person making the day-to-day decisions, or the oldest partner if the decision making is shared equally.
4. Because it is the farmer, and not the farm, who actually uses cooperatives, the term farmer is generally used throughout the paper.
5. The farm type of "other" refers to tobacco, cotton, other field crops, vegetables, fruits and nuts, poultry, and miscellaneous.

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