FACTORS INFLUENCING PRODUCER DECISIONS ON THE USE OF FUTURES AND OPTIONS IN COMMODITY MARKETING*

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Abstract

A probit model is used to quantify factors influencing the probability that a farmer used futures or options for commodity marketing. Results suggest size of farming operation (measured by gross farm sales), having a college degree(s), and membership in a marketing club have the greatest impact on the probability of using futures and options.

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INTRODUCTION

Effective commodity marketing by agricultural producers has received increasing levels of attention over the past two decades. Periods of heightened commodity price volatility, greater exposure to world supply and demand conditions, a more "market-oriented" farm policy, and periods of farm financial stress have all contributed to this additional focus. This increasing emphasis on marketing has drawn attention to programs designed to enhance producer understanding of alternative marketing strategies.

Expanding marketing alternatives for many of the traditional agricultural commodities generally requires the use of a forward pricing mechanism. Opportunities for using forward pricing marketing strategies are available to agricultural producers in a variety of forms (Paul, Heifner and Gordon). However, recent studies focusing on the use of forward pricing strategies suggests limited use by farmers, especially for those alternatives using futures and options (General Accounting Office; Mintert; Smith).

Section 1743 of the Food Security Act of 1985 mandated a pilot program involving producer trading of wheat, feed grain, soybean, and cotton futures contracts be conducted in at least 40 counties (U.S. Department of Agriculture). The Futures and Options Marketing Pilot Program was initiated in the spring of 1988 and available for two marketing years. The Pilot Program involved 41 counties in 22 states. The Extension Service in cooperation with the Agricultural Stabilization and Conservation Service (ASCS) conducted a required orientation session for producers located in the selected counties.

The purpose of the Pilot Program was to educate producers in the use of futures and options in commodity marketing. The Pilot Program used both educational and loss protection components to accomplish its goals. Participants in the Pilot Program's orientation sessions included both users and non-users of futures and options. The objective of this paper is to assess factors which influence whether or not producers attending the orientation sessions used futures and options for hedging purposes. Factors considered for analysis are suggested from previous studies, including analyses involving farmer use of alternative marketing strategies, farmer attitudes concerning alternative marketing arrangements, and the general adoption of technology by agricultural producers.

DATA

Data used in this analysis resulted from a telephone survey of participants from the Futures and Options Marketing Pilot Program's orientation sessions. The survey was conducted as an interim evaluation of the Pilot Program. A 50 percent random sample was selected from participant lists provided by the 41 county ASCS offices. This resulted in an initial sample of 985 participants, of which 823 were eligible for inclusion in the evaluation survey (eligibility required the respondent be a full-time farmer, part-time farmer, or a landowner receiving crops under a crop share lease). From the sample of 823 eligible participants, 125 could not be contacted or refused to participate in the survey. A total of 610 responses were obtained, resulting in a survey response rate of 74 percent.

From the 610 survey respondents, 15 were eliminated from this analysis due to incomplete information, leaving a total of 595 observations. Respondents were from all 22 states included in the Pilot Program,

representing the major agricultural regions of the United States. A wide variety of commodities, farm sizes, age groups, and educational levels were included in the sample. However, the Futures and Options Marketing Pilot Program was a voluntary program and was limited to 22 states. Even though the sample was a random selection of Pilot Program participants and appears to represent a wide variety of producers, it cannot be presented as a random sample from the general population of agricultural producers. More detailed data about survey procedures, respondent characteristics, and the survey instrument are available from the authors.

EMPIRICAL MODEL

Qualitative response models have become widely used in economics to assess factors influencing an individual's choice from among two or more alternatives. Such models are strongly linked to utility theory (Amemiya) and their application is well described in several basic econometrics texts (see Judge, et. al. or Pindyck and Rubinfeld). Within the agricultural economics literature, qualitative response models have been applied to a wide variety of situations involving individual choice. Capps and Cramer and Epperson et. al. compared the use of the probit and logit models to assess factors influencing participation in the food stamp program. Carley and Fletcher, Hill and Kau, and Rahm and Huffman applied qualitative choice models to analyze factors influencing alternative management practices or management decisions by farmers. Jones, Batte and Schnitkey applied a logit model to determine factors influencing Ohio farmers' demand for information. Fu et. al. and Turner, Epperson and Fletcher applied probit models to evaluate producer attitudes toward alternative methods of marketing.

The three common forms of qualitative choice models are linear probability, probit, and logit. The linear probability form has some statistical weaknesses, and is generally not recommended (Amemiya). Selecting between the probit and logit models is not strongly supported on theoretical grounds, implying the choice between the two models is an empirical issue. For binary choice models, results have been similar in direct comparisons which used a probit and logit model to assess the choice to participate in the food stamp program (Capps and Kramer, Epperson et. al.). Consistent with other analyses assessing producer choice in marketing decisions (Fu et. al.; Turner, Epperson and Fletcher), a probit model was used in this analysis.

Factors selected to include in the model were determined from other studies focusing on management decision making by farmers and limitations of the survey data. Shapiro and Brorsen used a Tobit model to analyze factors influencing the hedging decision for 42 selected farmers in Indiana. Debt position (a self reported debt to asset ratio), education, farm management experience, and perceptions toward the income stabilizing potential of hedging were the most significant variables in their analysis. Turner, Epperson, and Fletcher looked at producer attitudes toward electronic marketing. Age, on-farm storage capacity, expansion intentions, and producer perceptions regarding the fairness of farm prices were the most significant variables. In the analysis of producer attitudes toward peanut marketing alternatives by Fu et. al., number of enterprises, debt ratio, education, and the producer's location (state) were all significant. Rahm and Huffman related several factors to producer adoption of minimum tillage, with farm size, cropping systems, and soil characteristics being the most significant. Hill and Kau used a probit model to assess producer

decisions in Illinois about the purchase of a grain dryer. Enterprise size, type of farm (fed hogs or not), and age were identified as variables significantly influencing producer choice.

Educational level, farm size (measured by gross income from farming), location (by state or county), and age were available from the Pilot Program survey data. Other variables included were: participation in the government commodity program (often identified as the primary risk reducing mechanism for many agricultural producers); membership in a marketing club (currently being suggested as an effective method to get producers involved in using futures markets - see Erickson and Tierney); and whether the respondent was a full-time farmer, part-time farmer, or landowner receiving crops from a share lease. The empirical model is specified as:

$$FOUSE = f(FRMSTAT_i, GOVPART, MKTCLUB, EDUC_i, SIZE_i, REGION_i, AGE_i)$$

Where;

FOUSE = 1 if futures or options were used <u>for hedging</u> during 1986, 1987, or 1988; 0 otherwise,

$FRMSTAT_i$ = farming status (i = 1 for full-time farmer, 2 for part-time farmer, 3 for landowner receiving crop share),

GOVPART = government commodity program participation (1 if participated in 1988; 0 otherwise),

MKTCLUB = membership in a marketing club (1 if were a a member in 1988; 0 otherwise),

$EDUC_i$ = educational level (i = 1 for some post high school training, 2 for a bachelors or higher, 3 for a high school diploma or less),

$SIZE_i$ = gross farm sales in 1988 (i = 1 for $100,000 or less, 2 for $100,001 to $250,000, 3 for $250,001 to $500,000, 4 for over $500,000),

$REGION_i$ = regional location (i = 1 for western region, 2 for midwest region, 3 for southern region),

AGE_i = age of producer (i = 1 for 35 years or less, 2 for 36 to 50 years, 3 for 51 years or over).

Model parameters were estimated using a maximum liklihood procedure employing the Newton-Raphson convergence algorithm. For each variable with more than two categories (those subscripted with an i), the final category was excluded (i = 3 or 4) in the estimation process to eliminate the singular matrix problem.

RESULTS

Estimated model parameters and related statistical information are presented in Table 1. Overall, model results indicated a high level of significance (several of the variables were significant at the 1 percent level) and generally produced the expected signs for the explanatory variables. The percent of correct predictions was just over 70 percent and Efron's R-Square was 0.12. Even though R-Square may seem somewhat low, the value is within an acceptable range for a qualitative choice model analyzing such a diverse group of decision makers.

The two factors which consistently provided insignificant parameter estimates were farming status (full-time, part-time, or landowner receiving crop shares) and age. With regard to farming status, signs of the parameter estimates were as expected (going from a crop share landowner to a full-time or part-time farmer increases the probability of using futures and options), but the strength of the impact was inconsistent with expectations. Part-time status had a greater impact on the probability of using futures and options relative to full-time status. Estimation problems with this variable may be related to limited observations for

Table 1. Maximum Liklihood Estimates for the Probit Model Used to Analyze Factors Influencing Producer Decisions Regarding the Use of Futures and Options in Commodity Marketing

Variable Name	Estimated Parameter	Standard Error	T-Ratio[a]	Change In Probability[b]
Constant	- 2.036	0.369	- 5.52***	-
FRMSTAT1	0.215	0.324	0.76	0.071
FRMSTAT2	0.396	0.324	1.22	0.137
GOVPART	0.369	0.219	1.69*	0.118
MKTCLUB	0.537	0.156	3.44***	0.201
EDUC1	0.245	0.148	1.66*	0.078
EDUC2	0.602	0.145	4.16***	0.209
SIZE1	0.345	0.140	2.47**	0.114
SIZE2	0.572	0.164	3.49***	0.200
SIZE3	0.609	0.226	2.69***	0.215
REGION1	0.587	0.219	2.68***	0.196
REGION2	0.368	0.187	1.97**	0.116
AGE1	0.069	0.156	0.44	0.025
AGE2	- 0.104	0.146	- 0.72	- 0.036

N = 595
Percent of Correct Predictions = 70.6
Efron's R-Square = 0.12

[a]To test if the parameter estimate is significantly different from zero. Significance at the 10 percent level is indicated by *, significance at the 5 percent level by **, and significance at the 1 percent level by ***.

[b]The change in probability is calculated at the mean values. Since all variables are 0-1 type, the change in X_i is consistently a 1 unit change.

producers that were not full-time. Eighty-six percent of the sample represented full-time farmers, 8 percent were part-time, and 6 percent were landowners receiving crops from a share lease.

The estimated parameters for age group were also insignificant in the model. Additionally, the negative sign associated with AGE2 (36-50 years old) was inconsistent with expectations. Shapiro and Brorsen found experience (a proxy for age) to be inversely related to the level of hedging. Turner, Epperson, and Fletcher found age to be inversely related to attitudes toward innovative marketing alternatives. The negative sign for AGE2 implies the middle age group was less likely to use futures and options relative to the highest age group (over 50 years old). Age was also estimated as a continuous variable in another specification of the model, with similar results. The parameter estimate was insignificant and suggested higher age had a negative impact on the probability of using futures and options.

Participation in the government commodity program and membership in a marketing club both had a positive and significant impact on the probability of using futures and options. Government program participation was significant at the 10 percent level and marketing club membership was significant at the 1 percent level. Membership in a marketing club was one of the factors with the largest impact on the probability of using futures and options, increasing the probability by about 0.20. However, both variables tended to have observations grouped on one side or the other. About 91 percent of the survey respondents participated in the government commodity program and about 86 percent did not belong to a marketing club.

Level of education also had a significant and positive impact on the use of futures and options. EDUC1 represents some training after high

school (vocational or college) and slightly increased the probability of using futures and options relative to having a high school diploma or less. The parameter estimate for EDUC2 (a bachelor's degree or above) was significant at the 1 percent level, and substantially increases the probability of using futures and options (a change of 0.21). The positive impact of educational level on the use of futures and options was similar to results from Shapiro and Brorsen.

Farm size was grouped into four categories based upon respondent reported gross farm sales for 1988. Parameters estimating the impact of size were all significant (at the 1 or 5 percent level) and consistently positive. The change in the probability of using futures and options became greater as size increased, except for the largest size category ($500,000 or more in sales). The variable for the largest size category was omitted for estimation purposes. Therefore, the three remaining size groups all had a positive impact on the use of futures and options relative to the largest size category.

Three factors may explain why the largest size group was the least likely to use futures and options. First, this group contained a limited number of observations (about 7 percent of the sample). Second, this group was heavily influenced by cotton producers and cotton producers as a group were less likely to hedge. Third, Shapiro and Brorsen found that the debt ratio was an important determinant of hedging and tended to be positively correlated with the level of hedging activity. For production agriculture in general, larger and smaller farmers tend to be the least leveraged, while farms in the middle size categories tend to be the most highly leveraged. Thus, based upon expected degree of leverage, the two middle size groups (SIZE2 and SIZE3) should have a higher probability of using

futures and options relative to the small and large groups. Information on respondent debt ratio was not available from the survey, and therefore excluded from the model. Accordingly, model results may be reflecting the impact of leverage through the size variables.

Parameter estimates for the region variables were significant at the 1 percent level for REGION1 (west) and the 5 percent level for REGION2 (midwest). Both regions had a positive impact on the probability of using futures and options relative to the southern region (REGION3). The larger impact on the probability of using options was associated with the western region, with an increase in probability of 0.196 compared to 0.116 for the midwest.

SUMMARY AND CONCLUSIONS

Use of futures and options (or lack of use) by farmers as a means to forward price agricultural commodities has been receiving additional attention from several groups, especially over the last two decades. As discussed by Shapiro and Brorsen, most of the discussion concerning reasons farmers do or do not use futures and options has been normative in nature. The study by Shapiro and Brorsen represents an initial effort to quantify factors which may influence hedging decisions by farmers. Their sample of farmers was, however, restricted to a small group of 45 "Top Farmer" program participants from Indiana.

This study used a larger sample with greater diversity regarding geographic location, commodities produced, educational level, and managerial expertise. Data from 595 respondents to a telephone survey of participants in the 1988 Futures and Options Marketing Pilot Program were used in the analysis. Respondents were from 22 states representing a group of farmers with diverse socio-economic characteristics. A probit model was

used to identify how various factors influenced the probability that a farmer had used futures or options for commodity marketing during the previous three marketing years (1986, 1987, and 1988).

Model results suggested size of farming operation (measured by gross farm sales), possession of a bachelor's degree or above, and membership in a marketing club had the greatest positive impact on the probability of using futures and options. Region was also an important variable, with the western and midwestern regions having a positive influence on the probability of using futures and options relative to the southern region. Farming status (full-time, part-time, or landowner receiving a crop share) and age had insignificant parameter estimates.

Efforts to increase the use of futures and options in commodity marketing should consider characteristics which tend to have a positive impact on the probability of using. If a program is initiated with the goal of increasing use of futures and options by producers, such a program should focus on producers in the farm sales range of $100,000 to $500,000 with higher levels of education. If a program is designed to focus on the general farm population, education will likely play an important role in program success. Use of marketing clubs as an educational tool appears to be quite effective in getting producers to begin using futures and options.

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