Identifying Farmer Characteristics Related to Crop Insurance Purchase Decisions

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Abstract

Crop insurance is an area of federal agricultural policy that has been a source of continual calls for reform and improvement, yet there are a limited number of empirical studies examining farmers' insurance purchase decisions. As far as we are aware, this study is the first to utilize farm level data from the Southeastern U.S. We look at the farmer's decision to purchase or not purchase crop insurance using data from Georgia cotton and peanut farmers. We find that farmers appear to do a good job of weighing the benefits of crop insurance against alternative forms of self-insuring and risk-diversification.

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Introduction

Federal crop insurance, first designed in 1938, was developed by the federal government to protect farmers against lower than expected yields caused by any number of contributing factors, including: weather shocks, insect damage, soil and plant diseases, etc. Throughout most of its history, however, it has been characterized by low participation and less than ideal actuarial performance. With significant changes occurring in farm policy in recent years, federal crop insurance has been a topic of debate among policy makers and producers alike, with the call for reform continually increasing. As a result of the government attempting to reduce its role in providing price and income support to farmers and the contradictory 1998 disaster aid, crop insurance reform has been a top priority for the Clinton administration.

With the partial removal of subsidized farm programs across the nation and with recent trade barriers lifted by NAFTA and other such agreements, the U.S. government is forcing its agricultural producers towards an uncertain era of increased risks driven by free market forces. Instead of relying on ad hoc disaster relief payments, often referred to as "free crop insurance," producers are being encouraged to seek other risk management tools including: hedging with the use of the futures and options markets, forward contracting with buyers, crop diversification, and increased crop insurance, etc.

The call for crop insurance reform is continually increasing as the Federal Government is lessening its role in providing a "safety net" for production agriculture. The apparent goals of the Federal Government have prompted the USDA's Risk Management Agency and individual private insurance companies to explore new insurance coverage plans and other risk management

tools to assist producers in the transition as the Federal Government transfers more risk to the private sector. As these agencies struggle to provide producers with a means of efficient insurance coverage, it would be beneficial to recognize the characteristics of farmers that are correlated with their crop insurance purchasing decisions.

The primary objective of this study is to evaluate the characteristics of farmers who purchase crop insurance. The awareness of which farmers are most likely to buy crop insurance will allow insurance companies to create a “target market” of potential clientele. Allowing insurance companies to concentrate their marketing efforts towards farmers in this “target market,” would protect against wasting valuable resources in areas that do not show promising results, and would provide insight for the development of new products for farmers who currently are not well served by any existing policies. We will try to identify the characteristics of this "target market" by estimating logit models of crop insurance purchase decisions by Georgia cotton and peanut farmers. While several similar studies exist, our farm level data is rare in that it comes from outside the Midwest; previous farm level studies have used data from Kansas (Coble et al., Smith and Goodwin) and Montana (Smith and Baquet). As in almost all previous studies, we focus on standard multiperil crop insurance (MPCI) policies, whether basic (CAT) or higher protection level buy-up policies.

Literature Review

Three major studies have been performed using farm level data to estimate models of crop insurance purchase decisions: Smith and Baquet for Montana wheat farmers, Smith and Goodwin, and Coble et al. for Kansas wheat farmers. Goodwin also did a similar study using Iowa corn farmer data aggregated up to county level. We mostly focus on the variables and

results from these studies, but mention other studies when appropriate. There have been numerous studies on the demand for crop insurance that each portray a different angle for investigation; however, the ones mentioned above pay particular attention to the factors that affect the insurance purchasing decisions of the farmer. The knowledge of these factors is essential for establishing a target market, for evaluating the soundness and longevity of insurance programs, and for assessing reasons for the lower-than-hoped purchase rates of federal crop insurance policies. Although the variables in these studies vary enormously from one project to the next, there are a few variables that seemed to be common among the majority: the expectation of disaster relief payments, education, average farm size, farm diversification, farm debt (farm liabilities, farm net worth, debt-to-asset ratios etc.), off farm income, average yield, and rented farm land. These variables are most prevalent across studies; however, a closer look will be taken at the individual focuses and conclusions of each study.

The history of receiving deficiency payments was an important variable in many previous studies on crop insurance demand and purchasing decisions. A deficiency payment variable was statistically significant in explaining the decision to purchase insurance in Smith and Baquet and Just and Calvin, but was not significant in studies preformed by Barnett, Skees, and Hourigan; Edelman, Schmiesing, and Khajastek; and Goodwin. The researchers finding this variable significant agree that a history of receiving disaster relief payments may reflect higher returns to insurance because historically yields have been more variable.

Education level proved significant for both the purchasing decision and for the coverage level decision in Smith and Baquet's study. This confirms earlier studies by Just and Calvin, and Edelman, Schmiesing, and Khajastek who found that participation in MPCI is positively correlated with education level. Smith and Baquet also incorporated other demographic

variables in their study, including age and years farming. These variables, however, were found to be insignificant.

The variable correlated with farm size in Smith and Baquet's study was not significant. This finding agrees with Smith and Goodwin; most other studies, however, have found a positive correlation between farm size and participation in the MPCI program. For example, an empirical analysis of the demand for MPCI by Goodwin found that farmers were more likely to purchase insurance if they had a larger than average farm. Smith and Baquet believe that the reason it is not significant in their study is because most farms in the sample are relatively large, with an average size of over 4,500 acres. This is one area where the greater diversity of farms in the Southeast could lead to a better insight into the role of a factor in crop insurance purchase decisions.

Surprisingly, the degree of diversification was insignificant in Smith and Baquet and in Coble et al. Smith and Baquet speculate that their finding is due to limited alternative uses for non-irrigated land in Montana. This is also true in Kansas, but again the Georgia data should provide a better empirical look at this question as Georgia farmers have over 50 "major" commodities to choose from in their operations.

Many studies used a measure of wealth variable including, a farmer's net worth or a debt to asset ratio, and off farm income. In Smith and Baquet; Smith and Goodwin; and Coble et al. all found a farmer's net worth to be a significant variable in explaining purchase decisions. However, off farm income was found to be insignificant by Smith and Goodwin. These findings suggest that farmers with larger beginning wealth or current period income are less likely to purchase crop insurance (a sign of self-insurance). In this study, we are particularly interested in examining signs of self-insurance either through income, net worth, or enterprise diversification.

Econometric Analysis

Model Specification

Two separate regression models were employed for this study, one to account for the crop insurance purchase decisions of cotton farmers and another to account for those of peanut farmers. Many farmers are engaged in both cotton and peanut farming and, therefore, a single farmer could have one observation included in each crop's regressions. Logit models were used to determine the effect of the explanatory variables and which of those variables are most correlated with farmers' crop insurance purchase decisions.

The dependent variable is a binary variable representing the purchase (1) or failure to purchase (0) at least the minimum level of federal crop insurance. No discrimination is made between farmers that purchased only CAT policies and those that purchased higher levels of coverage. Independent variables are included for farmer characteristics such as age, education level, household income, and years of farming. Further independent variables for farm characteristics included farm size, rented acres, acres of the particular crop, total number of farm enterprises (commodities), total assets, and total debt. A few crop specific variables are also included that related to farming practices for cotton and peanut production in Georgia that attempt to model some of the production risk characteristics of the farming operation. All variables in each model are listed in tables 1 and 2.

The Data

The data obtained for this study are collected from a mail survey conducted by The University of Georgia's Center for Agribusiness and Economic Development for another project. The survey was mailed in March 1999 to 1473 Georgia cotton farmers randomly selected from a list provided by the Georgia Commodity Commission for Cotton. The response rate to the

survey was low, about 5%, partly because the survey was complicated and lengthy. From the returned surveys and after selecting the variables to be included in this study, 44 of the surveys were complete for use in the cotton model and 33 for the peanut model. There are fewer peanut observations because the survey was sent out to cotton farmers in anticipation that they might have peanut acreage as well.

Results

Gauss software (Aptech Systems) was used to perform maximum likelihood estimation by a Gauss-Newton search algorithm with multiple convergence criteria. The estimated vector of coefficients for the explanatory variables along with precision and goodness-of-fit statistics are shown in tables 3 and 4 for the cotton and peanut models, respectively.

In addition, as performance information, it is worth reporting that both models correctly classified all observations into the purchase and nonpurchase categories. That is, predicted purchase probabilities are greater than 0.5 for all farmers that purchased crop insurance and less than 0.5 for all farmers that did not. For cotton the split was 36 purchased, 8 not purchased; for peanuts the data are 27 purchased, 6 not purchased. We also calculated the marginal probabilities tables for the explanatory variables (evaluated at a representative vector of explanatory variables from the sample that has a predicted purchase probability close to 0.5). Unfortunately, the marginal probabilities are extremely sensitive, meaning that small changes in the characteristics cause farmers to change their crop insurance purchasing decisions. As a result, the marginal probabilities are suspiciously large, jumping in every case between forecasting a certain purchase and a certain nonpurchase. This instability in the marginal probabilities is likely a result of each model's having perfectly classified every observation into the correct decision category (along with some amount of multicollinearity). This highly unusual

result, while indicating that the variables explain the crop insurance purchase decisions very well, appears to be contributing to some poor behavior in the marginal probabilities.

For the cotton farmer model, all the variables, except two region specific dummy variables are significant at the α=0.10 significance level. The pseudo-R^2 = 0.9604, proving the regression line fit the data very well. All of the coefficients have the expected sign except for the RENT variable. It was expected that the more rented acres a farmer had, the more likely he would be to purchase insurance. Instead, the estimated coefficient has a negative sign for this variable which is contradictory to previous studies. One reason for this contradiction could be that some farmers have noncontiguous rented land and have tracts in different soil types. The survey responses show that many farmers have acreage in several surrounding counties and could feel a sense of protection from a diversified geographic arrangement. This geographic diversification may lower the perceived production risk and therefore the demand for crop insurance.

The estimated coefficients for INCM and ENTPRI have the expected negative signs and demonstrate the farmer's ability to self-insure. The number of enterprises is a measure of how well diversified the farmer is and was not found to be significant in studies on the mid-Western states (Smith and Baquet, Coble et al.). Diversification may not have been significant for these studies because there are limited crops to pursue in the mid-West as opposed to the South where there are a wide variety of crops and livestock that a farmer can produce.

The coefficients for TOTASS and DEBT also have the expected signs (+, -) and their estimated coefficients are of the same magnitude. This result is important because it implies that farmers are basing crop insurance purchase decisions (partially) on their net worth--assets minus debts--which would be in line with economic theory. Farmers with more debt are more likely to

purchase crop insurance because of pressure from lending institutions, but the results show that debt balanced by assets will not cause this effect. The TOTASS variable, like the INCM and ENTPRI, has a negative sign and demonstrates the farmer's ability to self-insure. Together, these four variables show self-insurance is taking place through wealth resources and "portfolio" diversification.

Although it was difficult to predict the signs for coefficients on AGE, EDUC, and FARMY, it was expected that AGE and FARMY would have the same sign, whatever the outcome. The results; however, are somewhat confusing because AGE has a negative coefficient and FARMY has a positive one. This suggests that the older a farmer is, the less likely he is to purchase crop insurance, but the longer he has been farming the more likely he is to purchase. The estimated coefficient for EDUC has a negative sign, suggesting that the more education a farmer has, the less likely he is to purchase crop insurance. This supports the theory that better educated farmers are better managers, are exposed to more sophisticated risk management practices and, therefore, are less likely to purchase crop insurance. Another reason that older and more educated farmers are less likely to purchase insurance could be the anticipation of disaster relief from the Federal government. Even though this form of relief is supposed to decline, the 1998 disaster relief contradicted the government's efforts. This theory of course does not explain the positive relationship between the purchasing decision and the number of years the farmer has been farming.

In analyzing the coefficients of variables related to production risk, the CIPM variable's coefficient reveals a positive relationship between the use of IPM practices and insurance purchases. Farmers wanting to cut down on pesticide usage are faced with a greater amount of uncertainty and are, therefore, more likely to purchase crop insurance to compensate. The

coefficient for BTRR also reveals a positive correlation between the planting of cotton with the stacked gene, BT/RR and crop insurance purchases. Farmers willing to participate in new technology may also face greater uncertainty and thus, be more likely to purchase crop insurance (Black). Farmers planting this stacked gene cotton are forced to pay accelerated technology fees and may feel the need for some sort of compensation, should yields be less than anticipated. Farmers utilizing cotton that is Roundup-ready may also have a tendency to plant that cotton in the most troublesome tracts for ease of weed control (Vencill). The coefficients for REG3 and REG4 show farmers less and more likely, respectively, to purchase crop insurance than in the base region. These results appear to match local weather patterns relative to areas of more and less consistent rainfall. Thus, farmers appear to self-assess their production risk and insure accordingly.

For the peanut farmer model, coefficients on all variables are significant at the α=0.10 significance level except INCM and CONS. The pseudo-R^2 = 0.9537, again showing how well the regression line fits the data. Like the cotton model, the RENT and EDUC variables have a negative impact on the insurance purchasing decision and AGE and FARMY have opposite signs. The implications regarding the effects of DEBT, TOTASS, and ENTPRI in the cotton model hold for the peanut model as well. Again, self-insurance through asset reserves and diversification to reduce overall yield and revenue risk appear to be strong substitutes for federal crop insurance.

Although TSWV's coefficient is significant at the α=0.10 significance level, it does not have the expected sign. The results imply that if a farmer observes the tomato spotted wilt virus in the previous year's crop, he is less likely to purchase crop insurance. This result clearly

contradicts common sense. The coefficients on the regional dummy variables do conform to our expectations and match up with regional rainfall patterns as they did for cotton.

Conclusions

This study focused on identifying farmers' characteristics that are correlated with their crop insurance purchasing decisions. The identification of these characteristics will allow insurance companies to concentrate their marketing efforts towards farmers in a "target market," and will protect against wasting valuable resources in areas that do not show promising results. The identification of these characteristics will also provide insight for the development of new products for farmers who currently are not well served by any existing policies.

The major policy implication revealed by this study is that farmers who have the ability to self insure generally are not interested in crop insurance and, therefore, it is unrealistic to get 100% participation in the crop insurance program. The empirical data show that farmers with the ability to self-insure, by diversifying and accumulation of sufficient wealth reserves in terms of income and total assets, pursue these strategies as a substitute for the federal crop insurance program.

These results are valuable because very little empirical work on crop insurance has been preformed in the South. This is ironic considering that many of the complaints and problems associated with crop insurance stem from the South. This study is the first to be completed in the South that uses farm level data. Most crop insurance studies measure the demand for crop insurance and are focused on the Midwest.

As the call for crop insurance reform continues into the future, further research on the subject will be warranted. Other variables that could be included in purchase decision models

such as this one are average yield, average price received, off farm income, if the farmer received disaster assistance in the preceding years, and if the farmer utilizes other risk management tools like futures and options or forward contracts. Researchers should strive to collect the rich farm level primary data sets necessary to properly investigate the many remaining questions surrounding the federal crop insurance program.

Finally, the empirical results suggest that farmers are willing to self-insure through own-wealth and risk-diversification (through producing multiple commodities). Perhaps government policy should search for ways to create greater opportunities for farmers to take advantage of these approaches to insurance rather than trying to boost participation through larger subsidies. In regions without a wide selection of commodities to choose from, perhaps risk-diversification pools could be created linking farmers in one region with those in another. Canada's form of tax-deferred accounts to protect farmers against income swings might allow less-wealthy farmers to self-insure (assuming, of course, that the government does not provide a bailout as a substitute for withdrawals from the funds during low income years). Helping the marketplace to work may be a more affordable and superior solution to government insurance subsidies.

Table 1. Explanatory Variables Included in the Cotton Farmer Logit Model

Variable	Explanation
INSUR	Dependent dummy variable indicating whether the farmer purchased crop insurance in 1998 (1= yes insurance, 0= otherwise)
AGE	The age of the respective farmer
EDUC	The education of the respective farmer
INCM	The farmer's household income
FARMY	Number of years the farmer has been farming
lnTACRE	Total size of farm (acres owned + acres rented), natural log of
RENT	percentage of total acres that are rented
CACRE	Number of cotton acres in 1998
ENTPRI	Number of current crop/ animal enterprises
TOTASS	Total value of farm assets
DEBT	Total debt of farming operation
CIPM	Dummy variable indicating whether or not the farmer utilized integrated pest management on his cotton (1= yes, 0 otherwise)
BTRR	Dummy variable indicating whether or not the farmer utilized BT/RR cotton (1= yes, 0 otherwise)
CONS	Dummy variable indicating whether or not the farmer utilizes a consultant for any crop (1= yes, 0 otherwise)
REG2	Regional dummy variable indicating whether or not the farmer had cotton in the East district (1= yes, 0 otherwise)
REG3	Regional dummy variable indicating whether or not the farmer had cotton in the West district (1= yes, 0 otherwise)
REG4	Regional dummy variable indicating whether or not the farmer had cotton in the Central district (1= yes, 0 otherwise)

Table 2. Explanatory Variables Included in the Peanut Farmer Logit Model

Variable	Explanation
INSUR	Dependent dummy variable indicating whether the farmer purchased crop insurance in 1998 (1= purchased insurance, 0= no insurance purchased)
AGE	The age of the respective farmer
EDUC	The education of the respective farmer
lnINCM	The farmer's household income, natural log of
FARMY	Number of years the farmer has been farming
TACRE	Total size of farm (acres owned + acres rented)
RENT	Percentage of total acres that are rented
lnPACRE	Percentage of total acres planted in peanut, natural log of
ENTPRI	Number of current crop/ animal enterprises
TOTASS	Total value of farm assets
DEBT	Total debt of farming operation
TSWV	Dummy variable indicating whether or not the farmer observed the tomato spotted wilt virus in his 1997 peanut crop (1= yes, 0 otherwise)
CONS	Dummy variable indicating whether or not the farmer utilizes a consultant for any crop (1= yes, 0 otherwise)
REG2	Regional dummy variable indicating whether or not the farmer had peanut acreage in the East district (1= yes, 0 otherwise)
REG3	Regional dummy variable indicating whether or not the farmer had cotton in the West district (1= yes, 0 otherwise)

Table 3. Cotton Farmer Logit Model Results

Variable	Coefficient	Standard Error	T-Value	P-Value
INTER	-222.4272	119.3618	-1.8635	0.0733
AGE	-5.4756	2.6625	-2.0565	0.0495
EDUC	-28.9025	13.4242	-2.1530	0.0404
INCM	-0.6208	0.2795	-2.2214	0.0349
FARMY	8.8024	4.1439	2.1242	0.0430
LnTACRE	105.6709	48.4681	2.1802	0.0381
RENT	-63.6781	32.2089	-1.9770	0.0583
CACRE	0.1685	0.0781	2.1586	0.0399
ENTPRI	-34.7592	15.9917	-2.1736	0.0387
TOTASS	-188.3257	86.3460	-2.1811	0.0381
DEBT	177.1800	80.9136	2.1897	0.0374
CIPM	98.1859	49.4343	1.9862	0.0573
BTRR	24.6156	13.6846	1.7988	0.0832
CONS	35.9142	18.0474	1.9900	0.0568
REG2	-6.4722	48.1803	-0.1343	.8941
REG3	-114.5660	68.2574	-1.6784	0.1048
REG4	296.0756	149.3983	1.9818	0.0578

Log-Likelihood Value	-2.2721	Degrees of Freedom	27
Pseudo R^2	0.9604	Number of Observations	44

Table 4. Peanut Farmer Logit Model Results

Variable	Coefficients	Standard Error	T-Value	P-Value
INTER	578.0064	217.2300	2.6608	0.0159
AGE	-9.1027	3.3986	-2.6784	0.0153
EDUC	-29.5403	11.6374	-2.5384	0.0206
LnINCM	6.4222	4.2353	1.5163	0.1468
FARMY	8.7890	3.2162	2.7327	0.0137
TACRE	0.1183	0.0489	2.4206	0.0263
RENT	-106.5497	39.8215	-2.6757	0.0154
LnPACRE	75.8911	28.0158	2.7089	0.0144
ENTPRI	-19.7333	7.4725	-2.6408	0.0166
TOTASS	-104.7713	39.2332	-2.6705	0.0156
DEBT	130.6709	66.0326	1.9789	0.0633
TSWV	-13.1191	7.5043	-1.7482	0.0975
CONS	12.4783	17.1425	0.7279	0.4760
REG2	65.4751	25.9857	2.5197	0.0214
REG3	-22.8311	12.7254	-1.7941	0.08

Log-Likelihood Value	-1.9537	Degrees of Freedom	18
Pseudo R^2	0.9537	Number of Observations	33

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