2008
OSKWP0801

Economics Working Paper Series
OKLAHOMA STATE UNIVERSITY

Are Friendly Farmers Environmentally Friendly? Effect of Community Involvement on Environmental Awareness

Abdul B. A. Munasib
Assistant Professor of Economics
Department of Economics and Legal Studies in Business
Oklahoma State University
343 Business Building
Stillwater, OK 74078-4011
Phone (405) 744-8763
Fax (405) 744-5180
e-mail: munasib@okstate.edu

Jeffrey L. Jordan
Professor
Department of Agricultural and Applied Economics
University of Georgia, Griffin Campus
1109 Experiment Street, Griffin, GA 30223-1797
Phone (770) 228-7231, Ext. 106
Fax (770) 228-7208
e-mail jjordan@griffin.uga.edu

Department of Economics

Oklahoma State University
Stillwater, Oklahoma

339 BUS, Stillwater, OK 74078, Ph 405-744-5110, Fax 405-744-5180
Harounan Kazianga harounan.kazianga@okstate.edu
Abdul Munasib munasib@okstate.edu

Are Friendly Farmers Environmentally Friendly?
Effect of Community Involvement on Environmental Awareness[f]

Abstract

We study if community involvement makes an individual more environmentally friendly. An individual with greater attachment to the community is likely to be more socially responsible. They are also more likely to have better exposure and access to information about the importance of the environment and environmentally friendly practices. Using associational memberships as a measure of community involvement we study its effects on agricultural practices among Georgia farmers. Our findings showed that, first, community involvement had a positive effect on the decision to adopt environmentally friendly agricultural practices, and, secondly, it also had a positive effect on the extent to which farmers adopt these practices. These findings establish an additional dimension to the benefits that would accrue to policies that promote social interaction and civic engagement in rural areas associated with farming.

Key words: Membership, community involvement, social capital, environmentally friendly agriculture, endogenous regressor.

JEL Classification: Z13, Q2, Q3

[f] We thank Samrat Bhattacharya (FTAM, Cleveland, Ohio), and Devesh Roy (International Food Policy Research Institute, Washington, DC) for helpful comments.

I. Introduction

Does greater community involvement promote environmentally friendly practices? Research addressing this issue is virtually nonexistent. We study the effect of community involvement of the individual farmer – measured by her associational memberships – on her choices of practicing environmentally friendly agriculture. We use the *Georgia Farm Social Capital Survey*[1] that provides information about agricultural practices and associational involvements of the farmers in the state of Georgia.

We hypothesize a positive relationship between associational memberships and environmentally friendly agricultural practices. Community involvement may enhance social responsibility and thereby promote environmentally friendly behavior. Community involvement can also facilitate information channels – the individual may gain an understanding of the importance of the environment and obtain knowledge and training about environmental agricultural practices. While testing the hypothesis whether associational memberships promote environmental practices we address the issue of possible endogeneity of the membership variable, which is an important contribution of this paper.

I.1. The Membership Measure

The measure "number of associational memberships" – the so-called "Putnam's Instrument" popularized by Robert Putnam (Putnam 1995, Putnam 2000) – has a special place in the social capital literature. It is one of the most frequently used measures of social capital.[2] When membership is used to measure individual social capital it is essentially based on the 'network view' where social capital of an individual represents his social connectedness. This view also renders an optimization framework in a relatively straight-forward manner (Durlauf and Fafchamps 2004). An alternative view of social capital is the so-called 'trust/co-operation' view that defines social capital as the level of trust in the society (Paldam 2000). This, however, is not very conducive to individual optimization (Glaeser, Laibson and

Sacerdote 2002, Durlauf and Fafchamps 2004, Munasib 2005).

Even under the network view of social capital, the membership measure is not an adequate measure of individual social capital because, for instance, it does not take into account vital social network links such as friends and neighbors (Paldam 2000, Sobel 2002, and Fukuyama 2000, Munasib, 2005).[3] Therefore, in this paper, we use the membership measure simply as *a* measure of community involvement of the individual which, quite possibly, is also a partial measure of the individual's social capital.

I.2. Environmental Awareness and Community Involvement

We view the practice of environmentally friendly agriculture as a socially responsible behavior. Researchers have proposed several explanations for observed socially responsible behaviors consistent with the paradigm of mainstream economics. One of the most common approaches is to model these behaviors as "warm-glow" where the apparent selfless act causes a utility enhancement (Andreoni 1989). Artikov, Hoffman, Lynne and Zillig et al. (2006) find that in farmer's intentions of using weather and climate information and forecasts in farming decisions, attitude – serving as a proxy for the utility gained from the use of such information – had the most profound positive influence. Alternatively, models of deontological altruism assume that a certain charity threshold must be reached before a person can derive any satisfaction from private consumption (Asheim 1991). The general theme in these explanations is that apparently selfless socially responsible behaviors may in fact enhance the individual's utility. Ferrer-i-Carbonell and Gowdy (2005) find evidence of a negative effect of concern about pollution on subjective measures of well-being.

Of particular interest, in the present context, is the line of research that draws a connection between apparently altruistic socially responsible behaviors and social involvement. Artikov, Hoffman, Lynne and Zillig et al. (2006) find that the norms in the community – which they view as a proxy for the utility gained from allowing oneself to be influenced by others – played a large role in agronomic decisions. The theoretical basis for this connection is that identifying with a group or a network and getting involved with it affect individual preferences and choices (Durlauf and Fafchamps 2004). The relationship between social capital and civic responsibility, therefore, is a recurrent theme in the social capital literature (Krishna and Uphoff 1999). Some of the most widely discussed outcomes of social capital concern civic matters such as political participation and good governance, philanthropy, increased judicial efficiency, decreased government corruption, and promotion of cooperative movements (DiPasquale and Glaeser 1999, Goss 1999, LaPorta et al. 1997, Paldam and Svendsen 2000, Putnam 1995, Putnam 2000). Putnam (2000) argued that civic engagement is one of the most important predictors of philanthropy. Other charitable behaviors such as tendency to volunteer time (Putnam 2000, Ferrer-i-Carbonell and Gowdy 2005), and making monetary donations (Brooks 2005) have also been linked to social capital.

The issue of social responsibility is ubiquitous in the agricultural technology adoption literature. Lynne and Franklin (1998) find that the farmer's motivation is multifaceted. Farmers are motivated by self-interest values and beliefs, i.e., preferences that can be measured by attitudes toward the technology, as well as the public-interest values and beliefs, i.e., preferences related to social norms. Chouinard, Paterson, Wandschneider and Ohler (2008) model farmer's behavior in an expanded utility framework with two utility components: self and social interests. They find evidence that some farmers are willing to forego some profit to engage in stewardly farm practices.

Surely, social capital does not always lead to civic responsibility or socially responsible actions. A frequently used counter-example is that of organized crime syndicates where high levels of social capital are associated with socially harmful and destructive outcomes. We, in this paper, have a narrower focus than social capital. We are focusing only on community involvement and our measure is the membership variable that includes the types of organizations (from school to professional to recreational groups) that are more likely than mafia organizations to produce social responsibility and environmental awareness. Therefore, unlike the studies that claim a general link between social capital and socially responsible actions, our analysis is not vulnerable to this line of criticism.

The second possible connection between community involvement and environmental awareness is information. Channeling of information and Information diffusion are some of the most widely discussed aspects of social networks, especially at the individual level (Durlauf and Fafchamps 2004). When individuals interact with one another, transfer of information takes place. Often the purpose of such interaction – even in social circumstances – may be the sharing of information itself, and sometimes this information sharing occurs as a by-product in the form of a Marshallian externality.[4] As an individual becomes socially engaged through various social organizations he has a heightened exposure and access to information about the environment and environmental practices. Brown's (2004) study views education as the source conveying charity enhancing information which expands a person's knowledge set about situations to which a person might want to donate.

Associational involvement may also contribute to learning and training of environmentally friendly practices. The National Environmental Education and Training Foundation (NEETF) emphasize the importance of knowledge and information on successful environmental practices (Coyle 2005). The farmer may learn new techniques and know-how, obtain informal trainings from others who have already adopted such practices, and even obtain help implementing various practices. Barr (2000) argues that social networks among Ghanaian entrepreneurs served to channel information about new technology. The role of business networks in conveying information about employment and market opportunities has been much emphasized (Fafchamps and Minten 1999, Granovetter 1995, Montgomery 1991, Rauch and Casella 2001). In the literature on knowledge spillover, social ties and contacts play a crucial role not only in dissemination of ideas but also in the cross breeding of ideas through social interaction (Jacobs 2002, Krugman 1991).

The literature on technology adoption and information diffusion also indicates that spread of information and knowledge may in fact be more effective if it is shared through social interactions. When individuals share common interests and beliefs – which is often the case in associational activities – communication among them is more likely to be effective. As a result, learning from groups may be more effective compared to other avenues of learning (e.g. reading books). Munshi and Myaux (2002) find evidence that information diffusion among households with similar religious affiliations helps explain adoption of improved contraception methods in Bangladesh. Studies on agricultural technology adoption show that weaker and more moderate forces such as attitude and norms can be more effective than highly visible, more demanding external controls (Lynne et al. 1995).

To summarize: there are two main channels through which community involvement may lead to environmentally friendly agricultural practices – by promoting social responsibility and by providing knowledge, awareness, and training about the environment and environmental practices. Through the former channel, community involvement may affect people's preferences and make them more socially responsible and, thereby, more sensitive to the environment. Through the latter channel, even for a given preference structure, community involvement can still have a positive impact. Consider the situation where environmentally friendly agricultural practices are also the profit maximizing practices. Then, associational memberships – by providing information, knowledge and know-how about environmental practices – contribute to profit maximization. In case environmental agricultural practices are not necessarily the profit maximizing practices, the individual may still adopt these practices because they can be utility enhancing (possibly due to "warm glow" and "deontological altruism"), and associational memberships – again, by providing information, knowledge and know-how about environmental practices – contribute to utility maximization.

I.3. Contribution of this Paper

Researchers have typically focused on the aggregate level measures of environmental awareness and its connection to social capital. An extensive literature studies environmental awareness *at the aggregate level* (Saxton and Benson 2005), especially in the form of cross-country comparisons (Grafton and Knowles 2003, Duroy 2005). Aggregate social capital, via the mechanism of collective actions, plays an important role in these discussions (Pretty and Ward 2001, Varughese and Ostrom 2001, Pargal, Huq and Gilligan 1999). However, behind any group level action, there are individuals solving their own decision problems. It is important to recognize that individuals make choices as to what extent they want to be involved in activities regarding preservation (or degradation) of the environment. It is not sufficient to study the collective actions in the environmental movement without an understanding of the factors that shape the environmental attitude of the individual. In Anderson, Locker and Nugent (2002), microcredit operations create social capital, and social capital lowers the cost of collective action in managing common pool resources. The essential underlying mechanisms of microcredit operations, of course, are group meetings and group activities that bring individuals together and create a platform for interaction.

The understanding of environmental practices at the individual level will not only help us improve aggregate level policies but also help devise micro level policies that may be complementary to the aggregate level policies. Besides, micro level policies may be important enough to merit discussions independent of aggregate level policies. For instance, while we examine high profile macro level policies regarding water quality (e.g., Clean Water Act) the problem of individual's use of chemicals and fertilizers on lawns that lead to non-point source of leaching into ground water is largely overlooked.[5]

A number of studies, using data on rural Tanzania, have looked at the connection between social capital and the individual's actions regarding agricultural practices, but they measured social capital at the aggregate level. In studying two regions of Tanzania, DeTray (1995) found that participatory associations have a significant positive effect on farmers' market orientation. Isham (2002) showed that social capital (measured by 'ethnic affiliations') affects fertilizer adoption of the farmers. Narayan and Pritchett (1999) found that households from villages with higher levels of the social capital indices (constructed based on organization memberships) are more likely to use modern agricultural inputs.[6]

Unfortunately, studies that use aggregate level social capital necessarily face a serious conceptual challenge – what is the aggregation mechanism? The fact that social capital is subject to complementarities and that social capital does not have to be benign raise conceptual difficulties in aggregation (Glaeser, Laibson and Sacerdote 2002, Munasib 2005). Furthermore, estimation of aggregate social capital effects is subject to serious identification problems (Manski 2000, Durlauf and Fafchamps 2004). In this paper, instead of looking at any aggregate level measure of social capital for a location or a group, we focus on the individual and ask if the individual becomes more environmentally friendly when she becomes more involve in the community.

To the best of our knowledge, with the exception of Jacobs (2002), there has been no empirical study that looked at the effect of individual community involvement on individual environmental awareness. In the context of urban activism in three poor communities in greater Rio de Jeneiro, Brazil, Jacobs (2002) finds that while community involvement has a positive effect on group environmental activities, individual environmental activities are not affected by community involvement. The econometric analysis of this study, however, suffers from a number of limitations: the set of independent variables include very few controls and the issue of endogeneity of community involvement is not addressed. In contrast, this paper focuses on rural communities. We address the endogeneity issue and include a variety of control variables that may be correlated with both associational memberships and agricultural practices. Our findings show that community involvement does have a positive impact on the practice of environmentally friendly agriculture among the farmers.

The remaining of the paper has the following progression: section II describes the data, section III and IV explain the estimation issues and the econometric models, respectively, section V discusses the results and the finding, and section VI concludes.

II. Data

II.1. Georgia Farm Social Capital Survey[7]

The analysis for this paper is based on a telephone survey of Georgia farmers using a random dial approach. The survey was conducted by the Georgia Agricultural Statistics Service (NASS-USDA) in the winter of 2004. There were a total of 431 telephone interviews, representing a statistically significant sample of Georgia farmers based on the use of a simole random sampling procedure, with a confidence level of 95% and a $\pm 5\%$ margin of sampling error. A total of 921 phone contacts were made with a 46.8 percent response rate. Incidents of non-response included respondents who were unavailable, refused to participate, non-working numbers, answering machines, no answer/busy, or strange noise. Usable data was available for 317 households. Table 1 presents a comparison of the demographic characteristics of our sample and the Georgia farm population indicating that the sample is fairly representative. Georgia farmers are overwhelmingly male, white and generally older than the typical person in the state.

The survey had 76 questions including demographic and economic information about the farmer and the farm, information about community involvement of the farmers, and whether the farmer uses one or more of 13 environmentally friendly agricultural practices. The first part of the survey consisted of 18 “yes/no” responses to questions regarding farming practices. We did not ask farmers whether they used environmentally friendly techniques. Rather, a focus group of farmers and agriculture professionals were asked to develop a list of practices that would be considered “environmental friendly.” The thirteen practices were grouped as pest management (3 questions), grazing (3 questions), soil/nutrient management (5 questions), and organic (2 questions). In this survey, farmers with above average associational memberships adopted an average of 5.5 environmental agricultural practices compared to an average of 3.9 such practices adopted by farmers with less than average associational memberships (Table 2). In Table 2, we also see that a greater percentage of farmers with above average associational memberships adopted at least one environmental practice in each category of agricultural activities, namely, pest control, soil management, and grazing.

Table 3 presents the responses to questions regarding environmental agricultural practices. Nearly every farm (92 percent) adopted at least one of the four types of environmental practices. Almost half of all respondents were involved in at least one of the three environmental pest control practice (42 percent), 69 percent in at least one of the three environmental grazing practices, and 77 percent in at least one of the five environmental soil management practices. Only six percent participated in any form of organic production practices. The most common environmental practices were management-intensive grazing system (53 percent), mixes of pasture forage in single field (52 percent), cover crops (54 percent), and mulches/manures (52 percent). The least common practices were the organic practices.

The Second part of the survey asked the farmers a number of questions about associational activities. The questions were selected from the Social Capital Benchmark Survey 2000 conducted by the Roper Center for Public Opinion Research.[8] The Benchmark survey was designed to measure people’s civic engagements. Associational activities included 18 categories including religious organizations, adult sports, youth groups, parent/school groups, senior clubs, art clubs, hobby clubs, self-help clubs, internet groups, veterans groups, neighborhood associations, social welfare groups, unions, professional/trade groups, service clubs, and civil rights and political action organizations. Ninety-five percent of respondents belonged to at least one group.[9]

In tables 4 and 5 we describe in some detail the sample used in this study. Table 4 shows that the respondents were overwhelmingly married, homeowners, and registered to vote. Since there is little variation in these categories, they are excluded in our regression analysis. Table 5 presents the descriptive statistics of the variables used in the study. The sample mean of acres cultivated was 162 acres, which shows that the mean respondent was from relatively small farm operations. Only 8 percent of respondents cultivated more than 500 acres while 62 percent cultivated less than 100 acres. Livestock and poultry farms were the primary farm enterprise for 71 percent of respondents. This results from the large number of small cow/calf and poultry operations that dominate much of north Georgia agriculture. Thirty-six percent of the respondents had gross farm income of less than $10,000. Six percent of the respondents can be characterized as limited-resources farms – having total household income of less than $20,000. Twenty-two percent of farmers can be characterized as large farms having gross farm income of over $50,000. Approximately 20 percent of the respondents refused to answer the household income or farm income questions.

II.2. Dependent Variables

Our dependent variables are responses regarding environmentally friendly agricultural practices and they are of two types: indicator variables and ordered response variables (descriptive statistics on Table 5). The indicator variables PESTDUM, GRAZDUM, and SOILDUM denote whether the farmer is engaged in a certain *type* of environmental practice (e.g. PESTDUM indicates whether any of the environmentally friendly pest control measures are practiced). These variables indicate *adoptions of environmental agricultural practices*. The ordered response variables PEST, GRAZING, and SOIL stand for the number of each type of environmental practices that the farmer is engaged in (e.g. PEST is the number of environmental pest control measures that the farmer is practicing). These variables measure the *extent of environmental agricultural practices*. We also created a continuous variable, ENVPRAC, which aggregates over all four types of environmental practices. This is a summary measure of the extent of environmental practices. Note that, although ENVPRAC includes organic practices we do not have separate variables for organic practices. Since very few farmers – only 19 out of 317 farmers – adopted organic practices the number of observations is too small for meaningful regression analyses separately for organic practices.

II.3. Explanatory Variables

Our objective is to find whether the number of associational activities of the individual farmer have an independent effect on her practice of environmentally friendly agricultural practices. The variable of interest is the total number of associational memberships. The control variables may be classified as demographic characteristics, variables related to farm operation, and aggregate level location characteristics.

Respondent's demographic characteristics included education, family size, and number of children. Detailed categories of education are: high school dropout, high school graduate and some college, college graduate and post graduate. We have included family size because family size is likely to be correlated with the membership variable and, when the farm is operated by the family, it could also be correlated with agricultural practices. We have also included number of children since some writers have postulated that people behave generously toward their progeny or future generations to neutralize future tax payments (Barro 1974).

To account for the farm activities and effects accruing to forward linkages, we have used five dummy variables indicating farm types. Farm operation-related variables include the number of years of farm operation and acres cultivated. We did not include an explicit earnings variable. The income variables – both household income and farm income – have too many non-responses that significantly reduce the number of observations (by 21 percent). Instead of including an explicit income variable, we have included adequate proxies (education, years farming, and acres cultivated) that account for earnings.[10] To capture the aggregate level effects we have included county per capita income, county unemployment rate, and percentage of black population in the county. Since the farmers in our sample came from the rural counties (or the rural parts of the county), we decided not to include population density. Instead, the county population is included with the expectation that it will capture some of the macroeconomic characteristics such as the size of market, etc.

III. Estimation

III.1. Hypotheses

We test two hypotheses. First, associational memberships matter for adoption of environmental agricultural practices. We test this by studying the regressions of the indicator variables indicating involvement in environmental practices (i.e., PESTDUM, GRAZDUM, and SOILDUM). The second hypothesis is that associational memberships affect the extent to which the farmers are engaged in environmental practices. In this case, we study the regressions of the variables that indicate the number of environmental practices that the farmer adopted (PEST, GRAZING, SOIL, and ENVPRAC).

III.2. Econometric Issues

We use cross sectional regressions to study the relationship between the number of associational memberships of the individual and environmental practices adopted by that individual. This is a fundamentally different problem from the issue of estimating a group level effect, e.g. effect of group level social capital on individual level environmental awareness. Therefore, the problems of "correlated effects" and the question of "joint endogeneity" are not likely to arise (Manski 2000).[11] There are, however, a number of other econometric issues that do arise. We categorize them as structural factors and potential endogeneity of the membership variable.

Structural factors refer to the farm operation, particularly to its forward linkages. This is especially important for Georgia farms because a majority of these farms are small[12] and the predominant farm type is livestock and poultry (71 percent). Structural factors also refer to the size of the farm and age of farm operation. Farms with higher earnings are likely to be less risk-averse vis-à-vis the lower-earning farms in adopting new technology (Wandel and Smithers 2000). Demographic factors appeal to sources that influence the farmer's attitude and exposure towards environmentally friendly agricultural practices.

Flora (1995) hypothesized that an increase in environmental practices by farmers may increase social capital. Although Flora's hypothesis was at the community level and she did not adopt an econometric framework to test this hypothesis, we acknowledge the possibility that even at the individual level, a reverse causality may exist. For instance, farmers who are practicing environmentally friendly agriculture may want to be involved in organizations to come across other practitioners of environmental agriculture to share information and other experiences. In that case, the membership variable would be endogenous. We carried out Durbin-Wu-Hausman (DWH) tests of endogenous regressors to verify whether the membership variable is endogenous.

IV. Econometric Models

On the 'adoption' issue, we focus on the variables PESTDUM, GRAZDUM, and SOILDUM. We first carry out Durbin-Wu-Hausman (DWH) tests of endogenous regressors to test whether associational membership is endogenous in each of these regressions. The tests show that associational membership is not endogenous in PESTDUM and GRAZDUM. We, therefore, use probit regressions for PESTDUM and GRAZDUM, and instrumental variable Probit for SOILDUM to test if associational memberships have any significant causal effect on the adoption decisions.

On the issue of the extent of environmental agricultural practices, the dependent variables are PEST, GRAZING, SOIL, and ENVPRAC. We follow the same procedure of first testing for endogeneity of the membership variable. We find that associational membership is not endogenous is any of these regressions. So, we continue with an OLS regression for ENVPRAC (since ENVPRAC is treated as a continuous variable) and ordered probit regressions for PEST, GRAZING and SOIL (since they are ordered responses).[13]

IV.1. The DWH Tests and the Instruments

For the DWH tests we follow the procedure presented in Wooldridge (2002), and Davidson and MacKinnon (2004). We first run an OLS of the membership variable on all the exogenous variables and the instrument and calculate the residual. Then we run an OLS of ENVPRAC on all the right-hand-side variables and this residual. The test of significance (with a t statistic) of the estimated coefficient of the residual is the DWH test. To make the test robust to heteroskedasticity we employed the heteroskedasticity-robust t statistic. Following Davidson and MacKinnon (2004), to address the issue of potential endogeneity of the membership variable in the discrete response cases, we conduct a Durbin-Wu-Hausman (DWH) test of endogenous regressor the same way we do the test for ENVPRAC, the linear case.

The DWH test requires an exclusion restriction, a valid instrument. Econometric estimations with social network variables are notorious for their scarcity of valid instruments. Typically, when detailed information is available about the characteristics of the individuals within the social networks, it may be possible to device exclusion restrictions from that information [Calvó-Armengol, Patacchini, and Zenou (2009)]. Such data sets are extremely rare. In absence of such information we were unable to find a valid instrument outside the model. We, therefore, adopted the approach of using 'inside instrument' which is common in macroeconomic literature. We used the solution proposed in Lewbel (1997) where instruments are devised based on higher order moments of the data. The idea is closely related to instruments frequently used in GMM estimations where the characteristics of the data are exploited to obtain instruments. Lewbel's application was for a case where endogeneity is arising from measurement error in the right-hand-side variable; Millimet and Osang (2005) use the approach for endogeneities arising from reasons other than measurement errors. In our case, we used higher order moments of the membership variable as instruments in the DWH tests.

Since the validity of the instrument is crucial for the DWH test we carried out extensive tests to verify that the instruments are indeed valid. First, the instrument has to be 'relevant' in the sense that it should be able to explain variations in *number of memberships*. Secondly, it should not be a 'weak instrument' so that identification is not weak. And finally, it should be exogenous so that it can be excluded from the regressions of the outcome variables (i.e., the environmental practice variables). We ran first stage regressions to check if the instrument explains variations in the membership variable. We carried out the Stock and Yogo (2005) test of weak instruments. And, to check if the instrumental variable can be 'excluded', for each environmental variable we ran a regression with the instrument, the membership variable, and the rest of the independent variables on the right-hand-side. Our instruments satisfied all these diagnostics.

IV.2. Ordered Probit

To facilitate the interpretation of the parameter estimates in the Ordered Probit regressions we briefly describe below the Ordered Probit Model. Let y be an ordered response taking on the values $\{0,1,..,J\}$ for some known integer J. Assume that a latent variable y^* is determined by $y^* = \mathbf{x}\beta + \varepsilon$

where $\mathbf{x}$ is the vector of explanatory variables, β is $K \times 1$, and $\varepsilon | \mathbf{x} \sim \text{Normal}(0,1)$. Let $\alpha_1 < \alpha_2 < \ldots < \alpha_J$ be unknown cut points. Define, $y = 0$ if $y^* \leq \alpha_1$, $y = 1$ if $\alpha_1 < y^* \leq \alpha_2$, . . . , $y = J - 1$ if $\alpha_{J-1} < y^* \leq \alpha_J$, and $y = J$ if $y^* > \alpha_J$. Given the standard normal assumption about ε, probabilities of the responses, $P(y = 0 | \mathbf{x})$, $P(y = 1 | \mathbf{x})$, ... , $P(y = J - 1 | \mathbf{x})$, and $P(y = J | \mathbf{x})$, sum to unity. When $J = 1$, we have the binary probit model where $-\alpha_1$ is the intercept inside Φ. In this formulation of ordered probit model, x does not contain an intercept. When there are only two outcomes $\{0,1\}$, the single cut point is set to zero and the intercept is estimated, producing the standard probit model.

The sign on β_k unambiguously determine the direction of the effect of x_k on the probabilities $P(y = 0 | \mathbf{x})$ and $P(y = J | \mathbf{x})$, but not the probabilities of the intermediate outcomes $1, 2, \cdots, J - 1$. If $\beta_k > 0$, then $\partial P(y = 0 | \mathbf{x}) / \partial x_k < 0$, $\partial P(y = J | \mathbf{x}) / \partial x_k > 0$, but $\partial P(y = j | x) / \partial x_k$ for $j \in [1, J - 1]$ can have either sign. Therefore, to analyze the effect of a regressor in a meaningful way we have to look at the marginal effects on each ordered response. We report the detailed marginal effects for each response for the social membership variable.

V. Results and Discussion

From the DWH tests we conclude that the membership variable may be endogenous in the SOILDUM regression but exogenous in the other six regressions. As a result, we can continue with the following regressions to estimate the causal effects of the membership variable on adoption (and the extent) of environmental agricultural practices: Probit for PESTDUM and GRAZDUM, OLS for ENVPRAC, and Ordered Probit for PEST, GRAZING, and SOIL. For SOILDUM we used Instrumental Variable Probit regression with the same valid instrument that we used for the DWH test.

Table 6 presents the probit estimates of the adoption indicators. We find that associational memberships matter in adoption of environmental pest control and grazing practices. One unit increase in membership (i.e., one more associational involvement) from its mean level raises the probability of adoption of pest control measures by 2.6 percent and grazing practices by 1.9 percent. These are economically significant quantities because, for instance, if memberships increase by a unit for every farmer in the state of Georgia, we would see roughly 1,300 more farmers adopting environmental pest control practices. Adoption of environmental soil management practices, however, does not seem to be influenced by community involvement.

Among other variables that matter, most important are education of the farmer and the farm types. Farmers with college or post-graduate education are more likely to adopt environmental practices ('high school dropout' is the omitted category). The effects of farm types on adoption of environmental practices are very much in line with the type of farm operation ('livestock and poulty' is the omitted category). One curious finding is that compared to livestock and poultry farmers, tree farmers are less likely to adopt environmental soil management practices. In some of the regressions family size, acres cultivated, and the county level variables – per capital income, unemployment rates, and percent black – also mattered.

In table 7, in all four regressions, we find that associational memberships matter when we consider the extent of environmental agricultural practices. In the regression of the summary measure of the extent of environmental practices, ENVPRAC, an increase in membership leads to an increase in the number of environmental practices that farmers adopt: with every three unit increase in memberships, we expect to see the farmer engaging in an additional environmental agricultural practice. The ordered probit regressions show similar results; an increase in associational memberships lead to incremental increase in adoption of all three types of environmental practices.

The marginal effects are reported in table 7. They are evaluated at the mean values of the explanatory variables. In the cell associated with PEST and $i = 2$, for example, the value 0.01 indicates that there will be a 1 percent increase in the probability of the decision to adopt a second pest control measure if associational memberships of the farmer increase by one more unit from its mean of 3.7. As Table 7 shows, for PEST, GRAZING and SOIL, associational memberships positively affect the probability of adoption of each incremental environmental practice. Although membership does not affect the decision to adopt environmental soil practices, the extent of soil practice seems to be strongly influenced by the membership variable. This could be because practices like the use of cover crops are been used by conventional farmers for many years prior to the introduction of most environmental agricultural techniques (54 percent of the sample practices cover crops). They are less an environmental practice than just sound farming. The results of the ordered probit regression, however, does indicate that the community involvement encourage the farmer to adopt additional environmental soil management practices over and above the practices already adopted. For the rest of the explanatory variables, the results are similar to the adoption regression results. Among the other variables education and farm type matter the most. Family size and the county level variables also matter in some cases.

VI. Conclusion

Associational membership is a standard measure of social capital of the individual in the social capital literature. It is certainly not the most comprehensive measure since it does not capture a number of important aspects of the social connectedness of the individual (e.g., existence and intensity of network links of the individual with her friends, relatives, neighbors, etc.). Additionally, notions of trust and reciprocity (often associated with group level social capital) are also not directly enumerated in the membership measure. However, as a measure of community involvement embodying social responsibility and information dissemination due to community participations, it is certainly a relevant indicator.

Community involvement has been traditionally associated with positive outcomes of citizenship and promotion of the civic society. We found yet another civic matter – namely, environmental consciousness – where community involvement plays a positive role. We studied agricultural practices of Georgia farmers and their associational memberships. Using micro-data our findings showed that associational memberships have a positive effect not only on the decision to adopt environmentally friendly agricultural practices but also on the extent to which farmers adopted these practices.

We addressed an important econometric issue in our estimation: we tested for endogeneity and found that the membership variable was not endogenous in all but one of these regressions (the one case where possibility of endogeneity could not be eliminated, we used instrumental variable estimation). Our objective was to find whether associational involvement of the individual farmer has an independent effect on her practice of environmental agricultural practices. We tested two hypotheses. First, associational memberships mattered for adoption of environmental agricultural practices. Secondly, associational memberships positively affected the extent to which the farmers were engaged in environmental practices. The effects of associational memberships that we calculated were strong and economically significant: with every three unit increase in associational memberships, we expect to see the farmer engaging in an additional environmental agricultural practice. Further, an increase in associational memberships lead to incremental increase in adoption of all types of environmental practices studied.

This establishes an additional dimension to the benefits that would accrue to policies that promote community involvement and civic engagement in rural areas associated with farming. Those devising rural development strategies and policies may want to consider the role that community involvement plays not only in community health but also on the health of the environment.

Although we emphasized that there might be multiple channels – social responsibility and information channels – through which associational memberships affect environmentally friendly agricultural practices, due to data limitations we estimate the total effect and do not attempt to decompose. We, however, recognize that decomposing these effects and estimating their relative importance bear the potential for excellent future research.

References

Anderson, C. Leigh, Laura Locker, and Rachel Nugent. 2002. "Microcredit, Social Capital and Common Pool Resources," *World Development*, Vol 30(1), 2002: 95-105.

Andreoni, James. 1989. ''Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence.'' *Journal of Political Economy* 97(6):1447–58.

Artikov, Ikrom, Stacey J Hoffman, Gary D Lynne, Lisa M Pytlik Zillig, et al. 2006. "Understanding the Influence of Climate Forecasts on Farmer Decisions as Planned Behavior," *Journal of Applied Meteorology and Climatology*. Sep 2006. Vol. 45, Iss. 9; pg. 1202, 13 pgs.

Asheim, Geir B. 1991. ''Unjust Intergenerational Allocations.'' *Journal of Economic Theory* 54:350–71.

Barr, A. 2000. "Social Capital and Technical Information Flows in the Ghanaian Manufacturing Sector," Oxford Economic Papers, 52 (3), 539-59.

Barro, Robert J. 1974. ''Are Government Bonds Net Wealth?'' *Journal of Political Economy* 82(6):1095–1117.

Brooks, Arthur C. 2005. "Does Social Capital Make You Generous?" *Social Science Quarterly*, Volume 86, Number 1, March 2005.

Brown, Eleanor. 2004. Gifts of Money in America's Communities: College, Social Capital and Charitable Giving. NY: Campbell Public Affairs Institute.

Calvó-Armengol, A., Patacchini, E. and Y. Zenou (2009), Peer effects and social networks in education, *Review of Economic Studies* (forthcoming).

Carter, Michael and John Maluccio. 2003. "Social Capital and Coping with Economic Shock: An Analysis of Stunting of South African Children." *World Development*, 31, 7 (2003): 1147-1163.

Costa, Dora and Matthew Kahn. 2003. "Understanding the Decline in American Social Capital, 1953-1998," *Kyklos*, 56, 1, 17-46.

Coyle, Kevin. 2005. "What Ten Years of NEETF/Roper Research and Related Studies Say About Environmental Literacy in the U.S.," The National Environmental Education & Training Foundation (NEETF) Report, September 2005. Available at http://www.neetf.org/pubs/ELR2005.pdf.

Dasgupta, Partha. 2002. "Social Capital and Economic Performance: Analytics." mimeo, Faculty of Economics, University of Cambridge (2002).

Davidson Russell, and James G. MacKinnon. 2004. *Econometric Theory and Methods*, New York: Oxford University Press.

DeTray, Stephen. 1995. "Top-Down Versus Bottom-Up Organizations: An Analysis of Institutional Obstacles to Development in Rural Tanzania." Doctoral Dissertation. Department of Political Science: University of Washington.

DiPasquale, Denice. and Edward Glaeser. 1999. "Incentives and Social Capital: Are Homeowners better Citizens?" *Journal of Urban Economics*, Vol. 45, no. 2 (1999): 354-384.

Durlauf, Steven N. and Marcel Fafchamps. 2005. "Social Capital" in *Handbook of Economic Growth*, P. Aghion and S. Durlauf (eds.) (Amsterdam:Elsevier) p: 1639-1699.

Duroy, Quentin M. 2005. "The Determinants of Environmental Awareness and Behavior," Rensselaer Working Papers in Economics.

Fafchamps, Marcel and B. Minten. 1999. "Relationships and Traders in Madagascar," *Journal of Development Studies* 35 (6), 1-35.

Ferrer-i-Carbonell, Ada, and John M. Gowdy. 2005. "Environmental Awareness and Happiness," Rensselaer Working Papers in Economics, Number 0503, April 2005. Available at http://www.economics.rpi.edu/workingpapers/rpi0503.pdf.

Flora, C. B. 1995. Social Capital and Sustainability: Agriculture and Communities in the Great Plains and Corn Belt. *Iowa Experiment Station Journal Paper No. J-16309*.

Glaeser, Edward L., David Laibson, and Bruce Sacerdote. 2002. "The Economic Approach to Social Capital," *The Economic Journal* 112 (483), F437–F458.

Goss, Kristin A. 1999. ''Volunteering and the Long Civic Generation.'' *Nonprofit and Voluntary Sector Quarterly* 28(4):378–415.

Grafton, R. Quentin and Stephen Knowles. 2004. "Social Capital and National Environmental Performance: A Cross-Secitonal Analysis," *Journal of Environment and Development* 13: 336-370.

Granovetter, Mark. 1995. *Getting a Job: A Study of Contacts and Careers (2nd Edition)*. University of Chicago Press.

Grootaert, C. 2000. "Social Capital, Household Welfare, and Poverty in Indonesia." mimeo, World Bank (2000).

Hayley H. Chouinard, Tobias Paterson, Philip R. Wandschneider, and Adriennne M Ohler. 2008. "Will

Farmers Trade Profits for Stewardship? Heterogeneous Motivations for Farm Practice Selection," *Land Economics* 2008 84(1): 66-82.

Helliwell, J. 1996. "Economic Growth and Social Capital in Asia," in The Asia Pacific Region in the Global Economy: A Canadian Perspective, R. Harris, Richard, ed., Calgary: University of Calgary Press, 1996.

Isham, Jonathan. 2002. "The Effect of Social Capital on Technology Adoption: Evidence from Rural Tanzania," Journal of African Economies 11(1): 39-60.

Jacobs, Jamie Elizabeth. 2002. "Community Participation, the Environment, and Democracy: Brazil in Comparative Perspective," *Latin American Politics and Society*, Winter 2002, v. 44, issue. 4, pp. 59-88.

Jacobs, Jane. 1969. "Strategies for Helping Cities," *American Economic Review*, Part I, 59 (4) (1969), 652-56.

Jordan, Jeffrey L. 2004a. "Social Capital and Agricultural Sustainability," University of Georgia, Department of Agricultural and Applied Economics, *Faculty Series FS-04-04*.

Jordan, Jeffrey L. 2004b. "Levels of Social Capital in Georgia: Associational Activity in Georgia's Communities." University of Georgia, Department of Agricultural and Applied Economics, *Faculty Series FS-04-06*.

Jordan, Jeffrey L. 2004c. "Constructing a Human Development Index for Georgia's Counties." University of Georgia, Department of Agricultural and Applied Economics, *Faculty Series FS-04-08*.

Jordan, Jeffrey L. and Abdul Munasib. 2006. "Motives and Social Capital Consequence," *Journal of Economic Issues*, December.

Krishna, Anirudh and Norman Uphoff. 1999. "Mapping and Measuring Social Capital: A Conceptual and Empirical Study of Collective Action for Conserving and Developing Watersheds in Rajasthan, India." *World Bank Social Capital Initiative Working Paper no. 13*.

Krugman, Paul R., 1991. *Geography and Trade*. Cambridge, MA: The MIT Press.

LaPorta, R., F. Lopez-de-Silanes, A. Shleifer, and R. Vishny. 1997. "Trust in Large Organizations," *American Economic Review*, 87, 333-338.

Lewbel, A. 1997. "Constructing Instruments for Regressions with Measurement Error when no Additional Data are Available, with an Application to Patents and R&D," *Econometrica*, 65(5), 1201-1213.

Lynne, Gary D. et al. 1995. "Conservation Technology Adoption Decisions and the Theory of Planned Behavior," *Journal of Economic Psychology*, December 1995, v. 16, iss. 4, pp. 581-98.

Lynne, Gary D.; Casey, C. Franklin. 1998. “Regulation of Technology Adoption When Individuals Pursue Multiple Utility,” *Journal of Socio-Economics*, 1998, v. 27, iss. 6, pp. 701-19.

Maluccio, J., L. Haddad, and J. May. 2001. “Social Capital and Household Welfare in South Africa,” *Journal of Development Studies*, 36, 6, 54-81.

Manski, C. F. 2000. Economic Analysis of Social Interactions. *Journal of Economic Perspectives* 14(3), 115–136.

Millimet, D. and Thomas Osang. 2007. “Do State Borders Matter for U.S. International Trade? The Role of History and Internal Migration,” *Canadian Journal of Economics*, 40(1), 93-126.

Montgomery, J. 1991. “Social Networks and Labor-Market Outcomes: Toward an Economic Analysis,” *American Economic Review* 81 (5), 1408-1418.

Munasib, Abdul. 2005. “Lifecycle of Social Networks: A Dynamic Analysis of Social Capital Formation, the Relationship between Human Capital and Social Capital, and the Importance of City Size.” Ohio State University Dissertation Series, OhioLINK Electronic Theses and Dissertation (August 2005). http://www.ohiolink.edu/etd/view.cgi?osu1121441394.

Munshi, K. and J. Myaux. 2002. “Social Effects in the Demographic Transition: Evidence from Matlab, Bangladesh,” Working Paper, University of Pennsylvania.

Narayan, D. and L. Pritchett. 1999. “Cents and Sociability: Household Income and Social Capital in Rural Tanzania,” *Economic Development and Cultural Change*, 47, 4, 871-897.

Paldam, M. and G. Svendsen. 2000. “An Essay on Social Capital: Looking for Smoke Behind the Fire,” *European Journal of Political Economy*, 16, 339-366.

Pargal, S., M. Huq and D. Gilligan. 1999. “Social capital in solid waste management: evidence from Dhaka, Bangaldesh”, Social capital initiative working paper 16, World Bank.

Pretty, J. and H. Ward. 2001. "Social Capital and the Environment," *World Development* Vol. 29, No. 2, pp. 209-227, 2001

Putnam, Robert D. 1995. “Tuning In, Tuning Out: The Strange Disappearance of Social Capital in America.” *PS: Political Science & Politics* (December 1995): 664-683.

Putnam, Robert D. 2000. *Bowling alone: The collapse and Revival of American Community*. Simon and Schuster, 2000.

Rauch, J. and A. Casella. 2001. "Overcoming Informational Barriers to International Resource Allocation: Prices and Group Ties," *Economic Journal* 113(484) , 21-42.

Saxton, Gregory D. and Michelle A. Benson. 2005. "Social Capital and the Growth of the Nonprofit Sectorn," *Social Science Quarterly*, Volume 86, Number 1, March 2005: 16:35.

Varughese, G. and E. Ostrom. 2001. "The contested role of heterogeneity in collective action: some evidence from community forestry in Nepal", *World Development* 29, pp747-765.

Wandel, J. and J. Smithers, 2000. "Factors Affecting the Adoption of Conservation Tillage on Clay soils in Southwestern Ontario, Canada," *American Journal of Alternative Agriculture*, 15(4): 181-188.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*, Cambridge, MA: MIT Press, January 2002.

Tables

Table 1. Comparison of Demographic Characteristics of the Sample and the Population

Category	Subcategory	Sample respondents	Georgia Farmers*	All Georgia**
Male (percent of sample)		89.54	87.00	49.20
Female (percent of sample)		10.46	13.00	51.80
Age (years)		59.30	56.50	34.46
Race (percent of sample)	White	95.00	96.00	65.10
	African-American	4.58	4.00	28.70

* 2002 US Census of Agriculture.
** Statewide data from 2000 US Census (available at http://www.epodunk.com and http://fisher.lib.virginia.edu/collections/stats/ccdb).

Table 2: Association Memberships and Environmental Agricultural Practices

	Less than average membership	More than average membership
Number of observations	172.0	149.0
Mean of total number of environmental agricultural practices	3.9	5.5
Percent of the sample adopting at least 1 environmental pest management practice	33.7	51.0
Percent of the sample adopting at least 1 environmental grazing practice	68.0	70.5
Percent of the sample adopting at least 1 environmental soil management practice	70.3	84.6
Percent of the sample adopting at least 1 organic practice	1.2	11.4

Table 3. Environmental Agricultural Practices

Practice	Percent using	Practice	Percent using
Pest management*	42	Soil/nutrient management	77
Biological, cultural, physical pest management tools	26	Strip cropping, reduced or no-tillage	36
Habitat for beneficial insects or trap crops	12	Cover crops	54
On-farm biological cycle	17	Soil organic matter	33
Grazing	69	Maintain micro-organisms in soil	34
Management-intensive grazing system	53	Mulches/manures	52
Mixes of pasture forage in single field	52	Organic	6
Animal management system with two or more species	27	Certified organic	2
		Process or value-added organic	6

* These all relate to using insects, bacteria, fungi, and mulch that are already in the soil to improve soil fertility, and combat weed and insect pests.

Table 4. Description of the Sample

Category	Subcategory	Georgia Farm Social Capital Survey
Marital Status (percent of sample)	Married	86.72
	Divorced	6.64
	Widowed	4.15
	Never married / Single	2.49
Own home (percent of sample)		98.32
Registered to Vote (percent of sample)		95.00

Table 5. Descriptive Statistics: Explanatory Variables (N=317)

Variable	Mean	Std	Min	Max
Number of memberships	3.70	2.76	0.00	16.00
Any pest control practice (PESTDUM)	0.42	0.49	0.00	1.00
Any grazing practice (GRAZDUM)	0.69	0.46	0.00	1.00
Any soil management practice (SOILDUM)	0.77	0.42	0.00	1.00
Total Number of environmental practices (ENVPRAC)	4.60	3.00	0.00	13.00
Number of practices in pest control (PEST)	0.53	0.71	0.00	3.00
Number of practices in grazing (GRAZING)	1.30	1.07	0.00	3.00
Number of practices in soil (SOIL)	2.03	1.61	0.00	5.00
High school dropout	0.11	0.31	0.00	1.00
High school graduate and some college	0.57	0.50	0.00	1.00
College graduate and post graduate	0.31	0.46	0.00	1.00
Family size	2.45	1.07	1.00	7.00
Number of children	2.36	1.42	0.00	9.00
Years farming	33.00	17.05	2.00	86.00
Acres cultivated (100 acres)	1.62	3.48	0.00	39.00
Farm type: poultry	0.71	0.45	0.00	1.00
Farm type: fruits and vegetables	0.04	0.20	0.00	1.00
Farm type: crops	0.10	0.30	0.00	1.00
Farm type: trees	0.12	0.33	0.00	1.00
Farm type: other	0.03	0.16	0.00	1.00
County per capita income ($10,000)	2.13	0.42	1.48	4.48
County unemployment rate	4.85	1.11	2.60	10.10
County population (100,000)	0.50	1.08	0.02	8.18
Percentage black population in county	23.47	16.13	0.11	78.53

Table 6. Estimated Marginal Effects $(\partial p_1 / \partial x)$: Adoption of Environmental Agricultural Practices

	PESTDUM	GRAZDUM	SOILDUM
	Probit	Probit	IV-Probit
Number of memberships	0.0259 (0.0114)**	0.0186 (0.0118)*	0.0155 (0.0609)
High school and some college	0.1666 (0.0960)*	0.0556 (0.0889)	0.2179 (0.2658)
College grad and post graduate	0.2221 (0.1109)**	0.1454 (0.0907)	0.316 (0.3192)
Family size	-0.0549 (0.0292)*	0.0079 (0.028)	-0.0207 (0.082)
Number of children	0.0137 (0.0214)	-0.0214 (0.0214)	-0.0248 (0.0618)
Years farming	0.0017 (0.0018)	0.0008 (0.0018)	0.0045 (0.0052)
Acres cultivated	0.0108 (0.0102)	-0.0038 (0.0100)	0.0711 (0.0354)**
Farm type: fruits and vegetables	0.4404 (0.1201)***	-0.7195 (0.0526)***	0.4868 (0.5490)
Farm type: crops	0.1384 (0.1044)	-0.3367 (0.1044)***	-0.2171 (0.2988)
Farm type: trees	-0.1324 (0.0872)	-0.5984 (0.0741)***	-1.3125 (0.2641)***
Farm type: other	-0.2131 (0.1464)	-0.6075 (0.1099)***	-0.7674 (0.4537)*
County per capital income	0.0954 (0.1310)	0.2746 (0.1400)**	0.8511 (0.4113)**
County unemployment rate	-0.0889 (0.0372)**	0.0206 (0.0358)	0.1262 (0.1094)
County population	-0.0253 (0.0493)	-0.0339 (0.0564)	-0.212 (0.1491)
Percent black in county	0.0057 (0.0026)**	-0.0019 (0.0025)	0.0039 (0.0075)
Observations	317	317	317
Pseudo R^2	0.1	0.26	
Wald $\chi^2(14)$, (Prob > χ^2)			37.26, (0.0012)

Notes: (a) Robust standard errors in parentheses. (b) * significant at 10%; ** significant at 5%; *** significant at 1%. In case of GRAZDUM, the coefficient of the membership variable has a *t*-statistic of 1.6. So, we have marked it with * as well. (c) In case of SOILDUM, since the DWH test shows that *number of membership* may be endogenous, we used IV-Probit (Section IV has a detailed explanation of the DWH tests and the instrument). (d) Each regression has a constant that has not been reported.

Table 7. Regression Coefficients: Extent of Environmental Practices

	ENVPRAC	PEST	GRAZING	SOIL
	OLS	Ordered Probit	Ordered Probit	Ordered Probit
Number of memberships	0.3171 (0.0596)***	0.0724 (0.0260)***	0.0573 (0.0250)**	0.1009 (0.0241)***
High school and some college	1.1443 (0.5040)**	0.5366 (0.2465)**	0.144 (0.2107)	0.3444 (0.2011)*
College grad and post graduate	1.6145 (0.5713)***	0.6086 (0.2725)**	0.3006 (0.2389)	0.4834 (0.2277)**
Family size	0.046 (0.150)	-0.1572 (0.0692)**	0.0036 (0.062)	0.073 (0.059)
Number of children	-0.0568 (0.1127)	0.028 (0.0502)	-0.0152 (0.0470)	-0.011 (0.0448)
Years farming	0.0168 (0.0096)*	0.0027 (0.0044)	0.0023 (0.0040)	0.005 (0.0038)
Acres cultivated	0.0833 (0.0464)*	0.025 (0.0192)	0.00003 (0.0240)	0.0484 (0.0183)***
Farm type: fruits and vegetables	-1.0227 (0.7915)	0.7857 (0.3228)**	-2.4974 (0.5360)***	-0.3068 (0.3051)
Farm type: crops	0.4373 (0.5415)	0.3192 (0.2371)	-0.983 (0.2329)***	0.2853 (0.2153)
Farm type: trees	-3.0349 (0.4993)***	-0.3479 (0.2301)	-1.5239 (0.2316)***	-1.1452 (0.2124)***
Farm type: other	-2.608 (0.9792)***	-0.4057 (0.4751)	-1.4015 (0.4586)***	-0.7009 (0.3880)*
County per capital income	0.9597 (0.6980)	0.2982 (0.3075)	0.3467 (0.2857)	0.5461 (0.2757)**
County unemployment rate	-0.1011 (0.1922)	-0.161 (0.0864)*	0.1139 (0.0811)	-0.012 (0.0755)
County population	-0.1474 (0.2642)	-0.0267 (0.1150)	-0.0108 (0.1076)	-0.1477 (0.1038)
Percent black in county	-0.0006 (0.0133)	0.0081 (0.0059)	-0.0099 (0.0056)*	0.0012 (0.0052)
Observations	317	317	317	317
R^2 / Pseudo R^2	0.24	0.07	0.13	0.07

Notes: (a) Estimates of the cut points of the ordered probit regressions have not been reported. (b) Robust standard errors in parentheses. (c) * significant at 10%; ** significant at 5%; *** significant at 1%. (d) The ENVPRAC regression has a constant that has not been reported.

Table 8. Estimated Marginal Effects $\left(\partial p_i / \partial x\right)$ and Standard Errors of Number of Membership in the Ordered Probit Regressions of Table 8

	Number of environmental practices (i)					
	$i = 0$	$i = 1$	$i = 2$	$i = 3$	$i = 4$	$i = 5$
PEST	-0.028 (0.010)***	0.017 (0.006)***	0.010 (0.004)***	0.001 (0.001)*		
GRAZING	-0.019 (0.009)***	-0.003 (0.002)**	0.012 (0.005)***	0.011 (0.005)***		
SOIL	-0.028 (0.007)***	-0.011 (0.003)***	0.001 (0.001)	0.012 (0.003)***	0.016 (0.004)***	0.011 (0.003)***

Notes: (a) Estimates of the cut-offs have not been reported but are available on request. (b) Robust standard errors in parentheses. (c) * significant at 10%; ** significant at 5%; *** significant at 1%.

REVIEWER'S APPENDIX

In this Appendix we present the details of the Durbin-Wu-Hausman (DWH) tests and the tests for validity of the instruments. For the DWH tests, first we calculate the residual of a first stage regression of the membership variable which includes the instrument and all the independent variables on the right-hand-side. Then, for each of the environmental practice variables, we run a regression where the right-hand-side includes all the independent variables and the residual from the first stage. The DWH test is the test of significance of the coefficient of the residual. If it does not come out to be significant then *number of memberships* is not endogenous in the regression of that environmental variable.

Since the validity of the instrument is crucial for the DWH tests, before reporting the DWH test results we shall discuss the tests regarding the instruments. As explained in Section III, we are using higher order moments of the membership variable as instruments (Lewbel 1997). We carry out extensive tests for these instruments to verify that they are indeed valid instruments. Our experiments show that the forth centered moment (or CM4 for short) serves as a valid instrument for the membership variable when the dependent variable is SOILDUM and the third centered moment (or CM3 for short) serves as a valid instrument for the membership variable in case of all the other environmental variables. First, the instrument has to be 'relevant' in the sense that it should be able to explain variations in *number of memberships*. Secondly, it should not be a 'weak instrument' so that identification is not weak. And finally, it should be exogenous so that it can be excluded from the regressions of the outcome variables (i.e., the environmental practice variables). As Table A1 shows, both CM3 and CM4 explain variations in the membership variable and that identifications are not weak in either case (Stock and Yogo, 2005). To check if the instrumental variables can be 'excluded', for each environmental variable we have run a regression (OLS, Probit, or Ordered Probit, whichever is appropriate for the given environmental variable) with the following right-hand-side: CM3 (or CM4 for SOILDUM), the membership variable, and the rest of the independent variables. Table A2 shows these results and we see that CM3 and CM4 do not come out significant in any of these regressions indicating that they can be excluded in the regressions presented in Tables 6 and 7.

Finally, Table A3 shows the augmented regressions of the DWH tests. Here, the residual from the first stage (Regression [2] in case of SOILDUM and Regression [1] for the rest of the variables) is included on the right-hand-side. The residual shows up with an insignificant coefficient in all but one case, SOILDUM. Therefore, we conclude that it may be endogenous in the SOILDUM regression but exogenous in the other six regressions.

Table A1: First Stage Regression Estimates (Dependent Variable: *Number of Memberships*)

		Regression [1]	Regression [2]
3rd centered moment of membership		0.0108 (0.0007)***	
4th centered moment of membership			0.0008 (0.0001)***
High school & some college		0.8845 (0.3506)**	1.0138 (0.4011)**
College grad & post graduate		1.5907 (0.3912)***	1.9034 (0.4464)***
Family size		0.0223 (0.1055)	0.0576 (0.1208)
Number of children		0.143 (0.0786)*	0.1727 (0.0900)*
Years farming		-0.0036 (0.0068)	-0.0045 (0.0077)
Acres cultivated		0.0543 (0.0324)*	0.0729 (0.0370)**
Farm type: fruits and vegetables		0.4823 (0.5546)	0.5089 (0.6349)
Farm type: corps		-0.4291 (0.3795)	-0.4381 (0.4344)
Farm type: trees		0.6304 (0.3486)*	0.7405 (0.3989)*
Farm type: other		0.041 (0.6864)	-0.0422 (0.7856)
County per capital income		0.6301 (0.4879)	0.7645 (0.5585)
County unemployment rate		0.0379 (0.1348)	0.0165 (0.1543)
County population		-0.135 (0.1851)	-0.1762 (0.2118)
Percent black in county		0.0024 (0.0093)	0.0036 (0.0107)
Constant		0.4439 (1.3052)	-0.0217 (1.4929)
Observations		317	317
R-squared / Pseudo R-squared		0.56	0.42
Weak identification test (Kleibergen-Paap *rk* Wald *F*)		29.21	16.57
Stock-Yogo weak ID test critical values	10% maximal IV size	16.38	16.38
	15% maximal IV size	8.96	8.96
	20% maximal IV size	6.66	6.66
	25% maximal IV size	5.53	5.53

Table A2: Checking if the Instruments Can be Excluded from the Regressions of the Environmental Variables

	PESTDUM	GRAZDUM	SOILDUM	ENVPRAC	PEST	GRAZING	SOIL
	Probit	*Probit*	*Probit*	*OLS*	*Ordered Probit*	*Ordered Probit*	*Ordered Probit*
3rd centered moment of membership	-0.0008 (0.0007)	0.0006 (0.0011)		-0.0011 (0.0013)	-0.0007 (0.0006)	-0.0002 (0.0005)	-0.0004 (0.0005)
4th centered moment of membership			-0.0001 (0.0001)				
The membership variable and all other independent variables	yes	yes	yes	yes	yes	yes	yes
Observations	317	317	317	317	317	317	317
R-squared / Pseudo R-squared	0.1	0.26	0.14	0.24	0.07	0.13	0.07

Note: Significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3: Augmented Regressions of Durbin-Wu-Hausman (DWH) Tests of Endogenous Regressor

	PESTDUM	GRAZDUM	SOILDUM	ENVPRAC	PEST	GRAZING	SOIL
	Probit	*Probit*	*Probit*	*OLS*	*Ordered Probit*	*Ordered Probit*	*Ordered Probit*
Residual of regression [1]	0.0708 (0.0540)	-0.0556 (0.0873)		0.1006 (0.1314)	0.0665 (0.0516)	0.0153 (0.0367)	0.0342 (0.0388)
Residual of regression [2]			0.1052 (0.0559)*				
The membership variable and all other independent variables	yes	yes	yes	yes	yes	yes	yes
Observations	317	317	317	317	317	317	317
R-squared / Pseudo R-squared	0.1	0.26	0.14	0.24	0.07	0.13	0.07

Note: Significant at 10%; ** significant at 5%; *** significant at 1%.

Notes

[1] This survey was conducted by the Georgia Agricultural Statistics Service (NASS-USDA) on the farmers in the state of Georgia, the ninth most populous state of the United States (U.S. Census Bureau 2006). The data section (section 2) explains the survey in detail.

[2] Carter and Maluccio (2003), Grootaert (2000), Narayan and Pritchett (1999), Costa and Kahn (2003), Malucccio, Haddad and May (2001), and Helliwell (1996), are some of the frequently cited studies that used this measure. See Durlauf and Fafchamps (2004) for a detailed survey of studies that used this proxy.

[3] In addition to a detailed discussion of the 'membership' measure and its various criticisms, Munasib (2005) also discusses and makes use of an alternative approach. Also see Jordan and Munasib (2006) for a discussion of the determinants of associational activities.

[4] See Durlauf and Fafchamps (2004) for a detailed discussion.

[5] See the website of the U.S. Environmental Protection Agency (EPA) at http://www.epa.gov/owow/nps/facts/point1.htm.

[6] Note that Narayan and Pritchett (1999) do calculate individual level social capital and study its impact on household expenditures, but while explaining the probability of adopting improved agricultural practices they only include village level social capital in their regressions.

[7] This survey data along with the complete questionnaire is available at the Department of Agricultural and Applied Economics, College of Agricultural and Environmental Sciences, University of Georgia, Griffin Campus (http://www.griffin.uga.edu/grf/dept/agecon/soccap/). Please contact jjordan@griffin.uga.edu for any enquiry about the survey or the data. Also see Jordan (2004a, 2004b, 2004c) for more on this survey.

[8] Visit http://www.ropercenter.uconn.edu/research/datasets/social_capital.html for the details of Roper Center Surveys.

[9] See Jordan (2004b) for similar information about Georgia households.

[10] We have run separate regressions on a reduced sample with household income. The results do not significantly change. First, after including the proxies for income, income is no longer significant in all but one of the seven regressions. Secondly, inclusion of income, in this reduced sample, does not substantially change the effect of membership. Only is case of adoption of pest control, the effect of membership become statistically less significant.

[11] Social effects (or effects of group level variables) on the individual are notoriously difficult to measure, in large part due to identification problems described in Manski (2000). The "correlated effects," arises because decisions of individuals

within a group are similar due to shared (and possibly unobservable) characteristics. It becomes difficult to distinguish the so-called "endogenous interactions," in which individual decisions are influenced directly by the decisions of their peers, form the "correlated effects." A second difficulty arises when the observed choices are jointly endogenous: the choices of the group members cannot be regarded as exogenous influences since they are in turn influenced by the choice of the individual.

[12] USDA defines small farms as those with sales of less than $100,000.

[13] The maximum value of ENVRPAC is 13. To allow for the possibility that the variable is right censored, we have also run tobit regressions. Since the tobit regressions produced essentially the same results as the OLS regressions, we have reported only the OLS regressions.