Available online at www.sciencedirect.com

SCIENCE DIRECT®

Forest Policy and Economics 7 (2005) 757–770

Forest Policy and Economics

www.elsevier.com/locate/forpol

Measuring rural homeowners' willingness to pay for land conservation easements

Seong-Hoon Cho*, David H. Newman, J.M. Bowker

Department of Agricultural Economics, University of Tennessee, Knoxville, TN 37996-4518, United States

Abstract

Rapid growth of rural communities in the Blue Ridge Mountains of Macon County, North Carolina has been giving rise to concerns over declining environmental quality and increasing need for land-use policy. This paper examines willingness to pay (WTP) for hypothetical conservation easements as an alternative land-use policy for the county. Despite the fact that Macon County has struggled to adopt any land-use policy, the stated WTP for conservation easements of our study shows that homeowners potentially value the use of conservation easements. Estimated household's WTP to participate in an easement program ranges from $10.97 to $21.79 per year per household depending on modeling assumptions. Aggregate county WTP ranges from $360,772 to $109,825 depending on aggregation stance. This suggests a range of 53–175 acres entering the program per year, and a consequent decline in the rate of land conversion, compared to the 1987–1997 period, of 14–46%.

Keywords: WTP; Willingness to pay; Land conservation easements; Tobit; Heckit; CVM; Contingent valuation method

During the last two decades, there has been rapid growth in the Blue Ridge Mountains of North Carolina. Macon County, situated in the Blue Ridge Mountains, is an area specifically experiencing this rapid development. In the past decade, the county grew from 20,178 people to 29,811, an increase of nearly 48% and the number of housing units increased from 13,358 to 20,746, a gain of 55%. The higher increase of housing units relative to population growth reflects part-time residents and those who spend weekends in the mountains. For example, 45% of the new residences built in the county in 2002 were second homes. Some of the residents commute to jobs in the Atlanta area, 100 plus miles south of Macon County. An increasing number of rural homeowners, interfacing with neighboring urban communities, have expanded second home communities in the county at a rapid pace. The unprecedented growth of the metropolitan Atlanta area's northern suburbs like Cherokee County, Georgia (population of 51,748 in 1980 to 141,903 in 2000, a gain of 174%) parallels the rapid growth rate of Macon County.

This rapid growth of rural counties, interfacing with neighboring urban communities that are not direct urban-fringe communities, gives a new dimen-

* Corresponding author. Tel.: +1 865 974 7411; fax: +1 865 974 9492.

E-mail address: scho@mail.ag.utk.edu (S.-H. Cho).

1389-9341/$ - see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.forpol.2005.03.007

sion to the issues of the wildland–urban interface. The November 15, 2002 issue of the Asheville Citizen-Times quotes, "With four-lane access, it is not inconceivable that Macon will become part of the Atlanta metropolitan area in the foreseeable future." This rapid growth of Macon County has given rise to concerns over declining environmental quality and an increasing need for land-use policy. Scientific monitoring revealed that the water quality of certain streams of the county had declined significantly during the last two decades (N.C. Division of Water Quality, 2002). In addition, public services such as sewage treatment and water delivery have been severely strained.

Despite the common recognition of the consequences of such rapid growth, the perceptions about land-use policy among homeowners of the county are divided. Some oppose land-use policy because of concern over private property rights. Others support land-use policy with the hope for better managing development. Regardless of the divided perceptions, Macon County's Vision 2025 Committee unanimously approved its 72-page draft land-use plan on November 2001, the first of its kind in Western North Carolina. The draft of the land-use plan focuses on the regulation of highway corridors and high-impact uses such as polluting industries. The Macon County Board of Commissioners had also proposed a residential element in the regulation, but this was dropped after residents protested. According to a report by Asheville Citizen-Times, bumper stickers urging residents to "Protect Freedom/Stop Zoning" cropped up before a public meeting on the issue in 2002. The countywide land-use plan was shot down in 2002 after residents complained it had been drafted by the planning board without an adequate opportunity for the public to participate, contribute, or even understand the process. It was the third time in 10 years that attempts at land-use planning have been denied. After the controversial proposal for the countywide land-use plan, the Macon County Planning Board has just completed a series of 11 public input meetings on high-impact land-uses and will now consider new ordinances to propose to county commissioners.

Regardless of this recent turmoil and the challenges that the county has faced regarding a land-use plan, conservation easements have been relatively successful in the county in recent years as an alternative way of influencing sustainable development. Conservation easements are a legal agreement between a landowner and a land trust or government agency that permanently limits development of land. These easements are a less regulatory and more voluntary policy tool that are among the fastest growing methods of land preservation in the United States today. They can be defined to exclude certain activities on private land, such as commercial development or residential subdivisions. Funding for a conservation easement can be designed to come from a variety of sources, including local residents' donations and federal matching funds of those donations as accommodated under the Farmland Protection Program of the 1996 FAIR Act and the Farm Security Act of 2002.

The use of conservation easements was introduced in the county when The Land Trust for the Little Tennessee (LTLT) was incorporated as a non-profit entity in 1999. The LTLT made its first conservation purchase in November of 1999, with the aid of the NC Clean Water Fund and the Lyndhurst Foundation. The Trust purchased a 60-acre, 19th century plantation farmstead along the confluence of the Tessentee Creek and the Little Tennessee River. It was the first property along the 57 miles of free-flowing Little Tennessee River to be put into a land trust. Another 3.9 acres adjacent to the farm was added in 2000. Now, the LTLT and other individuals and organizations have protected about one-third of the river frontage along the Little Tennessee River.

Among the most well publicized conservation easements of the area is the "Needmore Tract preservation." The Needmore Tract is 4600 acres of land located in Western North Carolina; 1100 acres are in northern Macon County and 3500 acres are in southern Swain County. The tract of land was transferred from Nantahala Power and Light, a division of Duke Power, to Crescent Resources, the power company's development arm in January 2000. That transfer had many worried that the land, which contains farms, wilderness areas and some private homes, might be bought by a developer. The Needmore Tract was purchased by the NC Wildlife Resources Commission in January of 2004. Out of the $19 million purchase price, $2 million was raised by private contributions. The parcel is considered by many preservationists to be one of the most bio-

logically important pieces of land to be put in protected status in several years.

A 58-acre, outlying parcel of the Needmore Tract was purchased by the LTLT in 2002, with support from the Clean Water Management Trust Fund and private donations. This acquisition established the first of many conservation properties along the river corridor downstream of the town of Franklin. This 21-acre floodplain parcel was purchased by the LTLT in 2003 to protect a half mile of wetland and river frontage at the foot of Coweeta Creek, 3 miles downstream of the Coweeta Hydrologic Laboratory and a quarter mile downstream of the LTLT's Tessentee Farm Preserve.

The track record of the county indicates that conservation easements have been an easier tool to work with relative to regulations under the county land-use plan. Because conservation easements are designed to exclude certain activities on private land, private contributions are critical for the success of the program. Despite the important role of the private sector for the success of the program, there have been no systematic studies to clarify households' preferences about conservation easements. In particular, acceptance by local homeowners and a measure of their economic value or willingness to pay (WTP) for such programs is vital information for policymakers who would be charged with program implementation and allocation of resources for matching funds.

The existing literature has addressed people's perceptions regarding land-use policy (Dubbink, 1984; Healy and Short, 1979) and environmental amenities (Spain, 1993; Dubbink, 1984). Perceptions have been investigated with respect to resident's and homeowner's characteristics, including length of time of residence (Baldassare, 1986; Myers, 1989; Doherty, 1987), social class or income (Lovejoy et al., 1982; Salamon and Tornatore, 1994), and values and norms (Engel, 1984; Spain, 1993). However, these studies examine the impact of the respective characteristics on perceptions independently, even though all of these characteristics are found to have significant influences on perceptions about land-use policy. To our knowledge, there have been no previous studies which measure homeowner or aggregate WTP for conservation easements and estimated impacts on land conservation.

In this study, we assess local homeowners' acceptance of land value for conservation easements as an alternative land-use policy for the county. In doing so, we use the contingent valuation method (CVM) to estimate homeowner and county-wide WTP toward an easement program that would, at existing prices, slow residential land development to half its recent rate. In the process, we examine the efficacy of using CVM to obtain an economic value for this kind of service in a rapidly developing wildland–urban setting.

1. Data and survey Instrument

To assess WTP for conservation easements in Macon County, we designed a self-administered, mail-back questionnaire to characterize homeowners and their properties for the CVM analysis. The questionnaire was designed based on a 2002 assessment report by the N.C. Division of Water Quality and interviews with land planners, the director of the Little Tennessee River Watershed Association, and ecologists who are familiar with the area. Preceding the contingent valuation section, the questionnaire elicited information on household demographics, property characteristics, length of residency, opinions about public services, opinions about land-use policy, and knowledge of environmental issues.

Following convention (for a good example, see Reaves et al., 1999), the contingent valuation conservation easement scenario was structured to: (1) define the good or service being provided, i.e., the conservation easement program; (2) familiarize the respondent with the current land development status quo; (3) establish an expected outcome of how many acres per year at current prices could be expected to be entered into the program.

Defining a conservation easement was straight forward as most landowners in rural areas are familiar with easements. The conservation easement definition included the following:

> By establishing a fund that could be used to purchase conservation easements from willing landowners, Macon County plans to conserve lands. A conservation easement is a legal agreement between a landowner and a land trust or government agency that permanently limits development of land in order to protect it from development. Conservation

easements are flexible and designed to help landowners meet their goals. Farming and forestry can continue. With a conservation easement, you will continue to own and use your land and sell it (easement travels with deed) or pass it on to heirs. There may also be property tax incentives for using conservation easements. Consider a local fund has been proposed to support the conservation easement program. Current status of land-uses, use of funds and expected outcome of the project are described in the following.

The rate of land development used in the CVM description was based on county records data from 1987 to 1997. The description used to familiarize the respondent went as follows:

Between the years of 1987 and 1997, Macon County lost 2969 acres of agricultural land to development. The rate of loss, 12%, is much greater than the national rate of loss, which was 3% during the same period of time. The funds will be used for the purchase of conservation easements on agricultural and forestland to slow down the rate of loss and help maintain the rural landscape.

However, accurately portraying the expected outcome of one's payment and entrance into a Macon County conservation easement program was more problematic. Clearly, the amount of land entered into the program is a function of both land prices and the amount of money which people contribute. Hence, while we could not exactly predict an outcome, we informed respondents of the following potential outcome:

After establishment of the fund, the rate of loss on resource land is expected to slow down to half of the current rate because the county will be able to offer an incentive for voluntary conservation. If every household were to pay $20 annually into the fund, this would allow the purchase of approximately 300 acres of easements per year at current prices.

After being informed of the CVM scenario, respondents were asked, using a modified payment card format, the following:

Please indicate your willingness to pay into the fund by checking the appropriate box for the amount of property tax increase per year-or fill in another amount per year. $ 0, 1, 2, 3, 5, 8, 10, 20, 30, 40, 50, 100, or other _____.

Conceptually, using an indirect utility framework, the economic valuation construct can then be represented as:

$$V_0(Y_0, E_0, P_0) = V_0(Y_0 - WTP, E_1, P_0) \quad (1)$$

where, for a given individual, V_0 is a base level of utility, P_0 represents existing prices, Y_0 is current income, E_1 and E_0 represent the cases of having the easement program and not having the easement program, respectively. Annual household WTP is the amount of income a household would give up in order to gain the higher level of preserved land, E_1, while maintaining a constant level of utility.

Among CVM practitioners, there is no consensus on the optimal bid format. Some researchers prefer one of a number of dichotomous choice elicitation variants, which are thought to simplify the cognitive task faced by respondents while at the same time providing incentives for the truthful revelation of preferences (Bishop and Heberlein, 1979; Hanemann, 1984; Cameron and James, 1987). Others prefer open-ended formats as an increasing number of empirical studies have revealed that values obtained from dichotomous choice elicitation are significantly and substantially larger that those resulting from comparable open-ended questions (Desvousges et al., 1992; McFadden, 1994). In a recent comparison of question formats, Reaves et al. (1999) showed that the payment card format exhibited desirable properties pertaining to item non-response and protest bids relative to dichotomous choice and open-ended questions.

Following standard practice in CVM analyses, the respondents were asked to screen "protest zeros"; individuals giving a zero WTP were asked if this was because they did not value the proposed conservation's easements, or because they objected to the payment vehicle or some other aspect of the question (McFadden, 1994). The choices of answers include: (a) I can't afford to pay more taxes, (b) I don't think additional taxes are the best way to fund the conservation easement projects, (c) I don't believe conservation easements will lead to the outcomes as claimed, (d) It just isn't worth it to me to pay anything to change the current rate of land development, or (e) I would rather like to see more development. The households who

answered (a), (d), or (e) are classified as legitimate zero bidders who did not value the proposed conservation's easements. The households who answered (b) or (c) are classified as protest zero bidders who objected to the payments vehicle or some other aspect of the question.

The survey was mailed out to 1400 randomly chosen residents and homeowners in Macon County following Dillman's Total Design Method (Dillman, 2000). A total of 385 surveys were returned due to vacancies and/or wrong addresses. Three hundred forty-three out of the 1015 survey recipients responded to the survey with usable answers giving an overall response rate of 34%. This response rate is rather low relative to some previous studies that have estimated WTP for environmental goods. Using a very similar survey instrument and mailing approach, Bowker et al. (2003) obtained an 82% overall response rate. Johnston et al. (2003) measured rural amenity values using survey data with a 58% overall response rate. Breffle et al. (1998) measured neighborhood WTP to preserve undeveloped urban land using survey data with a 63% overall response rate. Choe et al. (1996) measured the benefit of surface water quality improvement using survey data with a 65% overall response rate.

Low response rates are not a problem if non-respondents are spread randomly among the population of interest. But low response rates may reflect bias, in that some subgroups could be less likely to respond than others. This can compromise survey results if respondents are not representative of the target population (Mitchell and Carson, 1989; Arrow et al., 1993; Desvousges et al., 1992). Exploring this issue further, Harrison and Lesley (1996) found that even very inexpensive convenience samples could serve as good proxies for expensive surveys with high response rates if explanatory variables in the estimated valuation functions were calibrated to the population of interest.

It should be noted that our response rate is at worst a lower bound for a couple of reasons. First, it is likely that given the large number of seasonal and second homes, people may not have received the survey in a timely manner and thus not responded. In addition, there has been a small but continuous flow of questionnaires returned long after the data entry process was concluded. Regardless, our relatively low response rate suggests our results should be interpreted with appropriate caution. We further address this issue in our summary and conclusions.

2. Results and analysis

Summary statistics for the CVM portion of the survey related to the conservation easements are reported in Table 1. Selected demographic and location characteristics of respondent households are reported in Table 2. The spatial location of the survey respondent households is shown in Fig. 1.

As evidenced in Table 1, a large percentage of households reported a WTP of zero. Regression analysis using ordinary least squares (OLS) for such data is known to lead to biased and inconsistent parameter estimates regression (Maddala, 1999; Greene, 2000; Ziemer and White, 1981). The zero-bid phenomenon is very common for CVM studies using either open-ended or payment card question formats (Bowker et al., 2003; Goodwin et al., 1993; Halstead et al., 1991; Norris and Batie, 1987). These studies have treated the WTP bids as if they were censored at zero, and estimated subsequent bid functions using Tobit estimators. However, Maddala (1999) and Sigelman and Zeng (1999) point out that if the zeroes in the data are the result of non-observability (strictly a nonnegative distribution) rather than true censoring at zero (some of the zeros representing negative values), then the mechanical application of the Tobit estimator is not fully appropriate.

Our data (Table 1) show that at least seven respondents bidding zero (3% of the entire sample and 6% of the zero bidders) actually favor more development. Under such conditions, it is conceivable that these respondents actually have a negative WTP for the easement program and that their true WTP is censored at zero. Under such conditions, the Tobit model would be appropriate. However, if one believes that households in the study are more likely to first consider the decision of whether to pay into the fund or not, and then if participating, how much to pay, the more general Heckit model wherein "pay or not" is estimated in the first stage and the positive WTP is estimated in the second stage would be preferred to the Tobit which imposes the presumption of censoring (Greene, 2000, p. 930; Sigelman and Zeng, 1999). We test both Tobit and Heckit models in our study because the nature of the decision problem for determining the WTP for conservation easements is unknown.

Table 1
Summary statistics of the survey answers regarding WTP for conservation easements

Questions	Frequency	Percent
How much you knew of the problems of fast development and rapid losing undeveloped lands of Macon County?		
None	67	20
Very little	78	23
Some	132	38
A lot	40	12
Detailed knowledge	9	3
No answers	17	4
Indicate your willingness to pay into the fund for conservation easement for the amount of property tax increase per year, or fill in another amount per year.		
$0	123	36
$1	9	3
$2	5	1
$3	2	1
$5	25	7
$8	0	0
$10	39	11
$20	54	16
$30	12	3
$40	9	3
$50	29	8
$100	10	3
No answers	26	8
If you answered zero to the proposed conservation easement project above, please indicate your reason(s).[a]		
I can't afford to pay more taxes.	79	34
I don't think additional taxes are the best way to fund the conservation easement projects.	75	32
I don't believe conservation easements will lead to the outcomes as claimed.	49	21
It just isn't worth it to me to pay anything to change the current rate of land development.	22	9
I would rather like to see more development.	7	3

[a] The multiple answers are the reason being over the number of observations of 343.

2.1. The Tobit model

The Tobit model identifies characteristics of homeowners that determine WTP for the conservation easements. Following Greene (2000), the Tobit model can be generally expressed:

$$WTP_i = \boldsymbol{X}_i\beta + u_i \qquad \boldsymbol{X}_i\beta + u_i > 0$$
$$WTP_i = 0 \qquad \boldsymbol{X}_i\beta + u_i \leq 0 \tag{2}$$

where for the ith household, $\boldsymbol{X}_i$ is a vector of explanatory variables, u_i is a random disturbance term, and $\boldsymbol{\beta}$ is a parameter vector common to all households. Assuming the random error is independent and normally distributed across respondents, the expected WTP for an observation drawn at random is:

$$E(WTP) = \Phi(\boldsymbol{X}\beta/\sigma)\boldsymbol{X}\beta + \sigma\phi(\boldsymbol{X}\beta/\sigma) \tag{3}$$

where Φ represents the normal distribution function, ϕ represents the normal density function, and σ represents the standard deviation. Furthermore, the expected value of WTP for observations above zero, here called E(WTP*), is simply $\boldsymbol{X\beta}$ plus the expected value of the truncated normal error terms (see, e.g., Amemiya, 1973). Then, the expected WTP can be expressed as:

$$E(WTP) = \Phi(\boldsymbol{X}\beta/\sigma)E\left(WTP^*\right) \tag{4}$$

It should be noted that unlike linear models, the marginal effect or partial derivative for a given explanatory variable is nonlinear and thus not equal to β_i. The decomposition of this marginal effect that is obtained by considering the effect of a change in the ith variable of $\boldsymbol{X}$ on WTP (McDonald and Moffitt, 1980):

$$\partial E(WTP)/\partial \boldsymbol{X}_i = \Phi(\boldsymbol{X}\beta/\sigma)\left(\partial E\left(WTP^*\right)/\partial \boldsymbol{X}_i\right) + E\left(WTP^*\right)\left(\partial\Phi(\boldsymbol{X}\beta/\sigma)/\partial \boldsymbol{X}_i\right) \tag{5}$$

Intuitively, the total change in WTP can be disaggregated into two parts: (1) the change in WTP of the above zero bids, weighted by the probability of being above the zero bid; and (2) the change in the probability of being above the zero bid, weighted by the expected value of WTP if above the zero bid. Eq. (4) can be evaluated at the mean of the $\boldsymbol{X}$s, $\bar{\boldsymbol{X}}$ with estimates of $\boldsymbol{\beta}$ and σ. The fraction of the total marginal effect due to the effect above the zero bid is

$$\partial E\left(WTP^*\right)/\partial \boldsymbol{X}_i = 1 - \boldsymbol{X}\beta\phi(\boldsymbol{X}\beta/\sigma)/\Phi(\boldsymbol{X}\beta/\sigma) - \phi(\boldsymbol{X}\beta/\sigma)^2/\Phi(\boldsymbol{X}\beta/\sigma)^2. \tag{6}$$

Table 2
Summary statistics of the variables

Variables	Mean	S.E.	Min	Max	Cases
Variables used in the final estimation					
WTP for conservation easements ($)	15.11	21.90	0	100	317
Duration of residency (year)	20.74	19.03	0	80	331
Distance to poorer water stream (km)	6.69	5.13	0.42	28.36	343
Household income ($)[a]	50,280	27,801	15,000	90,000	321
Knowledge (1=a lot or detailed)[b]	0.15	0.36	0	1	326
Second home (1=yes)[c]	0.38	0.48	0	1	333
City dummy[d]=within city limits)	0.88	0.32	0	1	343
Variables used in the preliminary estimation					
Age	60.81	14.06	20	93	333
Gender[e] (1=female)	0.34	0.48	0	1	325
College[f] (1=BS or higher)	0.49	0.50	0	1	329
Residential area[g] (1=residential area)	0.67	0.47	0	1	321
Property value ($)[h]	140,749	150,069	900	1,895,420	298
Elevation (km)	0.25	0.06	0.18	0.41	343
Closest distance to stream or river (km)	0.37	0.30	0	2.05	343
Closest distance to road (km)	0.06	0.10	0	0.62	343

[a] $15,000=household income declared as less than $30,000, $45,000=household income declared between $30,000 and $60,000, $90,000=household income declared more than $60,000.
[b] 1=knowledge levels declared as 'a lot' or 'detailed knowledge', 0=knowledge levels declared as 'none' or 'very little' or 'some'.
[c] 1=second home and 0=primary home.
[d] 1=respondents housing is within city boundaries of Franklin or Highlands and 0=outside of the boundaries.
[e] 1=female and 0=male.
[f] 1=college degree or higher than college degree and 0=no college degree.
[g] 1=property is located in residential area and 0=property is located in non-residential area.
[h] Sum of building value and land value.

We estimated total marginal effect, $\partial E(\mathrm{WTP})/\partial X_i$, using Eq. (4) and the fraction of the total marginal effect above the zero bid, $\partial E(\mathrm{WTP}^*)/\partial X_i$, using Eq. (5).

2.2. The Heckit model

Following Sigelman and Zeng (1999), the Heckit model is a response to sample selection bias, which arises when data are available only for cases in which a variable reflecting "pay," z^*, exceeds zero. They employ the Heckit model to analyze political contributions. In this model,

$$z_i^* = w_i\gamma + \mu_i \tag{7}$$

$$WTP_i = \boldsymbol{X}_i\beta + \mu_i \quad \text{observed only if} \quad z_i^*>0 \tag{8}$$

The error terms are assumed to follow a bivariate normal distribution with means 0, variances $\sigma_\mu=1$ and σ_ϵ, and a correlation coefficient ρ. Heckman's two-step estimator is usually used in this circumstance. The estimator is based on the conditional expectation of the observed WTP:

$$E\left(WTP|z^*>0\right) = \boldsymbol{X}\beta + \rho\sigma_\varepsilon\lambda(-w\gamma) \tag{9}$$

where, the inverse Mills ratio is $\lambda(-w\gamma)=(\phi(-w\gamma))/(1-\Phi(-w\gamma))$. It is only when Eqs. (7) and (8) are uncorrelated that the conditional expectation of WTP is $\boldsymbol{X}\boldsymbol{\beta}$. In the first stage, we obtain γ from a probit estimation of Eq. (7), where $z=1$ if $z^*>0$ and 0 otherwise. In the second stage, we estimate Eq. (9) using OLS regression. In the Heckit model, the marginal effect of the $\boldsymbol{X}_i$ on its conditional expectation is

$$\partial E\left(WTP|z^*>0,\boldsymbol{X}\right)/\partial\boldsymbol{X}_i = \beta_i - \gamma_i\rho\sigma_\varepsilon\delta(-w\gamma) \tag{10}$$

where, δ is defined as $\delta(.)=\phi(.)|(1-\Phi(.))$.

There is no immediate guidance on regressors to include in the WTP models. Previous literature has identified a number of possible factors including: length of residence (Baldassare, 1986; Myers, 1989; Doherty, 1987), social class or income (Lovejoy et al.,

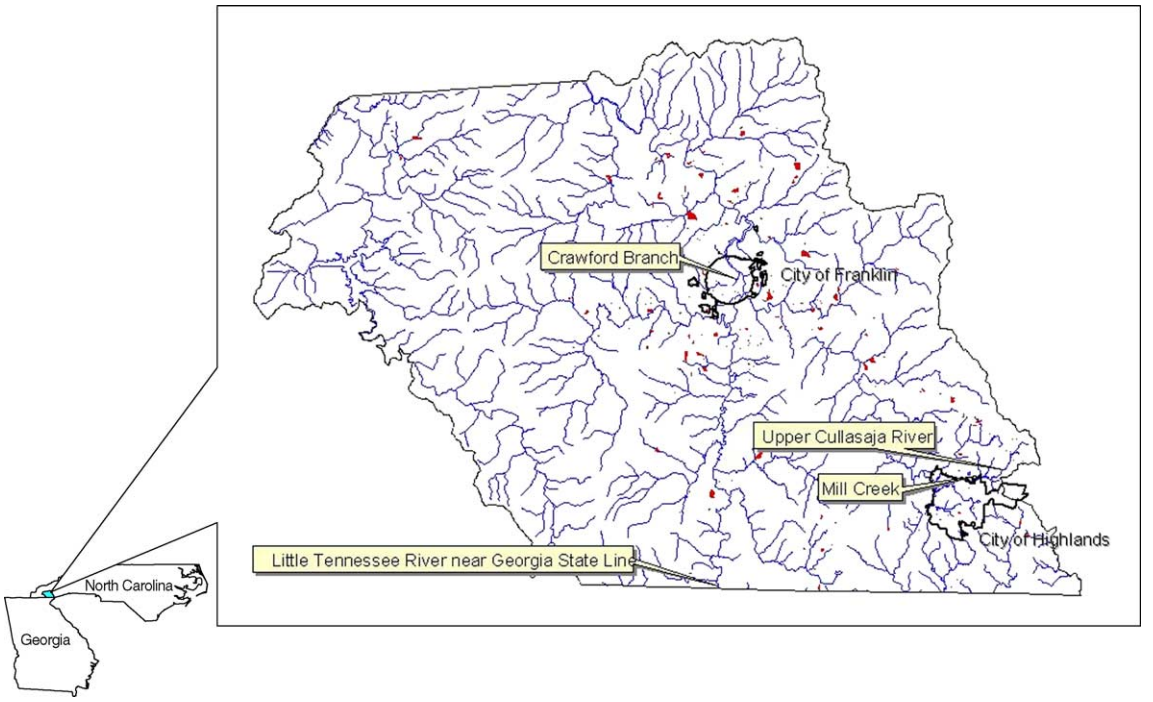

Fig. 1. Locations of survey respondents and four streams of poorer water quality in Macon Country, North Carolina (Stream and rivers are marked on curves, land parcels of survey respondents are marked on spots, and city boundaries are marked on bold curves).

1982; Salamon and Tornatore, 1994), and values and norms (Engel, 1984; Spain, 1993). Previous studies also suggest that willingness to pay for improved environmental amenities is a function of household characteristics and location (e.g., Breffle et al., 1998). As well, a number of household characteristics including income, sex, education, and knowledge about an issue have been found to be statistically significant in explaining WTP for environmental goods and services (e.g., Choe et al., 1996; Bowker et al., 2003). The length of residence has also been found to be an important factor for preferences of alternative environmental improvements (e.g., Johnston et al., 2003). Based on these studies, we include household characteristics, location variables, and length of residency as regressors for the CVM models evaluating WTP for conservation easements.

We used duration of county residency in years for the variable of residential length of time for primary homeowners and duration of second home use for second homeowners. Given the difficulty typically associated with obtaining exact household income information from surveys, respondents were asked whether they fell into any of three income categories—less than $30,000; between $30,000 and $60,000; and more than $60,000; respectively. For the regression analyses, interval midpoints were used for the first two categories and $90,000 for the final category.

The values and norms regarding specific environmental amenities are difficult to measure directly. However, we know they are affected by degree of knowledge about them. Thus, we include a knowledge level dummy variable indicating whether the respondent has self-assessed detailed knowledge about the issues related to rapid development and the county's loss of undeveloped land. In addition, we include a variable representing the household's proximity to problems resulting from rapid development. We use the closest distance to any of four streams in the county deemed to have poorer water quality. While this variable may reflect some self-selection, the expectation is that as the distance to poorer quality streams increases, the homeowner would have less to gain from conservation easements protecting streams and consequently WTP and distance would be inversely related.

Also, in the probit portion of the Heckit model, a dummy variable, indicating whether the house is located within city boundaries was used. Other variables like age, gender, education, housing characteristics (type of area, property value, elevation, distances to stream and road) were examined in the preliminary models and found to be statistically insignificant in all of the models. Summary statistics of the variables we used in the final estimation and preliminary estimation are reported in Table 2.

3. Estimation results

Tobit and Heckit regression models were estimated using LIMDEP. Table 3 contains results from the Tobit model, Table 4 contains results from the first stage of the Heckit model, and Table 5 contains results from the second stage of the Heckit Model. Inherent with nonlinear models, marginal effects depend on estimated parameters and values of the explanatory variables. Hence, reported marginal effects are calculated at the means of the explanatory variables.

The results indicate that the factors influencing whether or not WTP is zero are not the same as the factors that influence the WTP amount. Duration of residency, distance to the four streams of poorer water quality, and median income commonly influence both decisions of "pay or not" and the WTP amount. Knowledge level influences the WTP amount decision while whether or not the house is located within city boundaries influences "pay or not" decisions. While the same set of regressors is imposed in the Tobit specification, the added flexibility of the Heckit allows for differences in the regressors between the two stages. The statistically significant coefficient of sigma in the Tobit model and the statistically insignificant coefficient of lambda in the Heckit model show that bias in the estimation may be at the clustered zero response WTP rather than as a result of selection bias associated with censoring.

The estimates from Tables 3 (Tobit) and 5 (Heckit) show an inverse relationship between residency duration in the county and WTP for conservation easements. This is consistent with previous findings that newer residents of rural, urban-fringe communities place relatively higher values on amenities and conservation (Johnston et al., 2003; Dubbink, 1984; Healy and Short, 1979). The marginal effects are virtually equal across both models and insensitive to the inclusion of protest bidders. When we include protest bids and use the Heckit model, a 1-year increase in the duration of residency results in a $0.18 decrease in average WTP for all residents.

Households residing farther from any of the four streams of poorer water quality are more likely to have lower WTP for conservation easements. Using the Heckit model and including protest bidders, the marginal WTP for a 1-km increase in the distance to one of the four streams of poorer water quality would

Table 3
Tobit regression results

Variables	With protest zero			Without protest zero		
	Coefficient	Total effect	Sample mean	Coefficient	Total effect	Sample mean
Constant	1.012 (5.308)	0.604 (3.179)	1	5.652 (4.984)	4.392 (3.919)	1
Duration of residency (year)	−0.351*** (0.104)	−0.209***(0.062)	20.10	−0.248*** (0.098)	−0.192*** (0.076)	18.49
Closest distance to poorer Water quality (km)	−1.181*** (0.400)	−0.705*** (0.238)	6.53	−0.788** (0.371)	−0.612** (0.288)	6.17
Median income ($1000)	0.367*** (0.065)	0.219*** (0.039)	51.53	0.357*** (0.060)	0.278*** (0.047)	53.19
Knowledge dummy	10.205** (4.747)	6.092** (2.839)	0.16	16.624*** (4.555)	12.918*** (3.548)	0.14
Sigma	27.571*** (1.543)			23.095*** (1.245)	−2.046	
Number of observations	287[a]			216[b]		
Log likelihood	−922.41			−844.67		
LM test for Tobit	15.07			25.28		

***Indicates statistical significance at the 1% level; **indicates statistical significance at the 5% level; numbers in parenthesis are standard deviations.

[a] Out of the 287 observations used in the estimation, 114 observations are zero bids. Seventy-one among the 114 zero bids are protest-zero bids.

[b] Out of the 216 observations used in the estimation, 43 observations are non-protest zero bids.

Table 4
Probit regression results regarding pay or not (first stage of Heckit model)

Variables	With protest zero bids			Without protest zero bids		
	Coefficient	Marginal effect	Sample mean	Coefficient	Marginal effect	Sample mean
Constant	0.907*** (0.409)	0.340*** (0.152)	1	0.801* (0.523)	0.168* (0.109)	1
Duration of residency (year)	−0.013*** (0.004)	−0.005*** (0.002)	20.10	−0.011** (0.006)	−0.002** (0.001)	18.49
Closest distance to poorer water quality (km)	−0.061*** (0.019)	−0.023*** (0.007)	6.53	−0.046** (0.026)	−0.010** (0.005)	6.17
City dummy	−0.564* (0.309)	−0.190** (0.090)	0.89	−0.252 (0.392)	−0.047 (0.065)	0.88
Median income ($1000)	0.012*** (0.003)	0.004*** (0.001)	51.53	0.020*** (0.005)	0.004*** (0.001)	53.19
Number of observations	287			216		
Log likelihood	−168.83			−81.9		
Restr. log likelihood	−190.06			−98.91		
χ^2	42.46			33.98		
Percent correct predictions	70.38			85.19		

***Indicates statistical significance at the 1% level; **indicates statistical significance at the 5% level; *indicates statistical significance at the 10% level; numbers in parenthesis are standard deviations.

result in a $0.55 decrease in the WTP. Again, this result seems to be robust across models and whether protest bidders are included or not. The result would appear to suggest that as households are farther removed from worsening environmental conditions, their WTP for easements aimed at improving such conditions is reduced. We should note that we included a binary variable in preliminary models to assess whether living within city limits affected WTP. We found this variable to be insignificant.

Household income is positive and significant across both models indicating that conservation easements are normal goods. In the Heckit model, income only affected the second stage decision of how much to pay. Using the Heckit model and including protest bids, a $1000 increase in annual household income resulted in a $0.24 increase in average WTP for the conservation easement program. The Tobit results are not appreciably different.

Households subjectively claiming higher knowledge about land development issues are more likely to have a greater WTP. This variable is significant in both models and whether or not protestors are included. However, the difference in marginal WTP associated with being in the higher knowledge group is quite large between protestors and nonprotestors.

Table 5
Sample selection two-stage least squares regression results (second stage of Heckit model)

Variables	With protest zero bids			Without protest zero bids		
	Coefficient	Marginal effect	Sample mean	Coefficient	Marginal effect	Sample mean
Constant	10.499 (12.657)		1	3.623 (15.490)		1
Duration of residency (year)	−0.236 (0.180)	−0.180 (0.279)	16.67	−0.280* (0.174)	−0.189 (0.961)	16.67
Closest distance to poorer water quality (km)	−0.812 (0.582)	−0.547 (0.891)	5.88	−0912* (0.558)	−0.517 (1.230)	5.88
Median income ($1000)	0.293*** (0.125)	0.242 (0.161)	57.49	0.395** (0.197)	0.228 (0.934)	57.49
Knowledge dummy	12.003*** (4.292)	12.003*** (4.292)	0.17	12.362*** (4.299)	12.362*** (4.299)	0.17
Lambda	7.869 (19.257)		0.54	25.716 (31.770)		0.25
Number of observations	287			214		
R^2	0.149			0.151		
Adjusted R^2	0.124			0.127		

***Indicates statistical significance at the 1% level; **indicates statistical significance at the 5% level; *indicates statistical significance at the 10% level; numbers in parenthesis are standard deviations.

For example, including protest bids and using the Tobit model, inclusion in the higher knowledge group adds $6.09 to WTP. Excluding protest bids the marginal effect is $12.92, or about a $7 difference. This is an interesting result in light of the fact that the percentage of those in the high knowledge group does not differ between the protest and non-protest subsambles. It appears to suggest that high knowledge households, while no more likely to be protest bidders, have stronger preferences for conservation. That is, those high knowledge households that believe the CVM scenario will work, and thus will participate in the program, have considerably higher WTP values than other nonprotestor households. Therefore, counting protest bids as zeroes will likely lead to a potentially large underestimate of mean WTP if a number of the protestors are in the high knowledge group and have large WTP's but reject the CVM scenario as described.

Ultimately, the important benefit measures for efficiency analysis are the estimated household WTP and the aggregation of this measure county-wide. Estimated household WTP's toward the conservation easement program for both Tobit and Heckit models, with and without protest bids, are reported in Table 6. Sample mean WTP's for each model are calculated by averaging the predicted WTP's for each individual (Souter and Bowker, 1996). Depending on protestor assumptions, the annual household WTP values range from $21.79 for the Tobit without protestors to $15.57 for the Heckit without protestors.

Following Harrison and Lesley (1996), we also report income adjusted WTP's which range from $17.39 to $10.97. These means, adjusted through the estimated total marginal effect of income, reflect the differences between the mean income of each of our subsamples and county median income from the 2000 Census ($37,381). We acknowledge that the county median household income is a conservative estimate of the county mean household income.

In Table 6, we report aggregate county WTP, potential annual and decade easement acreages, and the consequent percentage reduction in farmland loss. These values are subject to considerable variability depending on (a) the preferred econometric model, (b) the inclusion of protest bids in the estimation, and (c) the aggregation assumptions. We report the range of values because there is no consensus in the literature regarding researcher judgments in these areas.

For example, Harrison and Lesley (1996) suggest adjusting sample average WTP for differences in objectively measured variables between the sample and population of interest through the regression coefficients. They do not discuss protest bids. These

Table 6
Household and county WTP for conservation easement acreage under alternative aggregation assumptions

	Tobit including protestors	Tobit without protestors	Heckit including protestors	Heckit without protestors
Under the assumption of county population household income				
Income adj. household WTP[a]	$13.20	$17.39	$12.56	$10.97
Aggregate WTP[b]	$273,847	$360,772	$260,582	$227,583
Farmland conservation per acre per year	133	175	127	111
Farmland conservation next 10 years	1030	1358	981	857
Reduction of farmland loss from 1987–1997	35%	46%	33%	29%
Under the assumption of zero non-respondents' WTP				
Household WTP	$16.30	$21.79	$17.43	$15.57
Aggregate WTP[c](NR=$0)	$114,974	$153,699	$122,945	$109,825
Farmland conservation per acre per year	56	75	60	53
Farmland conservation next 10 years	433	578	463	413
Reduction of farmland loss from 1987–1997	16%	19%	16%	14%

[a] Mean predicted household WTP is $16.30, $21.79, $17.43, and $15.57, the marginal effect of income is 0.219, 0.278, 0.242, and 0.228, and average sample household income is $51,533, $53,194, $57,486, and $57,486 for estimates of Tobit with protest, Tobit without protest, Heckit with protest, and Heckit without protest, respectively.

[b] Number of county households is 20,746.

[c] Survey response rate is 0.34.

means are then assumed representative for the population and aggregated across the relevant units. Using this approach we estimate annual county WTP across 20,746 households ranging from $227,583 to $360,772. Based on the average conservation easement price of $2059 per acre in North Carolina under the Farmland Protection Program by USDA through 2001, the county could conserve between 111 and 175 acres annually depending on the model and protestor assumption. The 10 year projected area conserved, based on an assumption of a 5.5% increase in the number of households (average increase of 1990–2000), a 9.2% increase in conservation easement price (average increase of market value of farmland and building of 1987–1997), and 2.7% discount rate (average consumer price index of 1990–2000), ranges from 857 to 1358 acres. This represents a decrease in the rate of development, compared to the 1987–1997 rate, of between 29% and 46%.

An alternative and more conservative approach is to assume WTP for nonrespondents is zero and report aggregates using with- and without-protestor WTP estimates (Halstead et al., 1992; Jorgensen and Syme, 2000). Bowker et al. (2003) claim that this approach is particularly attractive in situations where the method of delivery is not clearly separable from the end product. Given the relatively high percentage of protestors and nonresponse identified herein, such a conservative aggregation approach would seem prudent. Following this procedure, estimated county aggregate WTP for the easement program ranges from $109,825 to $153,699 annually. This would lead to conservation of between 53 and 75 acres per year. Following the above assumptions, between 413 and 578 acres would be conserved over the next 10 years. This 10-year amount represents a decrease in the rate of development compared to the 1987–1997 rate of about 14–19%.

4. Summary and conclusions

The rapid growth of rural communities in the Blue Ridge Mountains of Macon County, North Carolina, has caused concerns over declining environmental quality and increasing the need for land-use policy. County leaders have found that non-regulatory approaches have been politically more palatable as the county has tried to initiate a land-use plan to provide sustainable development options. For this reason, the county government is considering a less regulatory and more voluntary type of policy such as conservation easements. In this paper, we explore the use of contingent valuation to assess homeowners' willingness to pay for conservation easements as a possible alternative land-use policy.

Efficiency analysis based on CVM suggests that the potential annual value among county residents for a hypothetical conservation easement program ranges from about $110,000–360,000 per year. This would conservatively translate into the protection of 53–175 acres annually and up to 1358 acres over a 10-year period. If a program like this was implemented, the consequent slowdown in land development versus the period from 1987 to 1997 would range from 14–46%. Two caveats pertaining to these ranges should not be overlooked. First, the administrative costs of an easement program are not explicitly considered. This would likely reduce the acreage entering the program somewhat. Alternatively, we assume an easement price of $2059 per acre. This may in fact be substantially higher than what the county would have to pay to accomplish their objectives, and thus make the acreage estimates conservative.

Efficiency from a benefit cost perspective and public preference for a policy often diverge. For example, it is important to note that 123 out of the 287 respondents (43%) expressed no WTP for the program. However, 71 of these 123 (58%) were identified as protesting the instrument and thus, are likely to have positive value for the results of the program. Moreover, 66% of those surveyed chose not to respond at all for various reasons. In addition to potential indifference, it would be reasonable to expect that a large portion of these nonrespondents have little or no value for the program. Thus, the information provided in our survey instrument shows the possibilities that an easement program could bring to the county, but there would still be substantial political difficulties in passing a referendum. Nevertheless, a significant number of tax-funded preservation programs have passed in recent years as the public has responded to perceived land-use changes.

Our modeling results appear logical and consistent with previous literature. For practical purposes, we find little difference qualitatively or quantitatively

between the Tobit and Heckit specifications. This is especially true when the focus is on predicting sample mean WTP. Among the regressors, newer residents, second home owners, higher knowledge levels about environmental issues and higher income all correlate positively with WTP. Such results are consistent with the growing importance of forest amenities and environmental quality in segments housing markets in rural and wildland–urban interface areas. Clearly, the largest variability in results comes from underlying assumptions pertaining to county-wide aggregation.

Our use of CVM in this application leads to a number of somewhat mixed results which should not be overlooked. Because of potential political implications, we chose to define our contingent scenario in a somewhat ambiguous manner. This, along with the large proportion of second homeowners and the timing of the survey, may well have contributed to the relatively low response rate and a protest bid level approaching 25%. In situations where specific policies are at odds and more specific outcomes can be articulated in the survey instrument, we suspect that nonresponse and protest responses can be greatly mitigated. However, such exact specification is simply not always possible.

When the objective is more toward assessing potential support and value for possible land development policies rather than resolving litigation, contingent valuation and resultant economic information may prove useful to communities facing development problems. The output of this study might be used as a starting point for the analysis of specific growth management options of the county government. This would include land-use planning, actions of zoning boards, conservation commissions, and town councils regarding land-use policies in the future.

Acknowledgement

Seong-Hoon Cho is an Assistant Professor, Department of Agricultural Economics, University of Tennessee; David H. Newman is a Professor, Warnell School of Forest Resources, University of Georgia; J. M. Bowker is a Research Scientist, USDA Forest Service, Southern Research Station. We would like to thank Sara Cho, the Wildland-Urban Interface Forum participants at the 2004 annual meetings of SOFEW, and Dudley Hartel, Center Coordinator and Tom Holmes, Research Forester of USDA Forest Service, Southern Research Station for their useful comments. This material is based upon work supported by the NSF funded Coweeta Long Term Ecological Research, the USDA Forest Service, the Warnell School of Forest Resources, University of Georgia, and the Department of Agricultural Economics, University of Tennessee.

References

Amemiya, T., 1973. Regression analysis when the dependent variable is truncated normal. Econometrica 41, 997–1016.

Arrow, K., Solow, R., Portney, P., Leamer, E., Radner, R., Schuman, H., 1993. Report of the National Oceanic and Atmospheric Administration panel on contingent valuation. Federal Register 58, 4602–4614.

Baldassare, M., 1986. Trouble in Paradise: The Suburban Transformation in America. Columbia University Press, New York, NY.

Bishop, R.C., Heberlein, T.A., 1979. Measuring values of extramarket goods: are indirect measures biased? American Journal of Agricultural Economics 61, 926–930.

Bowker, J.M., Newman, D.H., Warren, R.J., Henderson, D.W., 2003. Estimating the economic value of lethal versus nonlethal deer control in suburban communities. Society and Natural Resources 16, 143–158.

Breffle, W.S., Morey, E.R., Lodder, T.S., 1998. Using contingent valuation to estimate a neighbourhood's willingness to pay to preserve undeveloped urban land. Urban Studies 35, 715–727.

Cameron, T., James, M., 1987. Efficient estimation methods for use with 'closed-ended' contingent valuation survey data. Journal of Environmental Economics and Management 15, 355–379.

Choe, K., Whittington, D., Lauria, D.T., 1996. The economic benefits of surface water quality improvements in developing countries: a case study of Davao, Philippines. Land Economics 72, 519–537.

Desvousges, W., Johnson, R., Dunford, R., Boyle, K., Hudson, S., Wilson, N., 1992. Measuring Non-use Damages Using Contingent Valuation: An Experimental Evaluation of Accuracy. RTI Monograph, 93-1. Research Triangle, North Carolina.

Dillman, D.A., 2000. Mail and Internet Surveys, 2nd ed. John Wiley and Sons, Inc., New York, NY.

Doherty, J.C., 1987. The out-of towners. Planning 53, 10–11.

Dubbink, D., 1984. I'll have my town medium rural, please. Journal of the American Planning Association 50, 406–418.

Engel, D.M., 1984. The oven bird's song: insiders, outsiders, and personal injuries in an American community. Law and Society Review 18, 551–582.

Goodwin, B.K., Offenbach, T.T., Cook, P.S., 1993. Discrete/continuous contingent valuation of private hunting access in Kansas. Journal of Environmental Management 39, 1–12.

Greene, W.H., 2000. Econometric Analysis, 4th ed. Prentice Hall, New Jersey.

Halstead, J.M., Lindsay, B.E., Brown, C.M., 1991. Use of the Tobit Model in contingent valuation: experiment evidence from the Pemigewasset Wilderness Area. Journal of Environmental Management 33, 79–89.

Halstead, J.M., Luloff, A.E., Stevens, T.H., 1992. Protest bidders in contingent valuation. Northeast Journal of Agricultural and Resource Economics 21, 160–169.

Hanemann, M., 1984. Welfare evaluation in contingent valuation experiments with discrete response. American Journal of Agricultural Economics 66, 332–341.

Harrison, G.W., Lesley, J.C., 1996. Must contingent valuation surveys cost so much? Journal of Environmental Economics and Management 31, 79–95.

Healy, R., Short, J., 1979. Rural land: market trends and planning implications. Journal of the American Planning Association 45, 305–317.

Johnston, R.J., Swallow, S.K., Tyrrell, T.J., Bauer, D.M., 2003. Rural amenity values and length of residency. American Journal of Agricultural Economics 85, 1000–1015.

Jorgensen, B.S., Syme, G.F., 2000. Protest responses and willingness-to-pay: attitude toward paying for stormwater pollution abatement. Ecological Economics 33, 251–265.

Lovejoy, S.B., Brown, D.J., Weitz, J.S., 1982. In migrants in nonmetropolitan communities: more dissatisfied with public services? North Central Journal of Agricultural Economics 5, 1–12.

Maddala, G.S., 1999. Limited-dependent and Qualitative Variables in Econometrics. Cambridge University Press, Cambridge, MA.

McDonald, J.F., Moffitt, R.A., 1980. The use of Tobit analysis. The Review of Economics and Statistics 62, 318–321.

McFadden, D., 1994. Contingent valuation and social choice. American Journal of Agricultural Economics 76, 689–708.

Mitchell, R.C., Carson, R.T., 1989. Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future, Washington D.C.

Myers, D., 1989. The ecology of "quality of life". In: Brower, D.J., Godschalk, D.R., Porter, D.R. (Eds.), Understanding Growth Management: Critical Issues and a Research Agenda. Urban Land Institute, Washington, D.C., pp. 87–105.

N.C. Division of Water Quality, 2002. Little Tennessee River Basinwide Water Quality Plan.

Norris, P.E., Batie, S.S., 1987. Virginia farmers' soil conservation decisions: an application of Tobit analysis. Southern Journal of Agricultural Economics 19, 79–90.

Reaves, D.W., Kramer, R.A., Holmes, T.P., 1999. Does question format matter? Valuing an endangered species. Environmental and Resource Economics 14, 365–383.

Salamon, S., Tornatore, J.B., 1994. Territory contested through property in a midwestern post-agricultural community. Rural Sociology 59, 636–654.

Sigelman, L., Zeng, L., 1999. Analyzing censored and sample-selected data with Tobit and Heckit models. Political Analysis 8, 167–182.

Souter, R.A., Bowker, J.M., 1996. A note on nonlinearity bias and dichotomous choice CVM: implications for aggregate benefits estimation. Agricultural and Resource Economics Review 25, 54–59.

Spain, D., 1993. Been-heres versus come-heres: negotiating conflicting community identities. Journal of the American Planning Association 59, 156–171.

Ziemer, R.F., White, F.C., 1981. A Tobit model of the demand for farmland. Southern Journal of Agricultural Economics 13, 105–109.