Public preferences and values for rural land preservation in Florida

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Abstract

This study develops a method to evaluate the influence of local geography on respondents' values for land conservation programs. The study employs a choice experiment to evaluate alternative conservation plans. Results indicate that residents' local landscapes do matter to the estimated values for such conservation programs. Our results also provide information about the divergence of political and economic jurisdictions for land conservation programs in Florida.

Introduction

Florida's rural landscapes provide numerous and diverse benefits to landowners, residents, visitors, and others. The state's forests, wetlands, rangelands, pastures, croplands, orchards, and other open spaces are important to the states market and nonmarket economy, supplying goods and services like agricultural and wood products, watershed protection, flood control, groundwater recharge, pollution abatement, climate stabilization, and wildlife habitat. Agriculture and natural resource industries represented 3.3 percent of Florida's gross regional product and contributed about $41.1 billion to the state's economy in 2003 (Hodges and Mulkey 2006). Rural landscapes also offer a multitude of outdoor recreational opportunities and aesthetic experiences to residents and that provides an important draw to millions of visitors to the state. Florida is also biologically diverse: 115 of 668 terrestrial and freshwater vertebrate taxa that occur in Florida are endemic to the state, and 57 federally listed threatened and endangered species also reside in Florida (Kautz and Cox 2001).

As in many places throughout the United States, the conversion of rural landscapes to urban and suburban land uses is an important concern in Florida. A major driver of this land use change is the state's booming population that grew an average of 39 persons per hour between

1980 and 2000. Florida's 23.5% population growth rate is among the nation's highest, and the state's population of 15.9 million in 2000 is expected to double by 2030 (US Census 2005). As a result of the development pressures, Florida's rural land base experienced a five-fold increase in urban conversion between 1964 and 1997 and lost nearly 5 million acres (2 million ha) of valuable agricultural lands. An additional 1.3 million acres (526,000 ha) are expected to be lost in the next ten years (Reynolds 2000). A more recent analysis indicates that an additional 7 million acres (2.8 million ha) of rural lands statewide will be converted to urban uses by 2060 if current trends continue (Zwick and Carr 2006).

Florida has a history of public acquisition of rural land for conservation purposes extending more than 40 years. Public acquisition of land for open space preservation in Florida started in 1964 with the issue of a $20 million bond, followed by a second bond program in 1972 established to purchase environmentally sensitive lands. These early initiatives were later expanded into the CARL (Conservation and Recreational Lands) program that aimed to conserve habitat for wildlife, unique natural areas and geologic features, wetlands, and historical sites. Preservation 2000, an ambitious ten-year land acquisition program was then initiated in 1990 with an annual budget of $300 million. This program was later extended through 2010 as the Florida Forever program (Larkin, Alavalapati, and Shrestha 2005). With about $3.7 billion paid to acquire 3.8 million acres (1.54 million ha) by 2004, Florida's state-sponsored public land acquisition program is one of the most aggressive in the country. In addition, many county and local governments followed the state's lead in vigorously acquiring private lands for open space preservation. For example, Alachua County voters agreed to raise $29 million through a new property tax to fund the Alachua County Forever land acquisition program in 2000 and become the 21st county in Florida to have a funded land acquisition program (Alachua County 2007).

Many private organizations such as the Conservation Trust for Florida and The Nature Conservancy also have systematic and long-running conservation easement and private land acquisition programs to conserve open space and precious habitat in Florida and throughout the U.S. In Florida, such organizations often collaborate with government sponsored programs to help achieve the conservation goals of both entities.

Support for funding land conservation measures remains strong around the U.S. In 2006 voters in 23 states approved 104 ballot measures for land conservation, an 80% approval rate. These measures resulted in $6.4 billion in new funding for land conservation (The Trust for Public Land and Land Trust Alliance 2007).

In order to provide some determination of the appropriate level of funding for programs like rural land conservation, aggregate measures derived from by vertically summing individuals' demand curves can be determined. A central question in the aggregate measure however, is how wide should be the reach of the vertical sum of values for the public good, that is, where should the boundary for aggregation be drawn. Cornes and Sandler (1996) distinguish between political and economic jurisdictions, the former being the administrative area charged with financing the provision of the good, and the latter referring to the population of individuals who enjoy the benefits of the good. Where the two jurisdictions coincide, the optimal condition of fiscal equivalence occurs. Fiscal equivalence may be an exceptional case since, for example, use values are likely to be greater nearer to the resource being valued and the point where use values diminish to zero may not coincide with any administrative boundary (Bateman et al. 2006). The situation is further complicated when non-use values for such measures as wildlife protection are considered, where the economic jurisdiction may extend well beyond the political jurisdiction (e.g., Loomis 2000).

The aggregate valuation measure consists of two components: the individual WTP estimate and the economic jurisdiction that forms the basis for the vertical sum. While it is clear that analysts should strive to obtain the best estimate of individual WTP possible, some argue that the extent of the market for the good in question is of greater consequence to arriving at an accurate aggregate value (Bateman et al. 2006;Bateman et al. 2000;Loomis 2000;Smith 1993).

This study reports on a statewide survey employing a choice experiment (CE) format to elicit stated preferences for landscape preservation programs in Florida. The results of the choice experiment are complemented by the inclusion of a set of variables describing respondents' local landscapes. These variables were generated with a geographic information system (GIS) and local spatial data sets, and provide information that aids in the determination of the economic jurisdiction, and thus the appropriate aggregate value, of landscape conservation measures in Florida.

Methods and Model

Choice experiments with similar methodology have been applied to a wide variety of valuation problems around the United States and elsewhere in the past several years (e.g., McGonagle and Swallow 2005;Layton and Brown 2000;Adamowicz et al. 1998). In Florida, choice experiments have been used in the valuation of specific ecosystem services (Shrestha and Alavalapati 2004), land conservation programs (Condon 2004), and ecosystem restoration (Milon et al. 1999).

An advisory committee consisting of members from stakeholder groups in commercial agriculture, local governments, and natural resource management agencies was established at the onset to guide the entire survey process. The questionnaire was developed during the winter and spring of 2006 beginning with three focus groups to learn about factors influencing perceptions regarding open space preservation and to pretest draft choice experiment questions. After incorporating feedback from the advisory committee and the focus groups, the questionnaire was finalized.

The survey was divided into four sections. The first section started with information on the purpose and objectives of the survey and provided a brief description about Florida's rural lands and natural areas and the environmental services they render to Floridians. The second section sought information on how important the respondents consider the benefits of open spaces, respondents' concerns about their loss, and their preferred approaches to address such losses. The third section contained the choice sets, while the final section contained several questions on socio-demographic characteristics.

Respondents were presented with information on four preservation program attributes. These attributes include: (1) the type of land for preservation, (2) the size of the area to be protected, (3) the location of the land relative to the respondents residence, and (4) the cost of the plan (i.e., the public money that would need to be collected in the form of tax or utility fees per household for five years to pay to conserve the land). Each of the four attributes had three levels, summarized in Table 1.

Construction of the choice sets was done using a fractional factorial orthogonal design, and was completed using the SAS *Optex* procedure. Each choice set included two scenarios (i.e., alternative land preservation programs A and B), along with a status quo, or opt out, alternative (C). Respondents were asked to choose one of the three options (i.e., A, B, or C), and each respondent was presented with a total of five choice sets.

To maximize the use of available funds and ensure statewide coverage, the survey was implemented through the Internet using the website www.surveymonkey.com. The site is relatively inexpensive as it provides the software to design the questionnaire, collect the responses (eliminating entry errors and labor), and analyze the results. An invitation to complete the questionnaire was sent to 100,000 randomly selected email addresses of adult residents in Florida through Expedite Marketing, a commercial email vendor. After the initial contact, a reminder email was sent to recipients approximately two weeks later. It was important to identify residents as the payment vehicle was assumed to be an annual fee by the household through an additional tax on property owners. The objective was to get a representative random sample of Florida households covering different regions of the state that represent different rural land use, population growth and urban development pressures.

Random utility theory (McFadden 1974) provides the theoretical basis for CE modeling and value estimation. The basic assumption underlying the theory is that the true but unobservable utility of a good or service *j* is composed of both deterministic and random components. Respondent *n*'s utility for alternative *j* is U_{nj}, a function of the attributes of the alternative X_j, the cost of the alternative (C_j), and the respondents income (Y_n) and socioeconomic characteristics (S_n):

$$U_{nj} = U(X_j, Y_n - C_j, S_n) = V(X_j, Y_n - C_j, S_n) + \varepsilon_{nj} = V_{nj} + \varepsilon_{nj} \qquad (1)$$

Where $V(\cdot)$ is the estimable systematic component of utility and ε_{nj} is a random error term with mean zero.

In this study, each attribute combination for alternative open space preservation programs is specified as alternative *j* in choice set *J*. The selection of alternative *j* over alternative *h* implies that the utility of U_{nj} is greater than that of U_{nh}. The utility is random because although respondents know their choices with certainty, the researcher's knowledge is incomplete and thus stochastic since it is based only on the observed behavior of respondents during the choice experiment. Accordingly, the probability, $P(\cdot)$, of an individual n choosing alternative j is expressed as

$$P(nj \mid J) = P[V_{nj} + \varepsilon_{nj} > V_{nh} + \varepsilon_{nh}],\ j \neq h\,. \tag{2}$$

If the random components are independent and identically distributed (iid) and extreme value, equation (2) can be rewritten as

$$P(nj \mid J) = P[\varepsilon_{nj} - \varepsilon_{nh} > V_{nh} - V_{nj}],\ j \neq h\,. \tag{3}$$

Our estimates were obtained using the random parameters logit (RPL) model, as follows. The alternative j is a specific alternative representing a change in management with its conditional indirect utility level U_j for respondent n, denoted

$$U_{nj} = \beta_n x_{nj} + \varepsilon_{nj}\,. \tag{4}$$

where x_{nj} are variables representing program attributes, β_n is a vector of unobserved coefficients that vary for each respondent n, and ε_{nj} is an unobserved random component that is independently and identically distributed (iid) and extreme value. β_n can be expressed as the sum of the population mean b and individual variation η_n, which represents the respondent's tastes relative to the overall population. Utility is thus

$$U_{nj} = bx_{nj} + \eta_n x_{nj} + \varepsilon_{nj}\,. \tag{5}$$

The analyst estimates b but η_n is unobserved, and so variation $\eta_n x_{nj}+\varepsilon_{nj}$ is the unobserved portion of utility. Since respondent's tastes are correlated across choice sets, the RPL departs from the standard logit model and does not satisfy the IIA property. Although computationally more demanding than logit, the RPL is useful in that it provides information about the degree to which individuals differ in their preferences for the attributes portrayed in the choice experiment (Train 1999;Hensher and Greene 2003).

If the analyst knew individual tastes, the choice probabilities would be the standard logit, where the probability that respondent *n* selects alternative *i* is

$$L_{ni} = \frac{\exp(\beta x_{ni})}{\sum_{ij \in J} \exp(\beta x_{nj})}. \qquad (6)$$

Since tastes are unknown, with the RPL model we can express their variation across the population as the density f(β|θ*), where θ* are the distribution's parameters. The probability that the respondent *n* selects alternative *i* is the integral of equation (6) over all possible values of β, weighted by the density of β:

$$Q_{ni}(\theta^*) = \int L_{ni}(\beta) f(\beta \mid \theta^*) d\beta. \qquad (7)$$

To estimate using maximum likelihood requires the probability of each respondent's sequence of choices. Let *i*(*n*) denote the alternative chosen by respondent *n*. If $\beta_n=\beta$, the probability of respondent *n*'s observed sequence of choices is

$$S_n(\beta) = \prod L_{ni(n)}(\beta). \qquad (8)$$

β*n* is unknown however, and as a result the probability is the integral of (8) over all values of β:

$$P_n(\theta^*) = \int S_n(\beta) f(\beta \mid \theta^*) d\beta. \qquad (9)$$

The log likelihood function is LL(θ)=

$$LL(\theta) = \sum\nolimits_n \ln P_n(\theta)\,, \tag{10}$$

although maximum likelihood estimation is not possible since the integral in (9) is not possible to calculate analytically. The probability $P_n(\theta)$ is therefore approximated via simulation by a summation over randomly chosen values of β with given values for the parameters θ. $S_n(\beta)$ is computed from draws of β, the process is repeated, and the resulting approximated choice probability taken as the mean of the repetitions is

$$SP_n(\theta) = (1/R)\sum\nolimits_{r=1,\ldots,R} S_n(\beta^{r|\theta}) \tag{11}$$

where R is the number of draws of β, $\beta^{r|\theta}$ is the rth draw from the distribution $f(\beta|\theta)$, and $SP_n(\theta)$ is the simulated probability of respondent n's series of choices. The simulated log likelihood function is

$$SLL(\theta) = \sum\nolimits_n \ln SP_n(\theta) \tag{12}$$

and the estimated parameters are those that maximize *SLL*.

Respondents' WTP associated with program attributes was estimated from RPL using Hanemann's (1984) method for determining the compensating surplus (*CS*):

$$CS = -\frac{1}{\beta_c}\left[\ln\left(\sum \exp_{v_{i0}}\right) - \ln\left(\sum \exp_{v_{i1}}\right)\right] \tag{13}$$

where β_c is the marginal utility of income (i.e., coefficient of the cost variable used in the model), and V_{i0} and V_{i1} represent the utility of the initial state and the choice alternative, respectively. The CS function for a marginal change in conservation program can also be estimated as the ratio of the estimated coefficient of the attribute β_j and the coefficient of the cost attribute β_c.

This ratio is the marginal rate of substitution (or part-worth) between price (such as tax) change and the change in the attribute and is a measure of the marginal value of a change in the attribute under consideration.

A set of variables describing respondents' local landscapes was created in order to evaluate a series of hypotheses about respondents' valuation of landscape conservation programs in relation to their particular surroundings. The inclusion of respondent zip codes in the final portion of the survey instrument allowed us to locate respondents in the landscape, which was taken as the centroid of their respective zip code. Once these point locations were identified, we used spatially-referenced data sets and a GIS to generate values for our geographic variables.

Two variables described the share of the respondent's local landscape that was in undeveloped use. For both variables we established the respondent's "local landscape" as a 20-km radius circle around their point location. This distance was chosen as it approximates the mean daily distance traveled for all persons as reported in the National Household Travel Survey (Bureau of Transportation Statistics 2001). We first determined the share of the local landscape occupied by agricultural and forestry land uses via a shapefile containing parcel attribute information collected by county property appraisers throughout the state, obtained from the University of Florida Geoplan Center. We then used another shapefile obtained from the Florida Natural Areas Inventory that included lands that have been "identified as having natural resource value and that are being managed at least partially for conservation purposes" (available at: http://www.fnai.org/gisdata.cfm). The polygon layers were converted to rasters, and the ArcMap Spatial Analyst Neighborhood Statistics tool was used to generate a surface for the entire state where the value of each cell indicated the percent of the local landscape dedicated to agriculture/forestry (our first landscape share variable, *AGSHARE*) or natural areas (our second landscape share variable, *NATSHARE*). The values of these two variables across the state are portrayed in Figure 2 (a) and (b). The cell values were extracted to the point layer containing respondent locations, and these values were then used in the subsequent regression.

We hypothesized that the presence of disamenities associated with urbanization might influence respondents' valuation of landscape conservation programs. One common urban disamenity is traffic, and in particular traffic congestion. Since we were unable to directly measure traffic congestion levels around the state, we developed a proxy measure using a line shapefile containing major roads (local, collector, and arterial functional classes) with lane count information for the entire state developed by the Florida Department of Transportation Road Characteristics Inventory, also obtained from the Geoplan Center (available at: http://www.fgdl.org/). We again employed the 20-km radius local landscape and ArcMap Spatial Analyst to generate a raster surface for the state whose cell values represented the density of lanes (*LANEDEN*, measured in lane km/km^2, Figure 2 (c)). As with the previous variables, the raster values were extracted to the point layer containing respondent locations, and included in the subsequent regression. Finally, we hypothesized that the presence of a substitute good may influence values for future conservation programs. In this case, access to coastal recreation opportunities in Florida may serve as a substitute for some use values arising from conserved land. To evaluate this we constructed a measure for coastal access (*COASTDST*) as the distance (km) from the respondent location to the Florida coastline.

Results and discussion

A total of 371 completed responses were received after approximately one month, the point at which the link to the questionnaire on SurveyMonkey.com was disabled. Our low response rate is not entirely uncharacteristic of the mixed record for internet surveys to date (Couper 2000), although other researchers at the University of Florida have had better success. For two similar Internet-based contingent valuation surveys conducted in 2000, (Berrens et al. 2003) reported response rates of 4.0% and 5.5%. Respondents to our survey were disproportionately middle aged and of higher incomes. Respondent socioeconomic characteristics are reported in Table 1. A total of 45 of Florida's 67 counties were represented in the survey; the locations of survey responses are plotted in Figure 2.

Consistent with their expressed concerns about the loss of open space in Florida, relatively few respondents opted for C, the status quo option that does not involve the purchase of additional conservation lands at a cost to taxpayers. In only 9.5% of the 1,520 completed choice sets was the status quo option selected. There was no indication of scenario bias in choice set selection: the response distribution was uniform across all 10 hypothetical A and B preservation program alternatives.

Respondent choices were first evaluated with a multinomial logit model, and testing for the independence of irrelevant alternatives (IIA) condition conducted using the Hausman-McFadden test (1984). The results indicated that the model violated the IIA condition, and as a result the less restrictive random parameters logit (RPL) model was used for analysis of the survey data.

Explanatory variables used in the model are given in Table 3. Choice set attributes were effects coded such that coefficients could be estimated for all attribute levels (Louviere et al., 2000). *AGRICULTURE*, *AC1000*, and *REGION* were designated as the base level for the three choice set attributes, and as such assigned a '-1' in the coding scheme, whereas other levels of the attributes were assigned a '1' when present in the choice set. Coefficients for the attribute base levels were determined as the negative sum of the coefficients for the other two attribute levels estimated by the model.

RPL models allow for preference heterogeneity by assigning distributions to the random parameters in the model. The random parameters for all choice set attributes were assumed to be normally distributed as we saw no convincing reason why any of them should be considered strictly positive or negative. The *COST* parameter was taken as fixed so that WTP estimates would be normally distributed and to ensure that the *COST* variable was nonpositive for all individuals.

Model estimation included both preservation program attributes and variables describing respondent socioeconomic characteristics. The model was estimated using the Discrete Choice command in LIMDEP (Greene 1998), and the estimated model performs relatively well (χ^2 = 759.53, 26 df, $p < 0.0001$). Model results and parameter estimates for preservation program attributes are given in Table 4, while estimated coefficients for respondent characteristics are reported in Table 5.

The coefficient on the *ASC* is negative and highly statistically significant, indicating that respondents preferred participation in proposed preservation programs over the status quo despite their attendant cost. As expected, the *COST* coefficient is negative and highly statistically significant.

With respect to the land type program attribute, results were in agreement with the expressed convictions about the relative importance of the various benefits afforded by open space recorded in the previous section of the survey instrument. The coefficient on *NATURAL* is strongly positive and *AGRICULTURE* strongly negative reflecting respondents' earlier emphasis on aesthetics, wildlife habitat, and water supply over jobs, income, and food supply. The coefficient on *PARKS* was modestly negative but not statistically significant. Proximity to open space generally allows respondents to enjoy greater benefits, and thus is likely to be more highly valued; the program location attribute results reflected this expectation, a result consistent with the distance decay found in other valuation studies (e.g., Bateman et al. 2006;Hanley, Schläpfer, and Spurgeon 2003). Respondents strongly preferred the location of program acreage nearer to their residence, indicated by the strongly positive and statistically significant coefficient on *CITY* while increasingly distant locations, *COUNTY* and *REGION*, received increasingly negative coefficients.

We would generally expect respondents to prefer greater acreage in a program to less acreage, all else being equal, and thus would expect the greatest acreage (i.e., the coefficient on *AC5000*) to receive the highest utility score. If however, some respondents consider the existing quantity of open space in their area to be nearly at the desired level, they may prefer lower acreage enrollment in a preservation program if they believe that enrollment of larger areas may generate an excessive tax burden or allocate too great a share of the landscape to open space, precluding other land uses. Estimation results indicate *AC1000*, the lowest acreage level, to be the preferred area for preservation programs. The coefficient on the middle level, *AC2500*, is negative and statistically significant, suggesting that respondents may consider the higher acreage values excessive, perhaps for one of the reasons noted above. The positive coefficient on the *AC5000* variable would seem to contradict this interpretation, but this coefficient is far from statistically significant and thus such an interpretation questionable. Whatever selection criterion is at work, we have no indication that respondents were confused by this portion of the survey instrument, and without evaluation of this attribute beyond the scope of this study an entirely satisfactory explanation of this result is elusive.

Two of six random parameters have statistically significant standard deviations, *PARKS* and *COUNTY*. Neither coefficient itself is statistically different from zero however, indicating that approximately equal numbers of respondents viewed this acreage level positively as negatively. The lack of significance of the standard deviations of the random parameters indicates that preference heterogeneity is not accounted for by the preservation program attributes and suggests that heterogeneity is largely attributable to respondent characteristics.

Five socioeconomic characteristics of respondents were interacted with *ASC* to assess their influence on preferences, and results were largely as expected. Two of these variables (*LOWN* and *MEMBER*) were coded as 0/1 dummy variables, while all others were coded as three-level dummy variables with the middle level used in estimation of the model.

Respondent age had a strong influence on support for preservation programs, as evidenced by the large magnitude and statistical significance of the age variables *AGE1* and *AGE3*. Older individuals may be reluctant to accept the tax burden associated with preservation as their incomes may be relatively low or fixed, and they may believe that the benefits afforded by preservation programs over time may accrue to younger individuals rather than themselves. Older respondents were less likely to support preservation programs in contrast to younger respondents. While younger respondents supported the conservation programs, new residents did not (*NEWRES* coefficient large and statistically significant). The combined result of these two characteristics may seem contradictory, that is, young people are seemingly more likely to have shorter tenure in the state, and one might expect the coefficients to be alike in sign. Many of Florida's new residents are retirees, which is consistent with the agreement in sign between new residents and older individuals. It is sometimes argued that rural residents are averse to regulations that reduce control over land use decisions, and this may have influenced respondents who were landowners (*LOWN*) and showed a strong preference for the status quo. It is generally hypothesized and often found that individuals with higher incomes are more likely to support conservation initiatives. This is consistent with our estimated coefficients on income (*LOWINC*, and *HIGHINC*), although neither proves to be statistically significant in this study. Not surprisingly, the respondent characteristic with the single greatest influence on the likelihood of support for preservation programs was membership in an environmental organization (*MEMBER*).

Variables describing respondents' local landscapes were interacted with the *ASC*, thus treated in the same fashion as the socioeconomic characteristics. We hypothesized that the greater the share of agricultural/forestry land uses would result in lower values for conservation programs. This was indeed the case, and the magnitude of the coefficient on *AGSHARE* does significantly affect WTP as discussed below. We posited the same relationship for the share of natural lands in the respondents' neighborhoods, although the coefficient on this variable (*NATSHARE*) was not statistically significant. The same was true for the density of major roads in respondents' local landscape (*LANEDEN*). This may be because the hypothesized relationship is not valid or because our proxy variable for the urban disamenity is not an apt measure. While the coefficient on *COASTDST* was statistically significant, it was relatively small in magnitude. The result indicates that respondents at greater distances from the Florida coast hold lesser preferences for conservation programs, counter to our original hypothesis. This may be because residents who opt to live nearer to the coast hold generally greater preferences for amenity-based lifestyles.

The individual influences on WTP of preservation program attributes are reported in the right hand column of Table 4. As noted, respondents generally prefer some sort of open space preservation to doing nothing, and the disutility level of the status quo situation is the WTP value of the *ASC*, $175.92 per household per year. The value of any combination of program attributes can be constructed from this baseline value by adding each individual WTP contribution to the baseline, and the mean values for open space preservation programs ranged from $81.63 to $266.03 annually per household.

Household WTP estimates were aggregated across Florida's 6.34 million households to provide a basis for evaluating land conservation program expenditures (Table 6). Mean annual household WTP was first multiplied by the number of households in the state to generate the simple annual aggregate WTP range of $518 million to $1.69 billion for the least- and most-valued preservation programs, respectively. Since the makeup of the survey sample significantly deviated from the state's population, this simple aggregation was adjusted to better reflect the state's residents. In the RPL model, age was found to be a statistically significant explanatory variable although income was not. Age was used in our first adjustment, while age and income were used to further refine our aggregate estimate thanks to readily available age-income cross-tabulated data from the 2000 Census (specifically, Summary File 3, Table P055, available at http://factfinder.census.gov). Since our sample overrepresented the mid-age and upper income strata and underrepresented older and low-income residents, groups whose WTP is lower than the estimated baseline level, the resulting adjustments were in a downward direction.

The first adjustment was based on the contribution to WTP derived from the estimated coefficient on respondent age and income in similar fashion to the program attribute combinations. The number of Florida households in each age category was determined from the 2000 Census data, and the number of households in each of nine cross-tabulated age-income categories (3 age groups × 3 income categories) multiplied by their respective WTP. These totals were then summed to obtain the age and income adjusted annual aggregate WTP. Taking into consideration the age and income characteristics of Florida residents, we estimated the annual aggregate WTP range from $301 million to $1.37 billion.

The second adjustment takes into account the four local landscape variables that were estimated in the model. Since the Census data is spatially referenced and polygon shapefiles are readily available, our geographic variables were combined with the age and income data to generate a WTP representation for the entire state (Figure 3). The household WTP surface represents the mean value for each 1 ha raster cell in the state. Our adjustment using the geographic variables resulted in potentially negative WTP values for the lowest-valued conservation plan alternative portrayed in Figure 3 and Table 6. All such values were converted to a zero since we view negative WTP values in this context to be inappropriate. Incorporating the landscape variables into the analysis resulted in an estimated annual aggregate WTP of $253 million to $1.40 billion for the highest- and lowest-valued programs, respectively.

Conclusions

This study developed a method to supplement the standard choice experiment valuation instrument with geographic data about respondents in order to assess their effect on demand, and give some indication as to the degree to which political and economic jurisdictions coincide for the types of conservation programs contemplated here. Our results indicate that the distribution of people and resources across the landscape does matter to valuation of the goods measured in this study. Although distinct from the distance decay noted in other studies noted above, the spatially sensitive demand response observed here is substantial. A serious shortcoming of this study is its limited sample size, which may account for the curious estimation result with respect to the acreage attribute. Nevertheless, the results do give some indication that at least for some of the conservation programs evaluated here, some Florida residents have nonpositive values. The political jurisdiction for programs like Florida Forever is the entire state of Florida, although our results indicate a lack of congruence with the economic jurisdiction for land conservation programs in the state. While for the higher-valued conservation programs economic and political jurisdictions do appear to coincide, they diverge for the lower-valued programs, with the result that aggregate WTP for conservation programs is significantly affected.

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Table 1: Program attributes and attribute levels.

Attributes	**Attribute levels**		
(1) Type of Land	agricultural (row crops, pastures, or groves)	forest, wetlands or other natural area	public parks and recreation area
(2) Size of Tract	1,000 acres	2,500 acres	5,000 acres
(3) Location	< 10 miles of town	within county	within region
(4) Annual cost (for 5 years)	$25/house/yr	$50/house/yr	$75/house/yr

Table 2: Characteristics of survey respondents compared to all Florida households.

Characteristic		**Survey respondents (%)***	**All Florida households (%)**
Length of residency in state (years)	0-5	12	-
	6-29	52	-
	30 or more	37	-
Age (years)	18-29	11	12
	30-59	76	54
	60 or more	12	35
Education	Up to HS degree	8	-
	College (some or degree)	68	-
	Advanced degree	24	-
Income ($)	Less than 25 K	8	31
	25 K to 99.9 K	61	59
	100 or more	32	10
Residence location	Urban	34	-
	Suburban	50	-
	Rural	16	-
Gender	Female	53	51
Homeowner		79	70
Own 10 or more acres of ag., forestry, or natural land		7	-
Member of environmental organization		25	-

* Percentages may not sum to 100 due to rounding.

Table 3: Variable definitions.

Variable	Description
	Preservation program attributes
Type of land to be protected	
AGRICULTURE	Row crops, pastures, groves, tree farms
NATURAL	Forests, wetlands, and other natural areas
PARKS	Public parks and recreational areas
Area of land to be protected	
AC1000	1,000 acres
AC2500	2,500 acres
AC5000	5,000 acres
Location of land to be protected	
REGION	Anywhere within respondent's multi-county region
COUNTY	Anywhere within respondent's county
CITY	Within 10 miles of respondent's town/city
COST	Annual household cost of establishing and maintaining conservation program ($25, $50, $75)
ASC	Constant
	Respondent local landscape characteristics
AGSHARE	Percent of land within 20 km radius of respondent dedicated to agricultural or forestry uses
NATSHARE	Percent of land within 20 km radius of respondent dedicated to conservation purposes
LANEDEN	Density of lanes (km lanes/km^2) of major roads* within 20 km radius of respondent
COASTDST	Respondent's distance from the coast (km)
	Respondent socioeconomic characteristics
NEWRES	Resident 0-5 yrs.
*MEDRES***	Resident 6-29 yrs.
OLDRES	Resident 30+ yrs.
AGE1	Age 18-29 yrs.
*AGE2***	Age 30-59 yrs.
AGE3	Age 60+ yrs.
LOWINC	Income < $25K
*MEDINC***	Income $25-99.9K
HIGHINC	Income $100+
LOWN	Owner of 10 or more acres of ag., forestry, or natural land = 1; nonlandowner = 0
MEMBER	Member of environmental organization = 1; nonmember = 0

* Local, collector, and arterial DOT functional classes; ** Indicates base level of dummy-coded variable.

Table 4: Estimated coefficients, standard deviations, and WTP effects for preservation program attributes

Variable	**Coefficient**	**Std. Error**	***p*** **<**	**ΔWTP**
COST	-0.0182	0.0077	0.0184	-
AGRICULTURE	-1.0216	-	-	-56.00
NATURAL	0.9268	0.2656	0.0005	50.80
PARKS	0.0948	0.1448	0.5128	5.19
AC1000	0.3732	-	-	20.45
AC2500	-0.4711	0.1709	0.0058	-25.82
AC5000	0.0980	0.1145	0.3921	5.37
REGION	-0.2276	-	-	-12.48
COUNTY	-0.1164	0.1140	0.3070	-6.38
CITY	0.3440	0.1800	0.0559	18.86
ASC	-3.2094	0.6953	0.0000	-175.92
Standard deviations of parameter distributions				
NATURAL	0.3215	0.4350	0.4598	
PARKS	1.7372	0.8966	0.0527	
AC2500	0.5912	0.5891	0.3157	
AC5000	0.3449	0.5478	0.5290	
COUNTY	0.8041	0.4661	0.0845	
CITY	0.3709	0.4063	0.3614	
Adjusted R^2	0.2676			
Log *L*	-1000.093			
N	1520			

Table 5: Estimated coefficients for landscape variables respondents' socioeconomic characteristics.

Variable	**Coefficient**	**Std. Error**	***p* <**
AGSHARE	0.01968	0.0085	0.0204
NATSHARE	0.01229	0.0108	0.2551
LANEDEN	0.00823	0.1237	0.9470
COASTDST	1.224 E-5	5.048 E-6	0.0154
NEWRES	0.8000	0.3626	0.0274
OLDRES	-0.3994	0.2870	0.1640
AGE1	-0.8033	0.4820	0.0956
AGE3	0.8624	0.3664	0.0186
LOWINC	0.2150	0.4470	0.6306
HIGHINC	-0.1448	0.2778	0.6022
LOWN	1.0676	0.4489	0.0174
MEMBER	-1.7376	0.4267	0.0000

Table 6: Aggregate annual WTP for highest- and lowest-valued open space preservation programs.*

	Highest	Lowest
Simple	$ 1.69 B	$ 0.518 B
Age and income adjusted	$ 1.65 B	$ 0.478 B
Age, income, and geography adjusted	$ 1.40 B	$ 0.253 B

* Highest-valued plan has natural area/1,000 ac/city attributes; lowest-valued plan has agricultural land/2,500 ac/region attributes.

Program Options	*Program A*	*Program B*	C
Type of land to be conserved	Agricultural	Forest/ wetlands/ natural areas	Not interested in either program
Area of additional land to be conserved	1,000 Acres	5,000 Acres	
Location of land to be conserved	Within 10 miles of your town/ city	Anywhere within your county	
Annual per household public expenditure (for 5 years)	**$50**	**$25**	**$0**

Please mark the CHOICE you would prefer: A ☐ B ☒ C ☐

In this example, the respondent preferred Choice B over Choices A and C

Figure 1: Example survey instrument choice set.

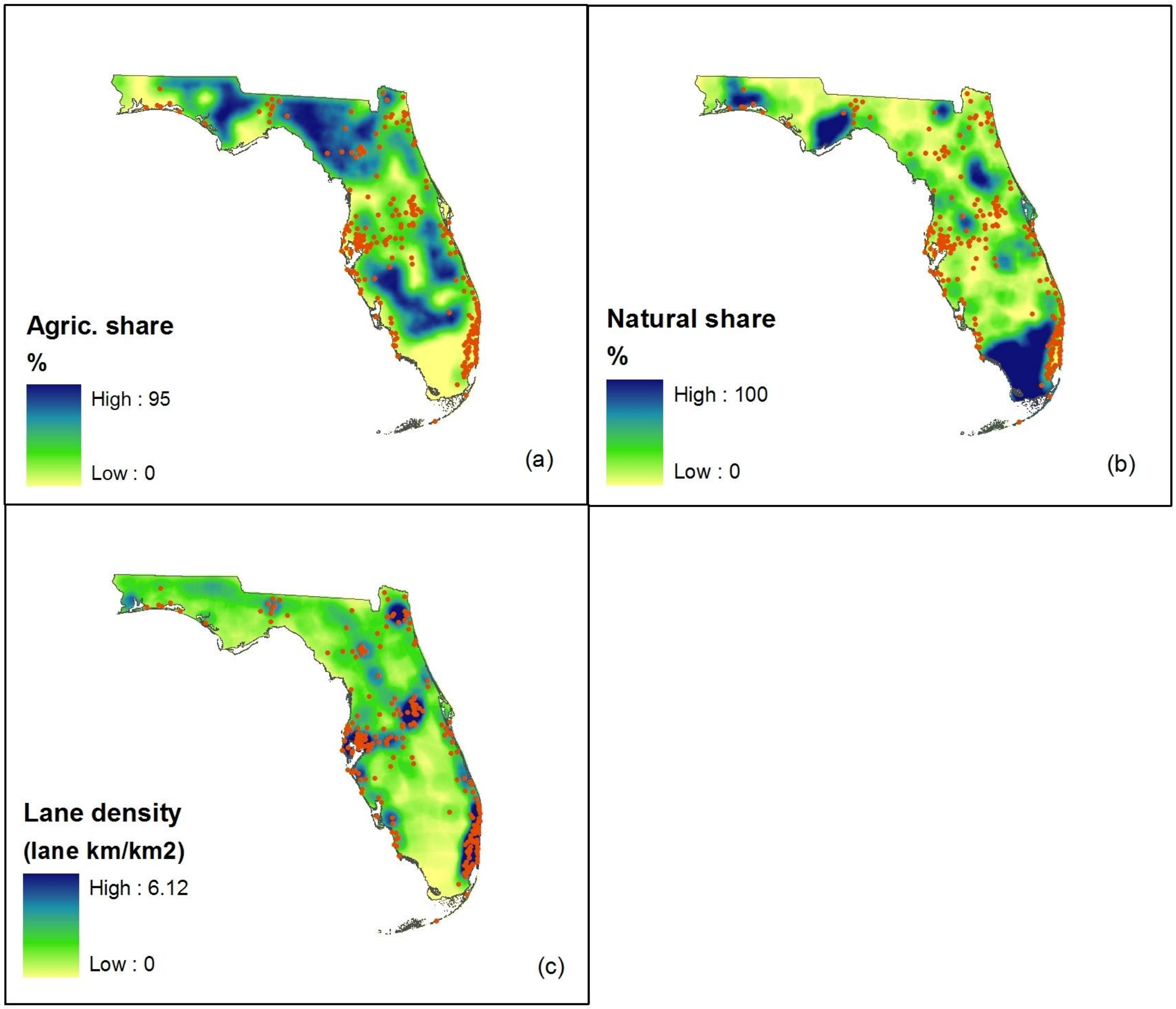

Figure 2: Statewide values for local landscape variables used in RPL model (a: *AGSHARE*; b: *NATSHARE*; c: *LANEDEN*). Orange circles indicate sample locations.

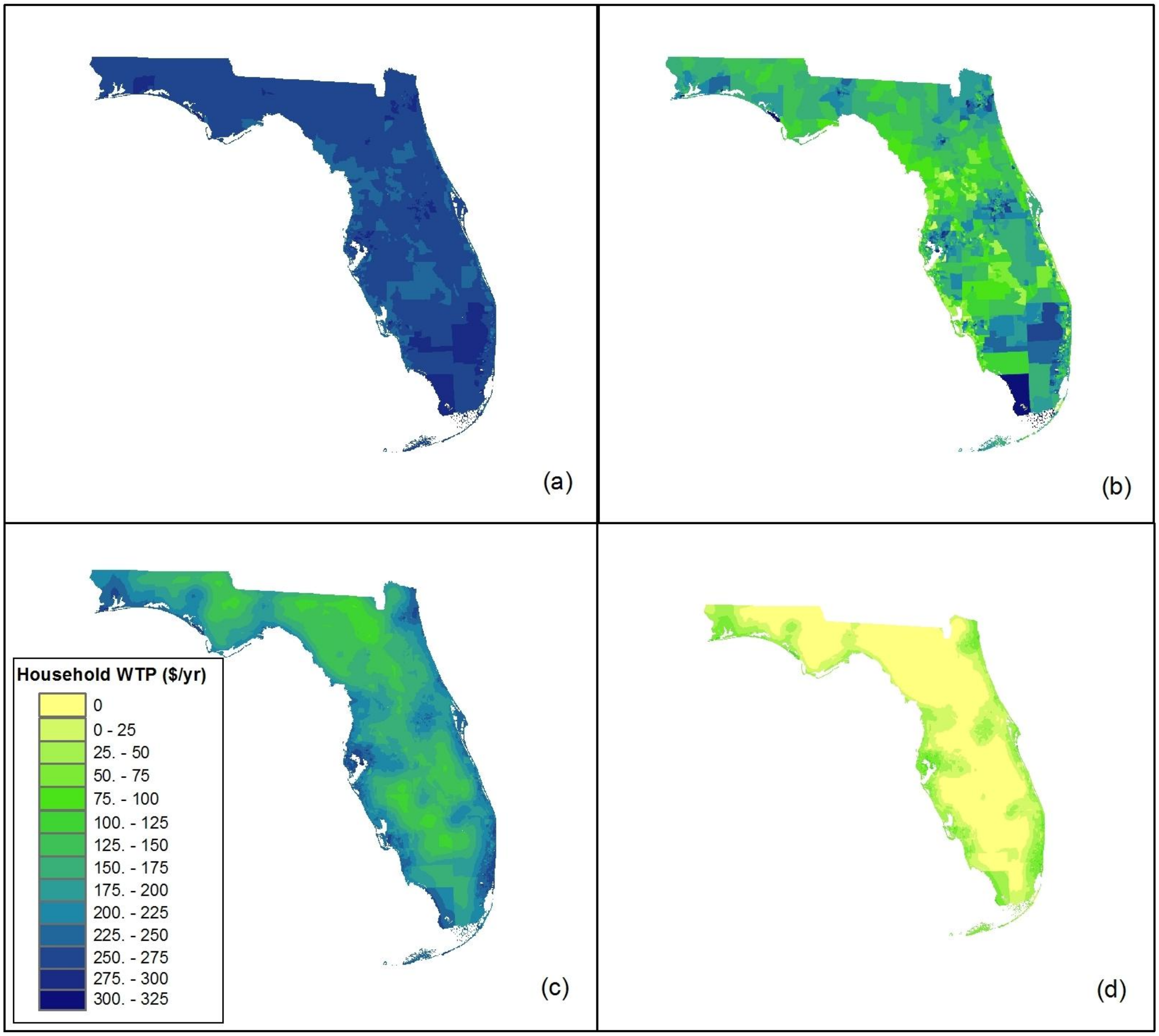

Figure 3: Household WTP for the highest-valued (a and c) and lowest-valued (b and d) conservation programs. Top panels consider only households' age and income characteristics, bottom panels account for local landscape effects on respondent WTP values. Values represented are the mean household WTP for each 1 ha cell.