Farm versus Forest: Physical Scarcity and the Role of Non-convex Preferences in the Valuation of Open Space

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Introduction

Development pressures emanating from regional urban centers increasingly motivate rural communities to evaluate the relative benefits of "economic development". Historically, local officials have often assumed that economic development requires conversion of a relatively natural, forested, or agricultural landscape to commercial, industrial, or residential use----leading to long-standing policies that encourage land conversions (Freedgood 1997; Nickerson 2001). Such patterns continue, despite, in many cases, abundant evidence that rural environmental quality constitutes the primary attraction that existing residents or potential immigrants seek in rural communities (Powers 1996).

In response to the loss of rural amenities to residential and commercial development, many public and private non-profit agencies are seeking to develop farmland and open space conservation programs that provide for the interest of the general public (Babbitt 1999; Furuseth 1987; Freedgood 1997). Because market signals are absent with regard to the values rural residents place on various types of undeveloped land, and given limited information regarding rural residents' demand for local farm and forest amenities (e.g., Kline and Wichelns 1994; Halstead 1984; Bergstrom et al. 1985; Beasley et al. 1986; Waddington 1990), analysts often ground rural conservation and development policies on familiar economic principal. These principles suggest that assessing the value of services provided by an additional (i.e., marginal) acre of land provides an economically defensible guide to setting priorities for which acres to protect. More specifically, land conservation policy is often based on the intuitively reasonable assumption that the highest marginal values are placed on those farm and forest amenities that are in the shortest supply (Beasley et al. 1986; Gardner 1977). That is, policy targeting conservation of a more scarce land cover (e.g., targeting farm preservation in a predominantly forested community, or forest land conservation in a farmland community) often seems intuitive on economic grounds (Feather et al. 1999; Vincent and Binkley 1993).

The economic foundation of previous belief is that preferences exhibit diminishing marginal valuations, resulting in a higher marginal value arises from amenities that are in relatively more scarce supply. Economists describe marginal values that fail to satisfy the assumption of diminishing marginal valuation as a nonconvexity. If preferences do not satisfy this prerequisite assumption, policies driven by marginal valuation do remain relevant, but their application and policy implications can become substantially more complicated (e.g., Anderson and Francois 1997; cf.: Baumol and Oates 1988; Burrows 1986; Helfand and Rubin 1994; Swallow et al. 1990). For example, in forest management, nonconvexity in values can create a public interest in land-use specialization (Swallow et al. 1990; Vincent and Binkley 1993). In this context, land-use specialization is contrary to the usual economic intuition, which recommends balancing marginal benefits and opportunity costs on each land management unit (Swallow et al. 1990; Swallow and Wear 1993).

Several reasons might contribute to nonconvexity in values. People often seek to live in place that has the features they desire. This is often referred to as “voting with their feet” by economists. In term of land conservation, households “vote with their feet” for environmental quality (Banzhaf and Walsh 2008), meaning people who like forest land are more likely to live in a place that is predominantly forest and they place higher marginal value on one more acre of forest than farm.

By contrast, economists have begun to recognize that context, or an individual’s frame of reference, is highly relevant in determining preferences for rural amenities (cf. Frank 1989). For example, in a unique theoretical contribution, Anderson and Francois (1997) argue that individual preferences over some public goods violate economists’ usual assumptions, and exhibit nonconvexity, because the marginal enjoyment of the good can be positively linked to the overall level of availability of the good. Preferences for rural landscape amenities may well fit Anderson and Francois's conditions. For example, if an individual strongly prefers the visual aesthetics of an open agricultural landscape, then the value of preserving an additional acre of farmland may be higher if the individual's community is dominated by farmland rather than by forest. On the other hand, if the same individual happens to live in a community that is dominated by forest land, she would put more marginal value on additional one more acres of forest rather than of farmland, even though the individual strongly prefers open agricultural landscape. In the latter case, the provision of one more acre of farmland doesn't change the land cover scheme to a vast open agricultural land which she prefers, but rather makes the already existing character of the community (i.e., forest landscape) less prominent. From an aesthetic point of view, a landscape with character is better than a scattered one. In this case, it's not just people "vote with their feet", but they would in some sense "change" their preference based on their community landscape character.

In this paper, we test residents' nonconvex preference towards hypothetical landscape conservation program by using a survey conducted in four counties in the state of Rhode Island. We chose these four counties to represent different land cover type in terms of forest and farmland based on their geographical information. By using a method similar to counterfactual analysis in the context of discrete choice model, we are able to distinguish between residents' "voting with their feet" and "changing" their preference based on their community character.

Conceptual Model

In the survey, respondent was asked to choose between "Program A", "Program B", or "Neither" that can provides her the greatest satisfaction or "utility". The "neither" option would be presented in a format consistent with the presentation of the two policy alternatives, Program A and B. Each alternative will be described by a bundle of attributes, namely the amount of forest land and farm land to conserve. Also included is monetary cost to the respondent's household, in terms of increases in household taxes required to implement the chosen program. The "neither" option is described as no conservation program to implement and no additional taxes to be levied, which indicates status quo. Econometric analysis proceeds on the assumption that respondent i chooses the program alternative, j, which provides the greatest satisfaction:

$$U_{ij} = U(X^j, Y_i - F_j, D_i) = v(X^j, Y_i - F_j, D_i) + \varepsilon_{ij} \quad (1)$$

where j = A, B, N, for program A, B or Neither; X^j represents a vector of characteristics of alternatives, A, B, or N; F_j is the increase in household taxes for the respondent's household if alternative j is implemented; $U(.)$ is a utility (or satisfaction) function that takes higher values for alternatives that the respondent ranks most favorably; $v(.)$ is an econometrically estimable part of utility; and ε_{ij} is an unobservable component of the respondent's utility for alternative j, modeled as a random error. This follows from the classic random utility model (e.g., McFadden 1974; Hanemann 1984). Here, Y_i represents the respondent's household income and D represents a vector of variables describing the respondent's community and demographic or environmental attitude characteristics on which satisfaction with alternative j may be conditional. Assuming ε_{ij} is independently and identically distributed (i.i.d.) and follows Gumbel distribution, the probability of individual i choosing program j (i.e., Plan A, Plan B or Neither) is given by:

$$\prod_{ij} = \frac{\exp(v_{ij})}{\sum_{j'} \exp(v_{ij'})} \quad (2)$$

where $j' \in \{\text{Plan A}, \text{Plan B}, \text{Neither}\}$; $v_{ij} = v(X^j, Y_i - F_j, D_i)$.

Since we hypothesize there are different types of residents (pro-farm, pro-forest, etc.) existed in the four counties in our study, we must account for heterogeneity. Latent Class Model (LCM) is a good way to capture this, as it assumes there are a finite number of types (classes) of people in the sample. Unlike mixed logit model, which adopts a continuous distribution of heterogeneous people, LCM is more suited for our study, as our respondents' preference can be quite different (cf., Boxall and Adamowicz 2002). LCM assumes that each class has a unique preference function, and each respondent can be matched to one of the classes with a probability function based on their social-demographic characteristics. Formally, the probability of individual i in class q is given as:

$$\mathbb{Pr}_{iq} = \frac{\exp(\beta_q D_i)}{\sum_{q'} \exp(\beta_{q'} D_i)} \tag{3}$$

where q' is an index across all classes {1,2,3,…,Q}; β_q is a vector of parameters. For each specific class q, the probability of individual i choosing alternative j is give as:

$$\prod_{ijq} = \frac{\exp(\lambda_q v_{ijq})}{\sum_{j'} \exp(\lambda_q v_{ij'q})} \tag{3}$$

where λ_q is a parameter for each specific class; v_{ijq} is class specific utility function. Finally, the probability of individual i choosing alternative j is given as:

$$\mathbb{Pr}_{ij} = \sum_q \mathbb{Pr}_{iq} * \prod_{ijq} = \sum_q \frac{\exp(\beta_q D_i)}{\sum_{q'} \exp(\beta_{q'} D_i)} * \frac{\exp(\lambda_q v_{ijq})}{\sum_{j'} \exp(\lambda_q v_{ij'q})} \tag{4}$$

Now we can construct respondent's willingness to pay (WTP) for a particular program rather than the no-action alternative as:

$$U(X^j, Y - WTP_j, D) = U(X^N, Y - 0, D), \text{ for j=A, B,} \tag{5}$$

Note the individual indicator i is omitted for simplicity. We note that this approach to analysis explicitly allows for a potential relationship between WTP, the respondent's household income, Y, and variables describing the demographic attributes or environmental attitudes, or motivations, of the individual, as components of D. We will explicitly denote these demographic, attitude, and motivation descriptors as D_D. In addition, components of D would describe the essential features of the respondent's residential community, and we denote these community descriptors as D_C. Thus D is divided into two sub-vectors of independent variables, so $D = (D_D, D_C)$, and an individual's WTP for program j is a function, defined as $wtp(.)$:

$$WTP_j = wtp\left(X^j, Y, D_D, D_C\right) \quad (6)$$

The dependence on the attributes of the no action alternative, X^N, is implicit and omitted for brevity.

Outline of Hypothesis Testing

In this study, we mainly focus on two types of landscape, wooded land-cover and forest land-cover. Therefore, an initial test of whether unanticipated public preferences exist will involve finding a positive relationship between WTP_j and D_{Ct}, such that

Hypothesis 1 Null: $\partial wtp/\partial D_{Ct} = 0$

Alternative: $\partial wtp/\partial D_{Ct} > 0$

where D_{Ct} represents the value of an element of D_C that measures the quantity of land in a particular land type t, with t representing either agricultural land-cover or wooded land-cover $(t \in \{a, w\})$.

A second way to test public preferences and an extension of Hypothesis 1 involves a direct comparison of per-acre willingness to pay for maintaining a marginal acre of land-cover type t in communities with differing quantities and proportions of the two prominent land-cover types, agricultural and wooded. Formally, it is given as:

Hypothesis 2 Null: $\partial wtp/\partial D_{Ca} = \partial wtp/\partial D_{Cw}$ given $D_{Ca} > D_{Cw}$

Alternative: $\partial wtp/\partial D_{Ca} > \partial wtp/\partial D_{Cw}$ given $D_{Ca} > D_{Cw}$

This second approach is technically not independent of the evaluation of Hypothesis 1, but it would have the advantage of presenting the results in a format of greater accessibility to policy planners and conservation stakeholders, and it would allow a qualitative judgment of the practical magnitude of the relationship found.

We use likelihood ratio test to examine these two hypothesizes, which will give us a basic picture of the structure of public preferences. Notice that both of these hypotheses don't distinguish between "voting with their feet" and "changing" their preference based on their town community character, as discussed in the previous section. It could be the case that our sample is filled with residents "voting with their feet", and most of the residents in other places don't have the ability to choose where to live based on their preference for forest land or farm land. Therefore we lose a great amount of external validity on this test. Since there's no way of knowing people's reason of residing where they are for sure, we need a strategy to control self-selection bias.

Counterfactual analysis is often used by economists who study impact evaluation. The basic idea is, if we want to know the impact of a certain intervention, we need to have "a comparison between what actually happened and what would have happened in the absence of intervention" (White 2006; cf., Gertler 2011). In the context of our study, if we observed that residents in a predominantly wooded land community have higher marginal WTP on additional acres of wooded land than farm land, we need their marginal WTP on both land-cover type had they not live in a community that is dominated by wooded land (i.e., a predominantly farm land town). Since we can't observe an individual who simultaneously lives in two different location, later we propose a strategy similar to constructing counterfactual in the literature of impact evaluation. To put our hypothesis formally:

Hypothesis 3

Null: $$\left\{\frac{[\partial wtp/\partial D_{Ca}]}{[\partial wtp/\partial D_{Cw}]} \text{ given } D_{Ca} > D_{Cw}\right\} = \left\{\frac{[\partial wtp/\partial D_{Ca}]}{[\partial wtp/\partial D_{Cw}]} \text{ given } D_{Ca} < D_{Cw}\right\}$$

Alternative: $$\left\{\frac{[\partial wtp/\partial D_{Ca}]}{[\partial wtp/\partial D_{Cw}]} \text{ given } D_{Ca} > D_{Cw}\right\} > \left\{\frac{[\partial wtp/\partial D_{Ca}]}{[\partial wtp/\partial D_{Cw}]} \text{ given } D_{Ca} < D_{Cw}\right\}$$

This hypothesis assesses whether the composition of community's land-coverages will alter the rate at which residents are willing to exchange acres of land maintained in different land-covers. In particular, the Alternative in Hypothesis 3 indicates that, if preferences exhibit unanticipated forms, then, contrary to the usual economic intuition, respondents with similar demographic and environmental attitudes will prefer to exchange an acre of the more scares land-cover type to maintain an additional acre of the more abundant land cover type, rather than the converse. If the average respondent exhibits preferences consistent with the usual economic intuition, then either the test will fail to reject the null hypothesis or an inequality marginal rate of substitution's in the equation will be opposite to that listed in the Alternative.

Study Location

For this study, we select four towns in the state of Rhode Island to run our choice experiment. These four towns represent different types of land-cover. As can be seen in Figure 1, Little Compton (LC) and Richmond (RM) are mostly rural, while Portsmouth and Middletown are mostly developed, or non-rural. While RM is mostly covered with forest land, LC has a lot more farm land. Here we mainly use RM and LC to form a contrast in our study, while taking Portsmouth and Middletown as a baseline. Note that even though LC is not predominantly covered by farmland, but given the fact that 59 percent of the land in Rhode Island is covered by forests and only 9 percent of land is covered by farmland, LC may well be suited as a comparison (Butler 2014). Later we will show that the residents of said area do agree with our conjecture.

Survey Design

The survey includes three major parts:

1. Social demographic questions, including respondent's childhood home background, age, income, education, etc.
2. 34 (17*2) Likert-scale questions ask respondent's general attitudes towards various features of land-cover type. The first 17 are about their actual town description; the second 17 are about how important these features are in their residing location decision making process.
3. Two choice questions where in each one respondent is asked to choose among two program alternatives (Program A, Program B) and one "Neither" option (status quo).

Figure 2 shows an example of our survey.

Survey was mailed to Rhode Island residents using the Total Design Method (Dillman 1978; 2000).

Variables Description

For ease of computation, we use principal component factor analysis in Stata to reduce the 34 Likert-scale questions into 3 continuous variables, each one of them shows a distinctive pattern of respondents' attitude towards community land-cover type. Table 1 illustrates the factor loadings after orthogonal varimax rotation using Stata. Noted, our initial analysis gives us 9 factors with eigenvalue larger than 1, we only pick 3 with highest value instead of following common practice of using all 9. This is because in our study, the attitude variables are only used to control our counterfactual analysis and the first three shows a distinctive pattern, also they can explains 38 percent of variation in the answer to Likert-scale questions. All of the numbers in Table 1 are normalized. By the design of our Likert-scale coding (see footnote of Table 1), the higher the factor loading, the higher the level of agreement that respondent have to the statement. Factor 1 describes respondents who state that their towns have actual rural character, such as providing rural living, wooded landscape, farm landscape, experiencing wildlife, stars at night, outdoor recreation. Factor 2 represents those respondents who believe the aforementioned characters are important in their decision of choosing where to live. It is interesting to see that the people who lives in rural community don't necessarily align with people who seek rural character, indicating "voting with their feet" might not be the common practice in our study area. Factor 3 tends to represent respondents who choose their residing location based on their extended family and childhood home town type. Based on all these characteristics, hereinafter we will label factor 1 "Rural", factor 2 "Pro-Rural" and factor 2 "Family". By using varimax rotated factors, we create three continuous variables under the name of previously mentioned labels (see Milan and Whittaker 1995).

Table 2 is a list of variables and their description. Note that we create a dummy variable equals one when factor scores are missing, this is because 40 percent of respondents didn't answer at least one Likert-scale question. Instead of throwing these observations out, we resolve it in this way to preserve computational power.

Empirical Result

First, we test whether residents in our study area agree with our conjecture that previously mentioned in the section "study location". Table 3 shows correlation coefficient between four town dummies and respondents' answer to statement 2 (rural living), 3 (suburban living), 4 (wooded landscape) and 6 (farm landscape) in part 1 (town description) of our Likert-scale questionnaire (see Table 1). As Table 3 demonstrates, residents in RM and LC are more willing to agree that their town provides rural living; residents in PM and MT are more willing to agree that their town provides suburban living. In terms of forest land versus farm land, RM residents think their town provides wooded landscape view, but not a lot of farm land; while LC residents think their town provides both landscape views, but more on farm land. This is to show that RM and LC are well suited to be the contrast in our study, and as PM and MT to baseline. From now on, $D_{Ca} > D_{Cw}$ (i.e., the town which has more farmland than forest land) in our hypothesis will be represented by LC, and $D_{Cw} > D_{Ca}$ by RM. Also note that, despite Figure 1 shows quite amount of farm land in both PM and MT, forest land in PM, neither of their residents views their town in this way.

We adopt a linear indirect utility function form for our empirical model. Formally, it is given as:

$$v\_ij = No \cdot (\alpha + \alpha\_lv \cdot likelytovote + \alpha\_LT \cdot LT + \alpha\_RM \cdot RM + \alpha\_ltr \cdot lengthtownresidence + \alpha\_g \cdot gender + \alpha\_a \cdot age + \alpha\_rent \cdot rent + \alpha\_inH \cdot incomeH + \alpha\_inmiss \cdot incomemiss + \alpha\_r \cdot rural + \alpha\_pr \cdot prorural + \alpha\_dfm \cdot Dfacmiss) + \beta\_cost \cdot cost + acresfarm \cdot (\mu + \mu\_RM \cdot RM + \mu\_LC \cdot LC + \mu\_ca \cdot childagri + \mu\_cw \cdot childwooded) + acresforest \cdot (\lambda + \lambda\_RM \cdot RM + \lambda\_LC \cdot LC + \lambda\_ca \cdot childagri + \lambda\_cw \cdot childwooded) \quad (7)$$

The estimation of LCM involves choosing the number of classes, Bayesian Information Criterion and Consistent Akaike Information Criterion are commonly used (Green and Hensher 2003; Kafle et. al. 2014). The general rule of thumb is to choose the one with the lowest number. Table 4 shows that 2 classes is the best fit for our sample. All of our hypothesis testing will be based on the two classes model.

Table 5 presents the estimation of our empirical model. We used a Stata module called lclogit to estimate our model (Pacifico and Yoon 2012). It implements Expectation-Maximization algorithm rather than the traditional quasi-Newton methods, which potentially solves the stability problem (Shen 2009; Green and Hensher 2003). Such implementation can also be found in commercially available discrete choice model software such as NLOGIT. The membership part of Table 5 describes the probability of individual i in class q. Respondents who view themselves living in rural town are less likely to be in class 1, meaning that residents of PM and MT are more likely to be in class 2.

Hypothesis Testing

For hypothesis 1, we use likelihood-ratio test since the “null” part is indicating that where respondent lives doesn’t impact his or her WTP, which in our empirical model indicates all the parameters involved with location dummy RM and LC are zero. Because the latter model is nested in our unrestricted model, we could use the LR test. Table 6 shows the result of imposing either leaving out RM or LC. Clearly where do respondents live have an impact on their preference toward landscape and land conservation program.

For hypothesis 2, we first estimate respondent’s marginal WTP for one more acre of farmland and one more acre of forest land given either she is a resident of RM (i.e. RM=1 in equation (7)) or resident of LC (i.e., LC=1 in equation (7)). They we calculate the sample mean marginal WTP. Table 6 reports the result and the difference in mean t test. The result shows that residents in RM do favor forest land more than farm land. Residents in LC shows the same pattern, but in a lesser magnitude. These results are confounded by self-selection bias, so we need to find a way to disentangle that out in order to make better policy implications.

For hypothesis 3, first we note that equation (7) is a representative utility function for all of our samples. So RM=1 and LC=0 indicates a person living in RM, but if we change reverse this two values (RM=0 and LC=1) while keeping other variables at the same value, we potentially create a counterfactual of that same person, as if we moved him or her from RM to LC. Based on that, we could create a counterfactual for every resident in LC and RM. By comparing resident's actual WTP for an additional acre of forest land and farmland to her counterfactual self's WTP for an additional acre of forest land and farmland, we essentially have the pure impact of changing town character to her preference regarding landscape. That is to say, we can tease out the self-selection bias, or "voting with their feet" effect that has been discussed previously. Table 7 shows the preliminary result of this. Based on the result, we can see that if resident of RM moves to LC, her WTP for additional acre of farmland will increase (from $4.1 to $7.8) and of forest land will decrease (from $9.3 to $8.1). The opposite change happens when resident of LC moves to RM. This is consistent with our hypothesis that the predominant landscape in your town will make you relatively more in favor of that landscape, compare to your original preference.

Conclusion

These preliminary results show that residents of our study area do show signs of noncovex preference. At local level (Hypothesis 2), the result is not very clear. But after we controlled for self-selection bias (Hypothesis 3), the message is much stronger and of better external validity, too. This suggests not only do we need the re-assessment of land conservation guidance at the federal or state level, but also include a proper interpretation of this new information at the local (e.g., town and county) level.

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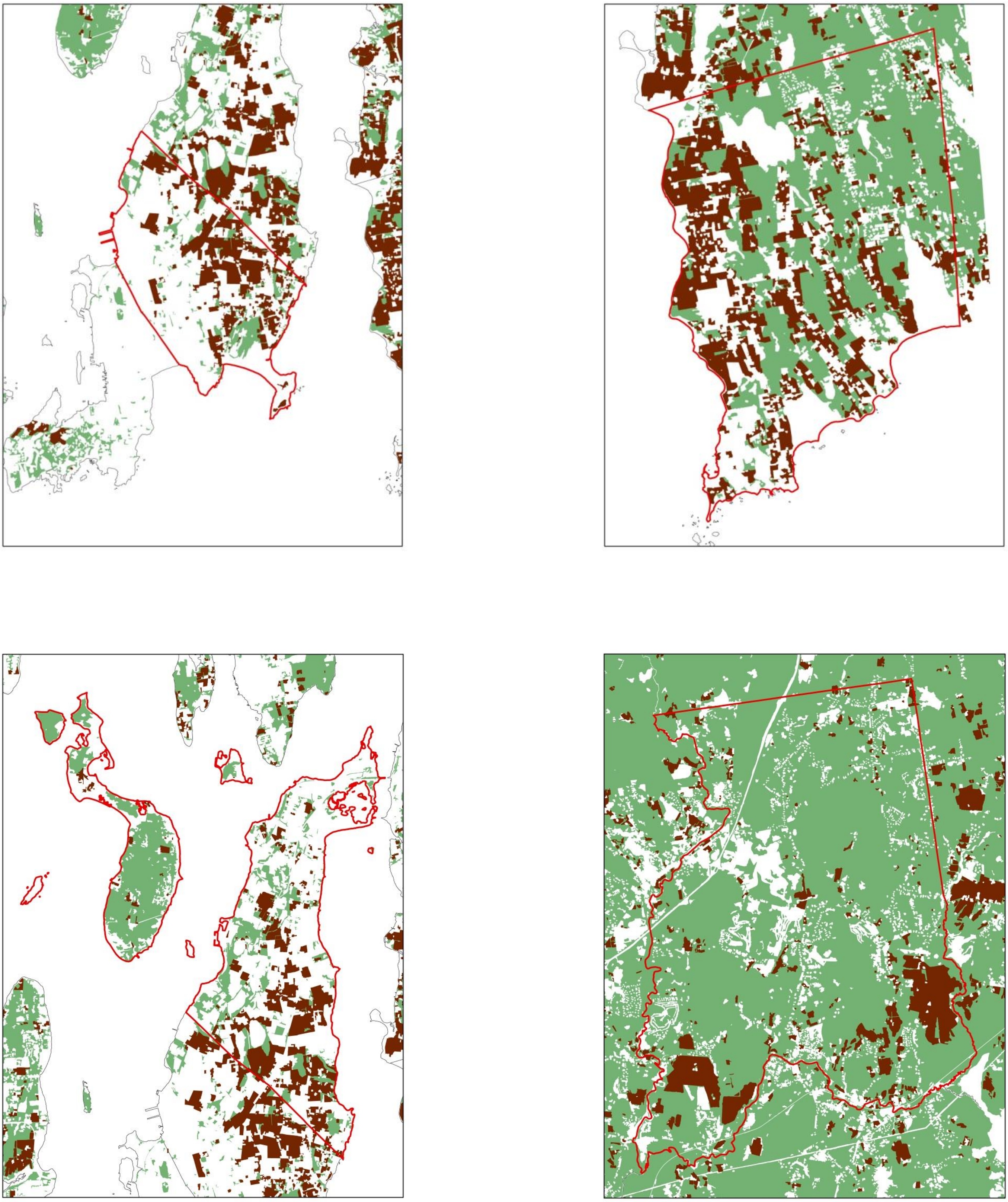

Brown area: Farmland
Green area: Forestland

Figure 1

Top Left: Middletown
Top Right Little Compton
Bottom Left: Portsmouth
Bottom Right: Richmond

Data source: RIGIS, 2015. Rhode Island Land Use and Land Cover 2011

Table 1 Factor Loadings of Likert-scale Attitudes Questions

Question	Factor1 Rural	Factor2 Pro-rural	Factor3 Family
My town provides a reasonable location for travel to employment or daily activities for me and my family	-0.0816	-0.1278	-0.0481
	-0.1644	0.1677	-0.2597
My town provides rural living	**0.7903**	0.0971	-0.0329
	0.3137	**0.6201**	-0.0751
My town provides suburban living and residential neighborhoods	-0.2579	-0.2408	-0.045
	-0.069	0.2361	-0.0243
My town provides a wooded landscape	**0.8027**	0.1349	-0.0317
	0.3541	**0.5738**	-0.1326
My town provides an affordable place to live	0.4303	0.0154	-0.2784
	0.1727	0.2582	-0.3377
My town provides a farm landscape view	**0.6831**	0.2164	0.1138
	0.1941	**0.6974**	0.0729
My town allows me to experience wildlife	**0.7704**	0.254	0.0099
	0.2816	**0.6936**	0
My town offers good schools	0.2047	-0.0258	0.1998
	-0.0105	0.2128	0.0821
My town offers a place where I can see the stars at night	**0.6642**	0.1345	0.1099
	0.1362	**0.6863**	0.0391
My town is near access to outdoor recreation (hiking, canoeing, hunting, etc.)	**0.6714**	0.2004	0.0422
	0.1387	**0.6556**	0.0525
My town is close to my extended family	-0.0102	-0.0762	**0.7176**
	-0.0556	0.1274	**0.6602**
My town offers an urban center surrounded by outdoor amenities or rural character	0.1799	-0.0562	0.2882
	0.0373	0.3484	0.1156
My town has good commercial amenities and services	-0.1281	-0.2015	0.0838
	-0.1594	0.2246	0.0673
My town is a good place for children to grow up	0.462	0.0292	0.2261
	0.0278	0.3149	0.1927
My town reminds me of where I grew up	0.1131	-0.0971	**0.6723**
	0.0734	0.3361	**0.5666**
My town is more suburban than where I grew up	-0.4166	-0.0728	0.137
	-0.0056	0.4742	0.1071
My town is more rural than where I grew up	**0.5036**	0.2479	-0.4166
	0.2791	**0.6052**	-0.1559

For each question, the number on top is the answer to question "How accurately does each statement describe your town?", where the answer ranges from Not Accurate (1) to Very Accurate (4); the number on the bottom is the answer to question "How influential was each factor in your decision to move to or continue to live in your town?", where the answer ranges from No Influence (1) to Substantial Influence (4).

Table 2 Variable Description

variable	Description
No	Dummy variable equals 1 for "No New Program" alternative and 0 for "Program A" and "Program B"
Acresfarm	Continuous variable equals to the acres of land preserved in program description; equals 0 in "Neither" option
Acresforest	Continuous variable equals to the acres of land preserved in program description; equals 0 in "Neither" option
Cost	Continuous variable equals the increase in taxes for implementing the program; equals 0 in "Neither" option
lengthtownresidence	The number of years respondent lived in this town
gender	Dummy variable equals 0 for woman and 1 for man
age	Respondent's age
rent	Dummy variable equals 1 if respondent rents her home and 0 otherwise
incomeH	Dummy variable equals 1 if respondent's total household income is higher than $60,000 per year and 0 otherwise
incomemiss	Dummy variable equals 1 if respondent didn't report their annually household income and 0 otherwise
likelytovote	Respondent's answer to a 5 points Likert-scale question "how likely would you vote to support one town-wide program rather than choosing no new program if you had another pair of programs to consider", ranging from 1 "very unlikely" to 5 "very likely"
childagri	Dummy variable equals 1 if the area respondent most considered hom when growing up is agricultural land, and 0 otherwise
childwooded	Dummy variable equals 1 if the area respondent most considered hom when growing up is wooded, and 0 otherwise
Rural	Factor score indicating that respondent's town has more rural character
Pro-Rural	Factor score indicating that respondent is seeking rural character when choosing where to live
Family	Factor score indicating that respondent is more family concerned when choosing where to live
Dfacmiss	Dummy variable equals 1 if factor score is missing and 0 otherwise
LC	Dummy variable equals 1 if lives in Little Compton
RM	Dummy variable equals 1 if lives in Richmond
MT	Dummy variable equals 1 if lives in Middletown

Table 3 Correlation Coefficient (Pearson's R)

	Rural Living	Suburban Living	Wooded Landscape	Farm Landscape
Little Compton	0.3288	-0.4812	0.2279	0.3051
Richmond	0.2251	0.008	0.3024	0.0088
Portsmouth	-0.2735	0.2862	-0.2444	-0.1362
Middletown	-0.4139	0.2924	-0.4224	-0.2512

The correlation coefficient is calculated by

$$r = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\left(\sum x^2\right) - \left(\sum x\right)^2}\sqrt{n\left(\sum y^2\right) - \left(\sum y\right)^2}}$$

Table 4 Full Size Model (N=1099)(No membership)

class#	LL(K)	BIC	CAIC
1	-1603.3506(24)	3375	3399
2	-1467.4416(49)	**3271.5159**	**3320.5159**
3	-1406.1573(74)	3320.6987	3394.6987
4	-1363.2523(99)	3406.64	3505.64

1 class model is the traditional multinomial logit, estimated using Stata module clogit. All the other LCM models are estimated using Stata model lclogit. K is the number of parameters to be estimated.

Table 5 Model Estimation

Class-specific utility function		
VARIABLES	Class 1	Class 2
No	8.486***	7.581***
	(1.301)	(1.995)
No_likelytovote	-1.811***	-2.778***
	(0.196)	(0.371)
LT_No	-0.625	1.291
	(0.781)	(0.978)
RM_No	-0.785	0.0581
	(0.788)	(0.975)
No_lengthtownresidence	0.0135	-0.0144
	(0.0109)	(0.0152)
No_gender	-0.199	0.0369
	(0.347)	(0.568)
No_age	-0.0114	-0.00524
	(0.0131)	(0.0222)
No_rent	-0.786	-0.422
	(0.575)	(1.443)
No_incomeH	0.183	-1.474**
	(0.397)	(0.692)
No_incomemiss	1.219	0.352
	(0.854)	(0.809)
No_factor1	1.166***	-3.530***
	(0.234)	(0.736)
No_factor2	-1.068***	0.718**
	(0.206)	(0.342)
No_Dfacmiss	-4.526***	5.842***
	(0.886)	(1.025)
acresfarm	0.00158***	0.00149**
	(0.000552)	(0.000756)
acresforest	0.00318***	0.000977
	(0.000632)	(0.000776)
RM_acresfarm	-0.000533	-0.000393
	(0.000761)	(0.000836)
RM_acresforest	-0.00159**	0.00234**
	(0.000803)	(0.000954)
LT_acresfarm	0.000142	0.00105
	(0.000717)	(0.000934)
LT_acresforest	-0.00100	0.000936
	(0.000838)	(0.000970)
cost	-0.000266***	-0.000328***
	(5.24e-05)	(6.51e-05)
childagri_acresfarm	0.000518	6.03e-05
	(0.000498)	(0.000585)
childagri_acresforest	-0.000939*	-0.000621
	(0.000503)	(0.000670)
childwooded_acresfarm	-0.000583	0.000932*
	(0.000476)	(0.000557)
childwooded_acresforest	0.000746*	0.00130**
	(0.000452)	(0.000541)

Membership	
littlecompton	0.403
	(0.374)
richmond	0.309
	(0.370)
middletown	0.363
	(0.405)
rural	-0.756***
	(0.177)
pro-rural	0.192
	(0.176)
incomemiss	-0.265
	(0.371)
Constant	-0.181
	(0.331)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 Hypothesis 1

	Log Likelihood(K)	chi-square(df)	p-value	reject null
Unrestricted Model	-1467.4418(49)			
$\alpha_{RM} = \mu_{RM} = \lambda_{RM} = 0$	-1486.2128(43)	37.542(6)	0.000***	yes
$\alpha_{LC} = \mu_{LC} = \lambda_{LC} = 0$	-1498.8274(43)	62.771(6)	0.000***	yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 Hypothesis 2

	Farmland($)	Forestland($)	Mean Diff.	p-value
Richmond	4.0686	9.2569	-5.1883	0.000
Little Compton	7.5654	7.7356	-0.1701	0.000

Table 7 Hypothesis 3

	Farmland	Forest land
Richmond	4.0686	9.2569
Richmond moving to Little Compton	7.5715	8.1088
Little Compton	7.5654	7.7356
Little Compton moving to Richmond	4.1034	8.7408

The numbers are all mean WTP.