Preferences for Residential Development Attributes and Support for the Policy Process: Implications for Management and Conservation of Rural Landscapes

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The rural public may not only be concerned with the consequences of land management; residents may also have systematic preferences for policy instruments applied to management goals. Preferences for outcomes do not necessarily imply matching support for the underlying policy process. This study assesses relationships among support for elements of the policy process and preferences for management outcomes. Preferences are examined within the context of alternative proposals to manage growth and conserve landscape attributes in southern New England. Results are based on (*a*) stated preferences estimated from a multi-attribute contingent choice survey of rural residents, and (*b*) Likert-scale assessment of strength of support for land use policy tools. Findings indicate general but not universal correlation among policy support indicators and preferences for associated land use outcomes, but also confirm the suspicion that policy support and land use preference may not always coincide.

Key Words: choice experiment, conservation, land use control, policy support, rural development, stated preference

The rural public may not only be concerned with the consequences of land management, they may also have systematic preferences for policy procedures applied to management goals (Abdalla, 2001; Johnston, Swallow, and Weaver, 1999; Northeast Regional Center for Rural Development, 2002; McLeod, Woirhaye, and Menkhaus, 1999). There is no guarantee respondents will support policies that are consistent with their stated preferences for land use outcomes. Indeed, respondents may possess strong preferences for management outcomes (e.g., wildlife habitat, public access) while being unwilling to accept the management processes required to generate those outcomes (Johnston, 2002). Despite this possibility, the literature provides little information indicating whether preferences for management outcomes are correlated with support for policies associated with those outcomes.

Consider the example of a scenic, rural viewshed. Residents may have strong preferences for the preservation of scenic amenities, and indeed may be willing to pay to preserve these attributes. However, they may be unwilling to accept changes in zoning or alternative land use regulations required to ensure these outcomes (e.g., required setbacks, increases in required road frontage). Despite a positive willingness to pay (WTP) for the management outcome, a lack of support for associated management tools may preclude welfare-improving policy change.

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This study examines relationships among the rural public's support for the policy process and the public's preferences and goals for land management and conservation outcomes. Preferences are considered within the context of alternative proposals to manage residential growth and conserve landscape attributes in southern New England.

Results are based on (*a*) stated preferences estimated from a multi-attribute choice survey of rural residents,[1] and (*b*) a Likert-scale assessment of strength of support for 21 growth management and conservation tools. Data are drawn from the *Rhode Island Rural Land Use Survey*—a survey developed and designed by the authors to assess rural residents' tradeoffs among attributes of residential development and conservation.

Description of the Model and Analysis

The choice experiment section of the *Rhode Island Rural Land Use Survey* asked respondents to consider and choose between two alternative development options for a hypothetical, 400-acre tract of forested land located in their town of residence, an area comprising just over 1% of the land area in each of the four towns sampled. Each presented option could differ across a set of spatial and nonspatial attributes. Analysis of these results provides insight into preferences for development and conservation tradeoffs—or management outcomes.

A subsequent section of the survey asked respondents to indicate their degree of support for, or opposition to, 21 different land use management policy options. Strength of support was indicated on a five-point Likert scale ranging from 1 = "strongly oppose" to 5 = "strongly support"—providing insight into respondents' support for different management mechanisms.

Findings are drawn from a qualitative comparison of (*a*) Likert-scale policy support ratings, and (*b*) results of the choice model of conservation and development (outcome) preferences. These initial findings are further explored through a model integrating principal-components factor analysis of Likert-scale responses with the discrete choice model of land use preferences.

[1] This approach to stated preference analysis has been variously called contingent choice (e.g., Opaluch et al., 1993), conjoint analysis (e.g., Roe, Boyle, and Teisl, 1996), or choice experiments (e.g., Adamowicz et al., 1998).

A Discrete Choice Model of Land Use Preference

To model a respondent's choice between development plans, we define a simple utility function that includes arguments for attributes of a rural residential development or conservation plan and the net cost of the plan to the respondent (Hanemann, 1984; McConnell, 1990):

$$(1)\quad U(\cdot) = U(\mathbf{X}_c, Y - F_c) = v(\mathbf{X}_c, Y - F_c) + \varepsilon_c,$$

where $\mathbf{X}_c$ is a vector of variables describing attributes of development or conservation plan c, Y is disposable income of the respondent, F_c denotes change in mandatory taxes and fees paid by the respondent under development plan c, $v(\cdot)$ is a function representing the empirically measurable component of utility, and ε_c is a term representing econometric error.

The respondent compares the current development plan ($c = A$) to the alternate development plan ($c = B$), such that the change in utility (dU) is given by:

$$(2)\quad \begin{aligned} dU &= U(\mathbf{X_A}, Y - F_A) - U(\mathbf{X_B}, Y - F_B) \\ &= [v(\mathbf{X_A}, Y - F_A) - v(\mathbf{X_B}, Y - F_B)] - [\varepsilon_B - \varepsilon_A] \\ &= dv - \theta, \end{aligned}$$

where F_A is the unavoidable household cost of plan A, and F_B is the cost of plan B. In this case, the payment vehicle for these costs is mandatory annual town taxes and fees paid by the household.[2]

The theoretical model assumes a respondent assesses the difference between utility under the two plans and indicates the sign of dU by choosing either the current ($dU > 0$) or alternate ($dU < 0$) development plan. If θ is assumed to have a logistic distribution, then the familiar logit model applies, in which the probability of selecting a given option is a logistic function of the utility difference dv (Maddala, 1983). This is the common random utility model often applied to contingent choice or conjoint survey data (Hanemann, 1984; McConnell, 1990).

The Survey

The *Rhode Island Rural Land Use Survey* was designed to assess rural residents' tradeoffs among attributes of residential development and conserva-

[2] Johnston, Swallow, and Weaver (1999) provide additional discussion of this type of payment vehicle specification.

tion. Development of the survey required over 18 months, including background research, interviews with policy makers and residents, and focus groups. Following Johnston et al. (1995), intensive focus group sessions and pretests were conducted to ensure the survey language and format could be easily understood by respondents, and that respondents shared similar and consistent interpretations of survey questions and instructions.

Contingent Choice Scenarios and the Econometric Model

Focus groups and expert interviews determined the selection of land use attributes for consideration in contingent choice scenarios, and led to a survey format in which information was presented on stylized maps of hypothetical development and conservation plans. Attributes distinguishing plans characterized protected open space, residential development, unprotected undeveloped land, scenic views, wildlife habitat, public access, recreational facilities, traffic, and taxes. Table 1 summarizes attributes distinguishing the development and conservation scenarios.

Prior to presenting respondents with development choices, the survey provided background community information and reminded respondents of tradeoffs implicit in development choices. Choice instructions and questions were then presented, in which respondents were given the choice of voting for the "current" development plan (CDP) or the "alternate" development plan (ADP), relative to the same 400-acre undeveloped site.

Each respondent considered three potential pairs of current and alternate plans. Respondents were instructed to consider each pair independent of previous choices, and to assume that all choices applied to the same 400-acre parcel. The survey characterized the parcel as undeveloped and forested prior to the choice of development plans; respondents were also told the approximate location of the parcel in their community. The "current" and "alternate" plans were presented as development or conservation options which would alter the existing state of this hypothetical undeveloped and unpreserved site.[3]

Labels for the two plans were chosen based on focus groups, with the goal of grounding respondents in the policy context surrounding actual local development proposals (Blamey et al., 2000). Respondents were also told, "If you do not vote for either plan, development will automatically occur as shown by the current development plan"—thereby specifying the status quo that would occur if no choice were made (Adamowicz et al., 1998). This framework was chosen to mimic actual community considerations of development proposals, wherein a landowner possesses the property rights necessary to permit development. However, officials may seek to influence the configuration of the development, delaying permits unless design changes are made. As a result, while some form of development or conservation is virtually certain, officials may exert some control over its ultimate form.

Fractional factorial design was used to construct a range of survey questions with an orthogonal array of attribute levels. All attributes were free to vary over their full range for both the current and alternate plans, with no imposed ordering of attribute levels between the two plans. This procedure resulted in 128 unique contingent choice questions divided among 43 different survey booklets (three questions per booklet). The chosen survey design had the added advantage of reducing the potential for "yea-saying" (Blamey, Bennett, and Morrison, 1999; Boyle et al., 1998), as most development plans incorporated both positive and negative elements. Hence, in most choice questions, neither the current nor alternate development plan offered a clearly superior choice for a respondent wishing to express environmental motivations (cf. Blamey, Bennett, and Morrison, 1999).

Because the choice data are comprised of three responses per survey, there is a possibility of correlated errors across responses (Alberini, Kanninen, and Carson, 1997; Poe, Welsh, and Champ, 1997). This correlation may be modeled using a variety of methods, including generalized estimating equation (GEE) models (Liang and Zeger, 1986; Johnston, Swallow, and Bauer, 2002), random-coefficients models (Train, 1998), and random-effects models (Pendergast et al., 1996).

In this case, we model potential error correlation by splitting θ in equation (2) into two components: $\tilde{\theta}$ that is i.i.d. across all respondents and for each individual respondent, and γ_h representing systematic variation related to unobserved characteristics of respondent h. If the γ_h are assumed normally distributed across respondents, and we retain the prior assumption regarding the logistic distribution of $\tilde{\theta}$, the model may be estimated as a random-effects logit model (Alberini, Kanninen, and Carson,

[3] Specifically, it was made clear that the "current" development plan did not represent the existing condition of the hypothetical parcel, but rather represented one of the two development plans being considered.

Table 1. Model Variables: Definitions and Summary Statistics for Current Development Plan (CDP) and Alternate Development Plan (ADP)

Variable Name	Description	Units and Measurement	Mean (Std. Dev.)
Adj$Open	The difference between acres of open space adjacent to developments and roads in the CDP and ADP	Acres in CDP minus acres in ADP [Range: !200 to +200]	!3.10630 (95.680)
Iso$Open	The difference between acres of open space not adjacent to developments and roads in the CDP and ADP	Acres in CDP minus acres in ADP [Range: !200 to +200]	2.61979 (53.457)
Size$Dif	The difference between acres of residential development in the CDP and ADP	Acres in CDP minus acres in ADP [Range: !200 to +200]	!1.54948 (90.751)
Dense$Dif	The difference in housing density in the CDP and ADP	Houses/acre in CDP minus houses/acre in ADP [Range: !2 to +2]	!0.00007 (0.9824)
Lg$Mammal	Difference between habitat quality for large mammals in CDP and that in ADP	Difference in wildlife habitat quality scale [1 = worst; 5 = best]	!0.00606 (1.2306)
Sm$Mammal	Difference between habitat quality for small mammals in CDP and that in ADP	Difference in wildlife habitat quality scale [1 = worst; 5 = best]	!0.01909 (1.2401)
Com$Bird	Difference between habitat quality for common birds in CDP and that in ADP	Difference in wildlife habitat quality scale [1 = worst; 5 = best]	0.03947 (1.7437)
Uncom$Bird	Difference between habitat quality for uncommon birds in CDP and that in ADP	Difference in wildlife habitat quality scale [1 = worst; 5 = best]	!0.00643 (1.7361)
Wet$Sp	Difference between habitat quality for wetland species in CDP and that in ADP	Difference in wildlife habitat quality scale [1 = worst; 5 = best]	!0.02625 (1.7347)
Traf$Light	Difference between dummy variables indicating the presence of a traffic light on the main road, in the CDP and ADP	Difference between dummy variables for CDP and ADP	!0.00257 (0.7044)
Tax$Dif	Difference in additional annual taxes and fees between CDP and ADP (resulting from management plan)	Dollars in CDP minus dollars in ADP [Range: !$325 to +$325]	!0.98678 (155.37)
Low$Vis	Difference between dummy variables indicating the presence of development either highly screened or not visible from the main road, in the CDP and ADP. Survey versions included eight separate photographs characterizing different development visibility levels; four of these photographs are characterized as low visibility development.	Difference between dummy variables for CDP and ADP	!0.00900 (0.7003)
Edge$Area	The difference between the edge-area ratio of residential development shown in the CDP and the edge-area ratio of residential development shown in the ADP. All ratios are calculated as the sum of the perimeter(s) divided by the sum of the area(s) of land highlighted for residential development in a development plan.	Calculated at a scale of 1 unit = 933.37 feet (e.g., a 1 unit × 1 unit sq. block is equivalent to 20 acres or ~871,180 sq. feet, with an edge-area ratio of 4) [Range: !14.85 to +8.5]	0.04524 (3.7013)
Develop2	Difference between dummy variables indicating the presence of a two-section, fragmented development in the CDP and ADP. In all cases, development sections are rectangular.	Difference between dummy variables for CDP and ADP	0.01505 (0.4252)
Develop4	Difference between dummy variables indicating the presence of a four- or five-section, fragmented development in the CDP and ADP. In all cases, development sections are rectangular.	Difference between dummy variables for CDP and ADP	!0.00587 (0.6042)
Develop$Road	Difference between dummy variables indicating the presence of developments located adjacent to main roads, in the CDP and ADP	Difference between dummy variables for CDP and ADP	0.00056 (0.7195)

1997; Hsiao, 1986). Because the model is binary, the IIA property and associated concerns do not apply.

Likert-Scale Policy Support Questions

Respondents were asked to indicate their degree of opposition or support for 21 different land use management policy options, on a five-point Likert scale ranging from 1 = "strongly oppose" to 5 = "strongly support." Descriptions of policy options were refined though focus groups and pretests, and selected with the assistance of local land use officials. Among others, these policy options included zoning changes, fee-based land preservation techniques, tax policies, housing caps, and various types of impact fees (table 2).

Based on the results of focus groups, all policies were described in simple, nontechnical terms. Although we attempted to assess general policy support independent of the particular set of land use attributes targeted, there are some implicit and unavoidable links between certain policy tools and particular types of land use attributes. For example, well-head zoning (described in the survey as "zoning to protect water quality") is necessarily linked to water quality attributes.

All respondents considered the same set of 21 policy options. Table 2 lists the policy options rated by respondents, and the mean support ratings associated with each option in each of the four rural Rhode Island communities sampled: Burrillville, Coventry, Exeter, and West Greenwich. Mean scores above 3.0 indicate that the average respondent supports the policy option, with higher scores denoting greater mean support. Mean scores below 3.0 reveal the average respondent opposes the policy option, with lower scores showing greater mean opposition.

Despite differences in the extent and type of development and the ongoing policy process in the rural communities sampled, respondents from the four communities reveal a high degree of consistency in policy support across the 21 management tools.[4] As expected, respondents indicated general support for conservation policy options, and general opposition to policy options encouraging development (table 2). However, the specific characteristics of policy tools are relevant. For example, tools which encourage conservation through explicit tax increases (e.g., policy options 5 and 9) are generally opposed by residents, compared to other conservation options which, in general, receive strong support. Results also illustrate that opposition to policies encouraging residential development (e.g., policy options 2 and 12) exceeds opposition to otherwise analogous policies encouraging commercial development (e.g., options 1 and 13).

Contingent Choice Results: Base Model

Surveys were mailed to 4,000 randomly selected residents of four Rhode Island rural communities (Burrillville, Coventry, Exeter, and West Greenwich) following the total survey design method (Dillman, 2000). Of the 3,702 deliverable surveys, 2,157 were returned, for a response rate of 58.2%. Response rates ranged from 50.4% (Coventry) to 58.7% (West Greenwich).

To allow for heterogeneity in preferences and policy support across different communities, individual choice models are presented for Burrillville and Exeter. Results are suppressed for Coventry and West Greenwich for the sake of brevity, and to allow sufficient discussion of Burrillville and Exeter results. Results from the two suppressed models offer little fundamental intuition beyond that provided by the Burrillville and Exeter models. The Burrillville model incorporates data from 528 surveys received from this community; these include 1,351 responses to choice questions. The Exeter model incorporates 1,338 responses from 538 surveys. Surveys returned by those few individuals who failed to respond in any way to choice questions were omitted from the analysis.

Model results are presented in table 3. Burrillville results are based on a random-effects logit model. An analogous random-effects model for Exeter would not converge given traditional maximum-likelihood methods; hence standard logit results are presented for this community.

Both models are statistically significant at $p < 0.0001$ (for Burrillville, !2LnL $\chi^2 = 441.52$, df = 16; for Exeter, !2LnL $\chi^2 = 470.12$, df = 16). Of 16 model attributes, 11 are significant in the Burrillville model, while 13 are statistically significant at $p < 0.05$ in the Exeter model. Signs of significant parameter estimates correspond with prior expectations derived from focus groups, where a priori expectations exist (cf. Johnston, Swallow, and Bauer, 2002).

[4] A notable exception is policy option 6, which reflects support for the revitalization of village centers using public funds. Support for this option is higher in communities with more distinct village centers (Burrillville and Coventry), and lower in communities with less obvious or populous village centers (Exeter and West Greenwich).

Table 2. Likert-Scale Strength-of-Support Ratings for Land Use Policy Options: Mean Ratings of Survey Responses from Four Rhode Island Rural Communities

Policy Option No.	Policy Option Description (survey text)	Rhode Island Community: Burrillville (n = 528)	Coventry (n = 504)	Exeter (n = 538)	West Greenwich (n = 587)
		<! ! ! ! ! ! ! ! ! ! ! Mean Rating		! ! ! ! ! ! ! ! ! ! !>	
1	Attract new commercial development to your town by offering tax incentives	2.69 (1.29)	2.52 (1.23)	2.46 (1.28)	2.32 (1.21)
2	Attract new residential development to your town by offering tax incentives	2.03 (1.02)	1.92 (0.98)	1.74 (0.86)	1.79 (0.91)
3	Encourage preservation by reducing property taxes on undeveloped land	4.14 (0.83)	4.14 (0.84)	4.06 (0.94)	4.12 (0.84)
4	Encourage new development by expanding public water and sewer services	2.53 (1.07)	2.57 (1.16)	2.08 (1.04)	2.09 (1.04)
5	Discourage people from moving into your town by increasing the tax rate	2.00 (0.88)	1.93 (0.88)	1.91 (0.87)	1.97 (0.92)
6	Revitalize town or village centers using new public funds	3.77 (0.89)	3.43 (0.95)	3.17 (1.05)	3.10 (1.06)
7	Purchase and preserve undeveloped land with private funds (e.g., land trust donations)	4.06 (0.76)	4.06 (0.82)	4.11 (0.78)	4.12 (0.84)
8	Purchase and preserve undeveloped land with public funds (e.g., public bond issues)	3.63 (0.97)	3.62 (1.04)	3.51 (1.09)	3.58 (1.05)
9	Purchase and preserve undeveloped land through a new real estate sales tax	2.64 (1.14)	2.64 (1.15)	2.72 (1.14)	2.74 (1.21)
10	Collect fees from developers to offset costs of additional public services for new developments	4.10 (0.83)	4.14 (0.85)	4.18 (0.83)	4.18 (0.88)
11	Collect fees from developers to offset additional environmental damages from new developments	4.24 (0.78)	4.27 (0.86)	4.29 (0.81)	4.30 (0.85)
12	Encourage residential development by decreasing zoning restrictions	1.94 (0.94)	1.91 (0.95)	1.74 (0.95)	1.62 (0.80)
13	Encourage commercial development by decreasing zoning restrictions	2.11 (1.07)	2.00 (1.03)	2.00 (1.11)	1.73 (0.88)
14	Require new developments to preserve some undeveloped land	4.15 (0.78)	4.19 (0.75)	4.22 (0.78)	4.23 (0.75)
15	Require trees and shrubs between new houses and roads	3.96 (0.84)	4.17 (0.80)	4.16 (0.80)	4.17 (0.79)
16	Further protect water resources by increasing zoning restrictions	4.03 (0.78)	4.10 (0.80)	4.08 (0.85)	4.12 (0.90)
17	Further protect wildlife resources by increasing zoning restrictions	4.01 (0.83)	4.09 (0.86)	4.00 (0.87)	4.11 (0.90)
18	Require new commercial development to occur along major roadways	3.81 (0.94)	3.64 (1.03)	3.74 (1.02)	3.82 (1.03)
19	Require new commercial development to occur within town or village centers	2.85 (1.09)	2.96 (1.19)	3.12 (1.11)	3.05 (1.17)
20	Institute a cap on the total number of new homes allowed to be built each year	4.06 (0.90)	4.15 (0.88)	4.04 (0.96)	4.14 (0.93)
21	Tighten enforcement of existing zoning and subdivision regulations	3.92 (0.84)	4.07 (0.82)	4.01 (0.86)	4.09 (0.85)

Notes: Mean ratings are based on a five-point Likert scale where 1 = strongly oppose and 5 = strongly support. Numbers in parentheses are standard deviations.

Table 3. Choice Model Base Results: Burrillville and Exeter

	Burrillville Model[a]		Exeter Model (std. logit)[b]	
Variable	Parameter Estimate	*z*-Statistic	Parameter Estimate	*z*-Statistic
Intercept	!0.051686	!0.74	0.172756***	!2.56
Edge$Area	0.140387***	5.08	0.122696***	4.42
Develop2	!0.187741	!1.00	!0.543437***	!2.87
Develop4	!0.478766***	!3.38	!0.381821***	!2.78
Iso$Open	0.006478***	4.62	0.006776***	4.64
Adj$Open	0.003523***	4.67	0.004272***	5.71
Develop$Road	!0.220212**	!2.01	!0.308200***	!2.77
Lg$Mammal	0.149862***	2.63	0.121017**	2.24
Sm$Mammal	!0.061103	!1.09	!0.065327	!1.21
Com$Bird	0.119919***	3.07	0.129623***	3.27
Uncom$Bird	!0.020583	!0.52	0.010469	0.28
Wet$Sp	0.004121	0.10	0.074446*	1.85
Dense$Dif	!0.928414***	!10.32	!0.850958***	!10.40
Size$Dif	!0.006295***	!6.41	!0.007224***	!7.35
Traf$Light	0.208801**	2.11	0.088353	0.91
Low$Vis	0.118877	1.22	0.240758***	2.56
Tax$Dif	!0.004833***	!9.74	!0.004946***	!10.69
$\ln(\sigma_v)$	!1.80	1.07	—	—
σ_v	0.41	0.22	—	—
ρ	0.14	0.13	—	—
!2LnL χ^2:	441.52 (Prob = 0.01)		470.12 (Prob = 0.01)	

Note: *, **, and *** denote statistical significance at $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.
[a] Burrillville results are based on a random-effects logit model.
[b] The random-effects model for Exeter did not converge appropriately using standard maximum-likelihood methods. Hence the presented results are based on a standard fixed-effects logit model.

Initial comparison of contingent choice results (table 3) with Likert-scale policy ratings (table 2) points to numerous areas in which preferences for land use outcomes coincide with support for associated policy mechanisms. Findings here are largely qualitative, and indicate that at a general, aggregate level, respondents appear to support policies (in the Likert-scale analysis) that generate outcomes for which marginal utility is positive (in the contingent choice analysis).

For example, aversions to residential development found in the choice model coincide with support for development-constraining policy tools. Choice model results reveal negative marginal utility associated with the size and density of residential developments (table 3, *Size$Dif* and *Dense$Dif*). Similarly, Likert-scale results show strong support for policies which explicitly limit or cap development (e.g., table 2, option 20). In contrast, policy options that would contribute to an increase in development (table 2, options 1, 2, 4, 12, and 13) received low Likert-scale preference scores—in all cases less than 2.75 on a five-point scale. Policy options which would contribute to an increase in *residential* development (table 2, options 2 and 12) are the lowest rated of all options.

Negative marginal utility associated with the placement of new residential developments alongside main roads (table 3, *Develop$Road*) coincides with support for a requirement that trees and shrubs be placed between new houses and roads (table 2, option 15). Similarly, respondents' support for policies which preserve undeveloped land (table 2, options 3, 7, 8, 9, and 14) coincides with positive marginal utility of preserved open space (table 3, *Iso$Open* and *Adj$Open*). However, the specific mechanism is relevant. Policies preserving undeveloped land using public bonds (table 2, option 8) and real estate transfer taxes (option 9) ranked lower than other conservation mechanisms, including preservation by land trusts (option 7) and through reductions in taxes on undeveloped lands (option 3).

The real estate transfer tax (option 9) was the only open space conservation option to receive a support rating less than 3.0 (i.e., the threshold between policy support and opposition).

Despite general agreement between aggregate policy support and choice model results, a particularly high degree of Likert-scale support does not guarantee that associated outcomes will be welfare-enhancing. For example, we find strong support for a policy option requiring housing developers to conserve open space as part of residential developments (table 2, option 14). However, choice model results reveal a relatively *lower* preference for open space located adjacent to residential development, compared to otherwise identical open space isolated from developments (table 3, *Adj$Open* versus *Iso$Open*). Based on these findings, the most highly rated mechanism for open space conservation provides a type of open space less valued by existing residents.

A Combined Preference Model

The above results reflect aggregate, qualitative comparisons of independent choice models and Likert-scale analyses. These findings may be further quantified through a model combining principal-components factor analysis of Likert-scale responses with the random-effects logit model. Such analysis may be used to assess statistical correlation among preferences for land use outcomes and support for policy tools. In recognition of the fact that factor analysis results will likely differ across communities, distinct factor models are estimated for the communities of Burrillville and Exeter.

Following Variyam, Jorday, and Epperson (1990), factor analyses are conducted to estimate a small number of underlying constructs which together account for a large percentage of observed variation in Likert-scale responses of policy support. These responses are analyzed using principal-components factor analysis of the response correlation matrix (Reyment and Joreskog, 1996), attempting to isolate latent factors which account for response heterogeneity (Bollen, 1989).

Burrillville Factor Results

Seven factors are retained based on a minimum eigenvalue of 1.0, accounting for 63.4% of the variation in Likert-scale responses. These factors are rotated using the VARIMAX method (Reyment and Joreskog, 1996). The rotated factor pattern for Burrillville is shown in table 4. Based on factor loadings, the seven factors are denoted as follows: 1 = *Pro-Zoning*, 2 = *Pro-Develop*, 3 = *Con-* [impact] *Fee*, 4 = *Pro-Purchase*, 5 = *Pro-Tax*, 6 = *Locate Commercial*, and 7 = *Pro-Commercial*.

Factor 1 (*Pro-Zoning*) is characterized by high factor loading (i.e., a loading greater than 0.5 in absolute magnitude) on policy options 15, 16, 17, 20, and 21—indicating strong support for policy options related to stricter zoning or restrictions on new development. Factor 2 (*Pro-Develop*) is characterized by high factor loadings for options 2, 4, 12, and 13—indicating support for policy options that *encourage* new residential or commercial development. Factor 3 (*Con-Fee*) incorporates high negative loadings for options associated with the use of impact fees (options 10 and 11). Factor 4 (*Pro-Purchase*) is characterized by high loadings on options 3, 7, and 8—representing different fee-simple methods of purchasing and preserving undeveloped land. Factor 5 (*Pro-Tax*) loads highly on options 5 and 9—both options involving an explicit increase in taxes to obtain conservation objectives. Finally, factors 6 and 7 are associated with support for commercial development policies.

Exeter Factor Results

Seven factors are retained based on a minimum eigenvalue of 1.0, accounting for 64.5% of the variation in Likert-scale responses. These factors are rotated using the VARIMAX method. The rotated factor pattern for Exeter is reported in table 5. Based on factor loadings, the seven factors are denoted as follows: 1 = *Pro-Zoning*, 2 = *Restrict-Develop*, 3 = *Pro-Develop*, 4 = *Con-Purchase*, 5 = *Con-Fee*, 6 = *Pro-Tax*, and 7 = *Commercial Center.*

While not identical, factor scores for the Exeter sample in many cases reveal patterns similar to those found in the Burrillville model. Factor 1 (*Pro-Zoning*) is characterized by high (> 0.5) loadings on policy options 16, 17, and 21, with a loading of 0.45 on option 19; this factor is similar to factor 1 in the Burrillville model. Factor 2 (*Restrict-Develop*) loads highly on options 14, 15, and 18—indicating support for tools which restrict residential development attributes, but do not explicitly reduce acres or density. Factor 3 (*Pro-Develop*) is characterized by high loadings on policy options 1, 2, 4, 12, and 13—tools providing incentives for development or relaxed restrictions on developers. This factor is analogous to factor 2 in the Burrillville model. Factor 4 (*Con-Purchase*) is characterized by high negative loadings on options 7 and 8, and is the near

Table 4. Rotated VARIMAX Factor Loadings: Strength of Support for Policy Options, Burrillville, RI

		FACTORS 1−7						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Policy Option	Description	*Pro-Zoning*	*Pro-Develop*	*Con-Fee*	*Pro-Purchase*	*Pro-Tax*	*Locate Commercial*	*Pro-Commercial*
1	Commercial tax incentives	!0.26340	0.22814	0.00610	!0.06867	!0.07978	0.07004	***0.73347***
2	Residential tax incentives	0.00416	***0.75585***	0.11073	!0.02229	0.00249	0.04416	0.02388
3	Reduce undeveloped land tax	0.07067	!0.12315	!0.08567	***0.62285***	!0.13503	!0.04884	!0.22588
4	Expand water and sewer	0.01641	***0.63368***	0.21774	!0.03302	!0.07953	0.00253	0.29827
5	Increase tax rate	0.11791	!0.16002	0.03549	0.07820	***0.66605***	0.02767	!0.12051
6	Revitalize town centers	0.24571	0.05107	0.20863	0.48418	!0.16735	0.02815	0.47503
7	Purchase and preserve w/private funds	0.07854	!0.28818	!0.30906	***0.62868***	!0.01338	0.04956	!0.00280
8	Purchase and preserve w/public funds	0.13052	!0.06863	!0.06289	***0.77369***	0.24399	0.07103	0.00184
9	Purchase and preserve w/tax funds	0.21075	0.10222	!0.18525	0.41065	***0.56260***	0.10172	!0.11085
10	Impact fees for public services	0.08597	!0.09084	***!0.88037***	0.02616	!0.00762	!0.02894	!0.02475
11	Impact fees for environmental damages	0.23472	!0.12084	***!0.82635***	0.12042	0.06586	0.03234	0.01381
12	Relax residential zoning	!0.17714	***0.75434***	0.13312	!0.17671	!0.00872	0.03060	0.09478
13	Relax commercial zoning	!0.27533	***0.51506***	!0.08866	!0.22662	0.01525	0.00497	0.48879
14	Require developers to preserve land	0.33180	!0.12274	!0.47205	0.18617	!0.41888	0.24529	!0.06088
15	Require trees and shrubs	***0.68090***	0.04176	!0.09842	0.09806	!0.15135	!0.03259	0.07193
16	Zoning for water protection	***0.78354***	!0.06898	!0.16708	0.07676	0.01668	0.02535	!0.20924
17	Zoning for wildlife protection	***0.79233***	!0.01699	!0.14077	0.20304	0.07913	0.00364	!0.22218
18	Require commercial development on roads	0.04161	!0.18711	!0.15093	0.03275	!0.26901	***0.63081***	0.29361
19	Require commercial development in town	!0.01641	0.12491	0.04068	0.04196	0.11691	***0.85311***	!0.04644
20	Development cap	***0.56570***	!0.34274	!0.20391	!0.00910	0.25867	!0.06261	0.26897
21	Tighten zoning enforcement	***0.58661***	!0.34444	!0.15907	!0.02728	0.30294	0.06220	0.13636

Note: Values appearing in ***bold italics*** denote loadings > 0.5.

Table 5. Rotated VARIMAX Factor Loadings: Strength of Support for Policy Options, Exeter, RI

		FACTORS 1−7						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Policy Option	Description	*Pro-Zoning*	*Restrict-Develop*	*Pro-Develop*	*Con-Purchase*	*Con-Fee*	*Pro-Tax*	*Commercial Center*
1	Commercial tax incentives	!0.30503	0.19232	***0.67126***	0.20581	0.01898	0.08940	!0.02226
2	Residential tax incentives	0.10710	!0.41094	***0.62820***	0.07559	0.16889	!0.17565	0.00715
3	Reduce undeveloped land tax	0.15736	0.18420	!0.10717	!0.42748	!0.08749	0.14792	0.45592
4	Expand water and sewer	!0.07378	!0.19679	***0.65176***	0.00771	0.15226	!0.20069	!0.01770
5	Increase tax rate	0.09829	!0.11473	!0.01790	!0.09521	0.08516	***0.80518***	0.06820
6	Revitalize town centers	0.01154	!0.06202	0.43302	!0.49285	!0.04536	!0.01641	!0.30135
7	Purchase and preserve w/private funds	0.14696	0.24484	!0.28622	***!0.64612***	!0.09335	!0.10966	!0.01437
8	Purchase and preserve w/public funds	0.17296	!0.00664	!0.17489	***!0.75714***	!0.11638	0.18775	!0.01351
9	Purchase and preserve w/tax funds	0.20877	!0.10992	!0.10268	!0.49531	!0.25985	0.43641	!0.09560
10	Impact fees for public services	0.05886	0.08247	!0.08934	!0.10273	***!0.90638***	0.00271	!0.00061
11	Impact fees for environmental damages	0.25540	0.05003	!0.10477	!0.05097	***!0.87954***	!0.01876	0.00098
12	Relax residential zoning	!0.18965	!0.20814	***0.63264***	0.09566	0.27619	!0.12891	0.06180
13	Relax commercial zoning	!0.35229	0.17448	***0.70645***	0.23240	0.06425	0.11908	0.00430
14	Require developers to preserve land	0.15254	***0.60511***	!0.18953	!0.30537	!0.07814	!0.17416	0.01682
15	Require trees and shrubs	0.45056	***0.54075***	!0.05144	!0.03745	!0.14110	!0.14022	0.06077
16	Zoning for water protection	***0.86128***	0.02835	!0.11717	!0.08808	!0.14221	0.05986	!0.02692
17	Zoning for wildlife protection	***0.86260***	0.00979	!0.10957	!0.12319	!0.17161	0.08126	!0.00774
18	Require commercial development on roads	!0.06999	***0.58768***	0.14089	0.12910	!0.16016	!0.07116	!0.41033
19	Require commercial development in town	0.04542	0.07335	!0.04331	!0.09416	0.00487	!0.01564	***!0.83494***
20	Development cap	0.39394	0.32582	!0.26192	!0.00684	!0.21848	0.43169	!0.00489
21	Tighten zoning enforcement	***0.56813***	0.32051	!0.30869	!0.17694	!0.09004	0.16529	0.08047

Note: Values appearing in ***bold italics*** denote loadings > 0.5.

converse of factor 4 (*Pro-Purchase*) in Burrillville. Factor 5 (*Con-Fee*), with high negative loadings on options 10 and 11, is analogous to the Burrillville model's factor 3. Factor 6 (*Pro-Tax*) is associated with a loading greater than 0.5 on option 5, with a loading of 0.44 on option 9—this parallels factor 5 in the Burrillville model. Finally, factor 7 (*Commercial Center*) is associated with a high negative loading on option 19, which would require new commercial development to occur within town or village centers.

Combined Preference Model Results

The combined choice model incorporates interactions among factor scores associated with policy tools which influence residential development. These include factors 1–5 in Burrillville (table 4), and factors 1–6 in Exeter. Factors related primarily to commercial development are omitted from the discrete choice model, as the choice model addresses only residential development alternatives. Despite similar interpretations, quantitative differences between factor scores in Burrillville and Exeter preclude estimation of a single, pooled model for both communities. Hence, independent statistical analyses are conducted.

Estimated factors are included in the random-effects logit models as standardized factor scores, with a mean of zero and standard deviation of one. This simplifies interpretation of estimated logit parameters, as the scores indicate the extent to which a factor score for a particular respondent differs from that of the sample mean (Reyment and Joreskog, 1996; Kline and Wichelns, 1998).

Because each respondent's factor scores are relative to the sample mean, the analysis corrects for any potential samplewide patterns of "yea-saying" (Blamey, Bennett, and Morrison, 1999; Boyle et al., 1998) or similar behavior which might tend to artificially inflate (or diminish) stated support for certain management tools. Factor scores are included both as linear terms and as quadratic interactions with other variables. This enables assessment of whether support for various management tools—as characterized by factor scores derived from principal-component factor analysis—is correlated with preferences for development or conservation outcomes.[5]

Model results are presented in table 6.[6] Both the Burrillville and Exeter models are significant at $p < 0.0001$ (!2LnL $\chi^2 = 575.50$, df = 101; !2LnL $\chi^2 = 670.18$, df = 118, respectively). A log-likelihood ratio test of the unrestricted models versus restricted models in which all effects related to Likert-scale factors are constrained to zero rejects the null hypothesis of zero collective influence at $p < 0.01$ (Burrillville !2LnL $\chi^2 = 133.98$, df = 85; Exeter !2LnL $\chi^2 = 200.06$, df = 102).

Because policy support was measured in a distinct section of the survey from contingent choice questions, statistical significance of these interactions may not be attributed to simple correlations among policy options and land use outcomes which might have otherwise been present in choice scenarios. Accordingly, the reported findings for the combined model are solely the result of preference heterogeneity related to support for particular types of land use policy.

The joint significance of factor score interactions does not indicate whether these interactions represent intuitive correlations between land use preferences and policy support. Hence, to assess the potential intuition underlying model results, we consider individual interactions associated with selected factor scores. Although statistically significant interactions are associated with all factor scores, we target discussion around factors with a relatively large or highly significant set of interactions.

Pro-Zoning Factor Score Interactions (Factor 1, Burrillville and Exeter)

A greater factor score for factor 1 implies stronger general support for zoning tools. Among statistically significant interactions for Burrillville respondents, those with greater-than-average scores for the *Pro-*

[5] Preliminary models were estimated to assess whether the choice models should be amended to incorporate additional interactions with demographic attributes such as age, education, and income. Likelihood-ratio tests assessing the joint significance of appended interactions fail to reject the null hypothesis of zero joint influence at $p < 0.10$ for combined quadratic interactions including a respondent's age, length of residency, a dummy variable indicating respondents with at least a four-year college education, and a dummy variable identifying respondents with income below $40,000 (Burrillville !2LnL $\chi^2 = 76.77$, df = 68; Exeter !2LnL $\chi^2 = 81.60$, df = 68). Based on these results, we proceed with a final model that includes interactions with factor scores as detailed above, but excludes interactions with demographic attributes.

[6] We also attempted to estimate this model using a random parameters structure (McFadden and Train, 2000). Despite adapting Train's conditional logit code for binary logit and using Halton sequence-based numerical integration (Train, 2002), neither models with all parameters random nor models with only the parameter on the payment vehicle *Tax$Dif* random (e.g., Layton, 2000) converged in several days of dedicated computer time. Based on the similarity of estimates between a random-effects 20-parameter primary-effects model and the same model with all parameters random (one of the largest random parameter models of which we are aware), we believe the random-effects model adequately addresses the panel structure of these data. Since the data are binary, the IIA implication relaxed by random parameters models is not an issue.

Zoning factor have a stronger aversion to housing density, as indicated by the negative and statistically significant parameter estimate associated with *Pro-Zoning*×*Dense$Dif*. Given common perceptions of zoning as a tool associated with constraints on housing density, the significance of this interaction is not unexpected. Tax changes (*Tax$Dif*) are also relatively less important for respondents with higher *Pro-Zoning* scores, an effect with less obvious economic intuition.

Among Exeter respondents, those with greater-than-average scores for the analogous *Pro-Zoning* factor reveal a significantly higher marginal utility of open space preservation (*Adj$Open*, *Iso$Open*) and of developments less visible from main roads (*Low$Vis*). Higher *Pro-Zoning* factor scores are also correlated with lower marginal utility associated with the division of developments into multiple, smaller clusters (*Develop4*). Hence, while results suggest correlation among support for zoning tools and land use attributes that might be influenced by zoning (e.g., housing density, low-visibility development) among both Burrillville and Exeter respondents, results differ across the two communities.

Pro-Develop Factor Score Interactions (Burrillville Factor 2, Exeter Factor 3)

Among Burrillville respondents, interactions involving factor 2 (*Pro-Develop*) indicate correlation among support for pro-development policies and a reduction in negative marginal utility associated with increases in housing density (*Dense$Dif*), the size of residential developments (*Size$Dif*), and the presence of developments adjacent to main roads (*Develop$Road*). Indeed, for those with particularly high scores for *Pro-Develop*, marginal utility associated with these land use attributes may be positive, while the average respondent maintains negative marginal utility for these attributes. This finding reveals a correlation between support for pro-development policies and positive preferences for attributes of residential development. However, among Burrillville respondents, support for such policies is *not* correlated with utility for conservation attributes such as preserved open space. Thus, results indicate that respondents in Burrillville who support pro-development policies maintain similar marginal valuations of conservation attributes other than those directly associated with residential development.

Exeter results reveal significant and intuitive correlations between support for pro-development policies and a reduction in negative marginal utility associated with housing density (*Dense$Dif*), and a decrease in the marginal utility of habitat improvements for large mammals (*Lg$Mammal*) and uncommon birds (*Uncom$Bird*).

However, other statistically significant correlations have less obvious intuition. For example, the positive sign of *Pro-Develop*×*Low$Vis* indicates higher *Pro-Develop* factor scores are correlated with a stronger preference for reductions in development visibility. Similarly, higher *Pro-Develop* factor scores are correlated with an increased marginal utility of certain types of open space preservation (*Pro-Develop*×*Iso$Open* > 0).

Hence, in both towns, respondents with stronger support for pro-development policies still favor attributes associated with open space conservation. Indeed, these respondents may, in some cases, exhibit stronger relative preferences for conservation.

Con-Fee Factor Score Interactions (Burrillville Factor 3, Exeter Factor 5)

Within the Burrillville sample, opposition to impact fees is correlated with lower marginal utility of open space adjacent to roads and developments, and higher marginal utility for the preservation of common bird habitat. Although statistically significant, these correlations defy simple explanation. Both open space and wildlife habitat are resources with a typically positive marginal utility which may be preserved as a result of funds raised through impact fees. However, the signs of the associated interactions (*Con-Fee*×*Adj$Open* and *Con-Fee*×*Com$Bird*) do not coincide.

Among Exeter respondents, results are more intuitive. For example, among other significant interactions, higher *Con-Fee* factor scores are correlated with a reduction in the negative marginal utility of housing density, *Con-Fee*×*Dense$Dif* (i.e., a more positive reaction to housing density) at $p < 0.01$.

Con- or Pro-Purchase Factor Score Interactions (Factor 4 in Burrillville and Exeter)

Among Burrillville respondents, factor 4 characterizes the extent to which respondents favor tools resulting in the purchase and preservation of open space. Among Exeter respondents, factor 4 characterizes the extent to which respondents oppose such tools.

Table 6. Combined Factor Analysis / Choice Model Results

Burrillville Random-Effects Logit Model			Exeter Random-Effects Logit Model		
Description	Parameter Estimate	*z*-Statistic	Description	Parameter Estimate	*z*-Statistic
Linear Attributes:			**Linear Attributes:**		
Intercept	0.07758	1.00	Intercept	!0.22687***	!2.77
Edge$Area	0.19372***	6.00	*Edge$Area*	0.15199***	4.29
Develop2	!0.32325	!1.51	*Develop2*	!0.51347**	!2.22
Develop4	!0.62014***	!3.86	*Develop4*	!0.50080***	!2.98
Iso$Open	0.00869***	5.24	*Iso$Open*	0.00720***	3.92
Adj$Open	0.00473***	5.47	*Adj$Open*	0.00479***	5.23
Develop$Road	!0.32627***	!2.60	*Develop$Road*	!0.36659***	!2.72
Lg$Mammal	0.20133***	3.12	*Lg$Mammal*	0.17991***	2.76
Sm$Mammal	!0.07232	!1.15	*Sm$Mammal*	!0.08848	!1.39
Com$Bird	0.12395***	2.83	*Com$Bird*	0.09654**	2.02
Uncom$Bird	!0.06152	!1.39	*Uncom$Bird*	0.02437	0.56
Wet$Sp	0.02315	0.51	*Wet$Sp*	0.08757*	1.80
Dense$Dif	!1.10914***	!10.34	*Dense$Dif*	!1.05341***	!9.75
Size$Dif	!0.00706***	!6.36	*Size$Dif*	!0.00866***	!7.18
Traf$Light	0.24119**	2.17	*Traf$Light*	0.14324	1.26
Low$Vis	0.16377	1.51	*Low$Vis*	0.24504**	2.17
Tax$Dif	!0.00525***	!9.09	*Tax$Dif*	!0.00631***	!9.86
Factor 1 Interactions:			**Factor 1 Interactions:**		
Pro-Zoning×Edge$Area	0.03617	1.11	*Pro-Zoning×Edge$Area*	0.02745	0.82
Pro-Zoning×Develop2	!0.34357	!1.48	*Pro-Zoning×Develop2*	!0.09642	!0.39
Pro-Zoning×Develop4	0.07518	0.44	*Pro-Zoning×Develop4*	!0.37666**	!2.12
Pro-Zoning×Iso$Open	0.00113	0.71	*Pro-Zoning×Iso$Open*	0.00511**	2.44
Pro-Zoning×Adj$Open	!0.00003	!0.04	*Pro-Zoning×Adj$Open*	0.00186*	1.92
Pro-Zoning×Develop$Road	!0.00938	!0.07	*Pro-Zoning×Develop$Road*	0.03739	0.27
Pro-Zoning×Lg$Mammal	0.00759	0.12	*Pro-Zoning×Lg$Mammal*	0.06156	0.90
Pro-Zoning×Sm$Mammal	0.01526	0.24	*Pro-Zoning×Sm$Mammal*	0.05665	0.87
Pro-Zoning×Com$Bird	!0.01672	!0.36	*Pro-Zoning×Com$Bird*	!0.05187	!1.04
Pro-Zoning×Uncom$Bird	!0.09371**	!2.03	*Pro-Zoning×Uncom$Bird*	0.00150	0.03
Pro-Zoning×Wet$Sp	0.03232	0.68	*Pro-Zoning×Wet$Sp*	0.02661	0.50
Pro-Zoning×Dense$Dif	!0.22294**	!2.14	*Pro-Zoning×Dense$Dif*	!0.08365	!0.87
Pro-Zoning×Size$Dif	!0.00145	!1.29	*Pro-Zoning×Size$Dif*	!0.00047	!0.38
Pro-Zoning×Traf$Light	0.07196	0.66	*Pro-Zoning×Traf$Light*	!0.01987	!0.17
Pro-Zoning×Low$Vis	0.16377	1.38	*Pro-Zoning×Low$Vis*	0.19556*	1.66
Pro-Zoning×Tax$Dif	0.00194***	3.44	*Pro-Zoning×Tax$Dif*	!0.00004	!0.07
Factor 2 Interactions:			**Factor 2 Interactions:**		
Pro-Develop×Edge$Area	!0.00051	!0.02	*Restrict-Develop×Edge$Area*	0.04612	1.34
Pro-Develop×Develop2	!0.04866	!0.21	*Restrict-Develop×Develop2*	!0.04645	!0.21
Pro-Develop×Develop4	0.25963	1.55	*Restrict-Develop×Develop4*	!0.21466	!1.18
Pro-Develop×Iso$Open	!0.00118	!0.70	*Restrict-Develop×Iso$Open*	0.00100	0.53
Pro-Develop×Adj$Open	!0.00000	!0.00	*Restrict-Develop×Adj$Open*	!0.00039	!0.40
Pro-Develop×Develop$Road	0.21904*	1.81	*Restrict-Develop×Develop$Road*	0.00713	0.05
Pro-Develop×Lg$Mammal	0.03904	0.59	*Restrict-Develop×Lg$Mammal*	0.02898	0.43
Pro-Develop×Sm$Mammal	0.04285	0.68	*Restrict-Develop×Sm$Mammal*	0.03271	0.49
Pro-Develop×Com$Bird	!0.03845	!0.89	*Restrict-Develop×Com$Bird*	0.01197	0.25
Pro-Develop×Uncom$Bird	0.00071	0.02	*Restrict-Develop×Uncom$Bird*	!0.02369	!0.49
Pro-Develop×Wet$Sp	!0.05858	!1.24	*Restrict-Develop×Wet$Sp*	!0.02347	!0.47
Pro-Develop×Dense$Dif	0.25970***	2.68	*Restrict-Develop×Dense$Dif*	!0.02512	!0.26
Pro-Develop×Size$Dif	0.00223**	2.08	*Restrict-Develop×Size$Dif*	0.00240**	1.98

(continued . . .)

Table 6. Continued

Burrillville Random-Effects Logit Model			Exeter Random-Effects Logit Model		
Description	Parameter Estimate	*z*-Statistic	Description	Parameter Estimate	*z*-Statistic
Factor 2 Interactions (cont'd.):			**Factor 2 Interactions (cont'd.):**		
Pro-Develop×Traf$Light	0.17265	1.57	*Restrict-Develop×Traf$Light*	0.01346	0.11
Pro-Develop×Low$Vis	0.09646	0.88	*Restrict-Develop×Low$Vis*	0.10386	0.88
Pro-Develop×Tax$Dif	!0.00056	!1.09	*Restrict-Develop×Tax$Dif*	0.00133**	2.24
Factor 3 Interactions:			**Factor 3 Interactions:**		
Con-Fee×Edge$Area	!0.00821	!0.27	*Pro-Develop×Edge$Area*	!0.04005	!1.18
Con-Fee×Develop2	!0.11404	!0.52	*Pro-Develop×Develop2*	!0.01097	!0.05
Con-Fee×Develop4	0.09276	0.58	*Pro-Develop×Develop4*	0.15616	0.90
Con-Fee×Iso$Open	!0.00200	!1.18	*Pro-Develop×Iso$Open*	0.00342*	1.83
Con-Fee×Adj$Open	!0.00155*	!1.74	*Pro-Develop×Adj$Open*	!0.00055	!0.60
Con-Fee×Develop$Road	!0.11520	!0.93	*Pro-Develop×Develop$Road*	0.08319	0.62
Con-Fee×Lg$Mammal	0.03776	0.58	*Pro-Develop×Lg$Mammal*	!0.12396*	!1.82
Con-Fee×Sm$Mammal	!0.09316	!1.49	*Pro-Develop×Sm$Mammal*	!0.06639	!1.05
Con-Fee×Com$Bird	0.10055**	2.24	*Pro-Develop×Com$Bird*	0.01158	0.23
Con-Fee×Uncom$Bird	!0.05620	!1.31	*Pro-Develop×Uncom$Bird*	!0.09249**	!1.97
Con-Fee×Wet$Sp	!0.03083	!0.67	*Pro-Develop×Wet$Sp*	0.04576	0.89
Con-Fee×Dense$Dif	0.09999	1.14	*Pro-Develop×Dense$Dif*	0.32707***	3.29
Con-Fee×Size$Dif	0.00094	0.81	*Pro-Develop×Size$Dif*	0.00062	0.51
Con-Fee×Traf$Light	!0.16560	!1.48	*Pro-Develop×Traf$Light*	0.10391	0.91
Con-Fee×Low$Vis	0.12544	1.13	*Pro-Develop×Low$Vis*	0.21997*	1.84
Con-Fee×Tax$Dif	!0.00033	!0.63	*Pro-Develop×Tax$Dif*	!0.00011	!0.19
Factor 4 Interactions:			**Factor 4 Interactions:**		
Pro-Purchase×Edge$Area	0.03820	1.21	*Con-Purchase×Edge$Area*	!0.01431	!0.41
Pro-Purchase×Develop2	!0.40161*	!1.83	*Con-Purchase×Develop2*	0.00413	0.02
Pro-Purchase×Develop4	0.00492	0.03	*Con-Purchase×Develop4*	!0.10306	!0.58
Pro-Purchase×Iso$Open	0.00200	1.22	*Con-Purchase×Iso$Open*	!0.00213	!1.01
Pro-Purchase×Adj$Open	0.00134	1.57	*Con-Purchase×Adj$Open*	!0.00147	!1.52
Pro-Purchase×Develop$Road	!0.00009	!0.00	*Con-Purchase×Develop$Road*	!0.14861	!1.07
Pro-Purchase×Lg$Mammal	!0.08574	!1.35	*Con-Purchase×Lg$Mammal*	!0.06191	!0.92
Pro-Purchase×Sm$Mammal	0.11317*	1.75	*Con-Purchase×Sm$Mammal*	0.00138	0.02
Pro-Purchase×Com$Bird	!0.02193	!0.50	*Con-Purchase×Com$Bird*	0.06176	1.19
Pro-Purchase×Uncom$Bird	0.00068	0.01	*Con-Purchase×Uncom$Bird*	!0.03672	!0.81
Pro-Purchase×Wet$Sp	0.00214	0.05	*Con-Purchase×Wet$Sp*	0.03901	0.76
Pro-Purchase×Dense$Dif	!0.13803	!1.39	*Con-Purchase×Dense$Dif*	!0.05802	!0.56
Pro-Purchase×Size$Dif	!0.00063	!0.57	*Con-Purchase×Size$Dif*	0.00137	1.09
Pro-Purchase×Traf$Light	0.12755	1.14	*Con-Purchase×Traf$Light*	0.01084	0.09
Pro-Purchase×Low$Vis	0.01603	0.14	*Con-Purchase×Low$Vis*	!0.00098	!0.01
Pro-Purchase×Tax$Dif	0.00057	1.08	*Con-Purchase×Tax$Dif*	!0.00301***	!4.72
Factor 5 Interactions:			**Factor 5 Interactions:**		
Pro-Tax×Edge$Area	0.05578*	1.65	*Con-Fee×Edge$Area*	!0.05868*	!1.66
Pro-Tax×Develop2	!0.16358	!0.68	*Con-Fee×Develop2*	0.11907	0.48
Pro-Tax×Develop4	!0.37328**	!2.14	*Con-Fee×Develop4*	0.11236	0.66
Pro-Tax×Iso$Open	0.00380**	2.30	*Con-Fee×Iso$Open*	0.00013	0.06
Pro-Tax×Adj$Open	0.00122	1.41	*Con-Fee×Adj$Open*	0.00007	0.07
Pro-Tax×Develop$Road	!0.15582	!1.17	*Con-Fee×Develop$Road*	!0.00848	!0.06
Pro-Tax×Lg$Mammal	0.00587	0.09	*Con-Fee×Lg$Mammal*	!0.10928	!1.59
Pro-Tax×Sm$Mammal	!0.04116	!0.65	*Con-Fee×Sm$Mammal*	0.06736	1.03
Pro-Tax×Com$Bird	!0.00322	!0.07	*Con-Fee×Com$Bird*	!0.01664	!0.34
Pro-Tax×Uncom$Bird	!0.00981	!0.21	*Con-Fee×Uncom$Bird*	0.03435	0.76

(continued . . .)

Table 6. Continued

Burrillville Random-Effects Logit Model			**Exeter Random-Effects Logit Model**		
Description	Parameter Estimate	*z*-Statistic	Description	Parameter Estimate	*z*-Statistic
Factor 5 Interactions (cont'd.):			**Factor 5 Interactions (cont'd.):**		
Pro-Tax×Wet$Sp	0.08994*	1.85	*Con-Fee×Wet$Sp*	!0.09721*	!1.91
Pro-Tax×Dense$Dif	!0.02141	!0.22	*Con-Fee×Dense$Dif*	0.25776***	2.87
Pro-Tax×Size$Dif	0.00144	1.27	*Con-Fee×Size$Dif*	0.00145	1.21
Pro-Tax×Traf$Light	!0.03947	!0.36	*Con-Fee×Traf$Light*	!0.09829	!0.84
Pro-Tax×Low$Vis	!0.02486	!0.22	*Con-Fee×Low$Vis*	0.01059	0.09
Pro-Tax×Tax$Dif	0.00124**	2.28	*Con-Fee×Tax$Dif*	0.00067	1.29
			Factor 6 Interactions:		
			Pro-Tax×Edge$Area	!0.02745	!0.81
			Pro-Tax×Develop2	0.13583	0.56
			Pro-Tax×Develop4	!0.07082	!0.42
			Pro-Tax×Iso$Open	0.00043	0.23
			Pro-Tax×Adj$Open	0.00185*	1.93
			Pro-Tax×Develop$Road	0.08520	0.61
			Pro-Tax×Lg$Mammal	0.00645	0.10
			Pro-Tax×Sm$Mammal	0.00846	0.12
			Pro-Tax×Com$Bird	!0.02302	!0.47
			Pro-Tax×Uncom$Bird	!0.04701	!0.97
			Pro-Tax×Wet$Sp	0.01100	0.21
			Pro-Tax×Dense$Dif	!0.07494	!0.80
			Pro-Tax×Size$Dif	!0.00319***	!2.63
			Pro-Tax×Traf$Light	0.08810	0.70
			Pro-Tax×Low$Vis	0.03707	0.31
			Pro-Tax×Tax$Dif	0.00347***	5.24
Factor Main Effects:			**Factor Main Effects:**		
Pro-Zoning	!0.05777	!0.73	*Pro-Zoning*	0.12860	1.50
Pro-Develop	!0.01081	!0.14	*Restrict-Develop*	0.09911	1.12
Con-Fee	0.11629	1.46	*Pro-Develop*	!0.06941	!0.83
Pro-Purchase	!0.07608	!0.96	*Con-Purchase*	!0.08285	!0.95
Pro-Tax	!0.04493	!0.55	*Con-Fee*	0.16370**	2.02
			Pro-Tax	0.03015	0.35
$\ln(\sigma_v)$	!1.51	1.02	$\ln(\sigma_v)$	!1.78	1.48
σ_v	0.47	0.24	σ_v	0.41	0.30
ρ	0.18	0.15	ρ	0.05	0.02
χ^2 for LR test ($\rho = 0$):	1.18 (Prob = 0.14)		χ^2 for LR test ($\rho = 0$):	0.53 (Prob = 0.23)	
!2LnL χ^2:	575.50 (Prob = 0.01)		!2LnL χ^2:	670.18 (Prob = 0.01)	

Note: *, **, and *** denote statistical significance at $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Although the interactions of *Pro-Purchase×Iso$Open* and *Pro-Purchase×Adj$Open* in Burrillville indicate a point-estimate gain in marginal utility associated with strength of support for the purchase and preservation of undeveloped land, this effect is not statistically significant at $p<0.10$ (for *Pro-Purchase×Adj$Open*, $p<0.12$). That is, from a statistical perspective, support for the purchase and preservation of open space is not correlated with the marginal utility of preserved open space. An analogous lack of statistical significance is found in the Exeter sample. However, among Exeter responses, we find significant and intuitive correlation between opposition to purchase and preservation of open space and an increased marginal utility of income (i.e., tax changes).

Pro-Tax Factor Score Interactions (Burrillville Factor 5, Exeter Factor 6)

This factor characterizes a respondent's willingness to support policies which include explicit tax increases. Among other statistically significant correlations, the significant parameter estimate associated with *Pro-Tax*×*Iso$Open* in Burrillville and *Pro-Tax*×*Adj$Open* in Exeter indicates the welfare gain associated with open space preservation is greater for those with higher *Pro-Tax* factor scores. Also among both samples, positive and significant parameter estimates associated with *Pro-Tax*×*Tax$Dif* support the intuitive result that higher *Pro-Tax* factor scores are associated with a lower marginal utility of income (or tax changes).

Implications and Discussion

Although the combined factor analysis-logit model suggests numerous intuitive correlations among support for land use management tools and marginal utility of attributes associated with those tools, model results also highlight the potential risk in presuming such correlations exist on a wide scale, or that all correlations will match simple intuition. While statistically significant correlations exist, results do not indicate a particularly pervasive set of associations between policy support and outcome preferences. Moreover, while we find no cases in which model results establish outright conflict between policy support and land use preferences, some statistically significant correlations defy simple, intuitive explanation.

Among the more statistically significant correlations are those involving the marginal utility of housing density and tax changes. For example, both Burrillville and Exeter responses show a statistically significant interaction between the pro-development factor and the marginal utility of housing density; this correlation is significant at $p < 0.01$ in both models. Similarly, *Tax$Dif* (the change in household taxes) has statistically significant interactions with at least two factor scores in each model. However, marginal utility for most model attributes is correlated (at $p < 0.10$) with at least one factor score, in at least one of the two estimated models.

While the preceding discussion has, for the most part, emphasized the presence of statistically significant interactions, a lack of statistical significance may also be of potential importance. For example, the model demonstrates no statistically significant relationship between strength of support for the purchase and preservation of undeveloped land and the marginal utility of preserved open space. Indeed, statistically significant interactions appear to be the exception rather than the rule.

Of 80 total interactions included in the combined model for Burrillville, only 15 are statistically significant at $p < 0.10$. In the Exeter model, 18 out of 96 interactions are statistically significant. These results suggest substantial independence among indicators of policy support and the marginal utility of associated land use attributes. While reasons for this outcome are unknown, it may be related in part to poorly defined associations among certain management tools and management outcomes among typical respondents (recall, support for tools and preferences for outcomes were measured in distinct sections of the survey instrument).

These results suggest that (*a*) the marginal utility for management outcomes is in many cases independent of support for tools which might be used to achieve those outcomes; (*b*) significant correlation among support for management tools and marginal utility of management outcomes may be more prevalent for particular types of outcomes (e.g., housing density, tax changes); and (*c*) the relationships among support for policies and preferences for outcomes are in some cases less intuitive than is typically assumed.

These conclusions have potential implications for the policy process in rural communities, particularly in cases where residents' support is required to enact policy changes. For example, one might speculate that if welfare gain resulting from open space preservation or similar policies is not correlated with support for tools designed to accomplish these goals (perhaps because residents have imperfect or inaccurate perceptions of management tools), then policy makers may face difficulty in obtaining a broad base of unequivocal resident support. However, in areas where policy support and welfare effects coincide, constituency-building may be more effective.

Model results also indicate correlations between policy support and the marginal utility of land use attributes may differ across communities. While in some cases the Exeter and Burrillville models produce similar results, there are also numerous differences in correlations found in the two models. These findings are not unexpected given differences in the communities sampled.

Despite similar demographic profiles, Burrillville is more densely populated (2000 population of 15,796, and a density of 284.1 persons/square mile) with more significant areas that might be characterized as suburban (U.S. Bureau of the Census, 2000; Rhode Island Department of Administration, 2001). Exeter is almost entirely rural, with a more sparse population (2000 population of 6,045, and a density of 104.7 persons/square mile) (U.S. Bureau of the Census, 2000). The communities also differ in terms of zoning and land development regulations as well as in the percentage of land preserved as open space by government or nongovernmental entities (Rhode Island Department of Administration, 2001). Such divergences in population density, land cover, and land use regulation could easily contribute to the statistical differences found here.

Conclusion

While the literature provides significant insight into the preferences of rural residents for outcomes of land management, preferences for outcomes do not necessarily imply matching support for the underlying policy process. Nonetheless, economists typically disassociate preferences for management outcomes from detailed analysis of policies that might generate those outcomes. Such piecemeal analysis may result in misleading or, at best, partial guidance to policy makers. The preceding analysis shows that preferences for management outcomes are sometimes, but not necessarily, correlated with support for associated policy tools. While numerous intuitive and statistically significant correlations exist, statistical significance does not guarantee an intuitive or easily interpretable relationship.

These findings highlight the potential limitations of preference elicitation methods used in isolation. While typical conjoint or choice models may reveal the marginal utility of management outcomes, they often fail to assess whether estimated preferences are linked with a corresponding support for management options able to deliver valued outcomes. Similarly, surveys that assess strength of support for management tools rarely assess the welfare implications of land use outcomes which would result from application of those tools. By overlooking the possibility of significant positive or negative correlations, researchers risk unanticipated public reactions to the policy process. This study highlights such potential complexities, in the hope of stimulating further research to aid in rural policy development.

To our knowledge, this study presents the first broad analysis of correlation among preferences for rural land use attributes and support for associated policy mechanisms. However, given the characteristics of available survey data, the analysis cannot explicitly address the impact of different policy tools on the welfare implications of land use policies. One possible direction for future analysis would be to incorporate detailed and varying descriptions of policy options into choice questions evaluated by respondents. Analysts could then assess individuals' support for different policy mechanisms relative to the marginal utilities associated with the physical land use outcomes.

More advanced analysis might also elucidate proposed tradeoffs among the attributes of the policy tools themselves, such as preferences for long-term flexibility, equitable treatment of residents or property owners, and the distribution of benefits and costs over heterogeneous stakeholder groups. Such research could facilitate academics' ability to extend the tools of preference assessment for use in designing more successful land use policy programs in the public interest. The challenge facing researchers is to develop means to incorporate such elements in stated preference surveys, while preserving survey formats that are manageable for typical respondents and findings that are accessible to the policy audience.

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