Stated Preferences and Length of Residency in Rural Communities: Are Development and Conservation Values Heterogeneous?

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Abstract

Newer residents of rural, urban-fringe communities are often assumed to have preferences for the development and conservation of rural lands that differ from those of longer-term residents. The existing literature offers little to verify or quantify presumed preference shifts. This paper provides a systematic, quantitative examination of whether stated preferences for development and conservation tradeoffs differ according to length of residency in a rural community, and explores implications of these findings for assumptions regarding development and conservation preferences. Results are based on stated preferences estimated from a multi-attribute contingent choice survey of Rhode Island rural residents. Heterogeneity—according to length of town residency—is incorporated using Lagrangian Interpolation Polynomials. This approach models the influence of policy attributes as a polynomial function of residence time, thereby allowing estimated coefficient values to vary as a continuous function of residence duration.

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Introduction

Newer residents of rural communities are often assumed to have preferences for the development and conservation of rural lands that differ from those of longer-term residents (Kelsey 1998; Spain 1993). Assumptions regarding preference heterogeneity associated with length of residency typically reflect one or more of a set of common themes. These include, among others: (a) the assumption that newer residents have relatively stronger preferences for restrictions on new development, with particular interests in maintaining the scenic value of land (Dubbink 1984; Healy and Short 1979); (b) the assumption that newer residents often demand expanded, improved roads and community services (Spain 1993; Kelsey 1998); (c) the assumption that the perception and value of rural attributes (e.g., wildlife habitat) differs according to the length of residency in a rural area, as a result of experiences related to longer-term rural residence (Myers

1987; 1989; Spain 1993), and; (d) the assumption that newer residents are relatively less concerned with the cost of living (including local taxes) and relatively more concerned with aesthetic and recreational attributes associated with rural communities (Spain 1993; Dubbink 1984).

Despite the ubiquity of these and other statements regarding preferences of newer and longer-term residents, the literature offers little to verify or quantify presumed preference shifts. Although a variety of works in the economics literature address heterogeneity in stated preferences for environmental policies (e.g., Swallow et al. 1994; Layton 2000; Loomis 1987), these works do not address preferences for rural land use, nor impacts related to length-of-residency.[1] While the geography, rural sociology, and planning literatures contain research that addresses attitudinal differences between new and more established community residents, this research focuses primarily on qualitative findings derived from ethnographic or other interview methods (e.g., Salamon and Tornatore 1994; Dubbink 1984). Those works that apply quantitative methods typically emphasize measurement of relatively abstract attitudes towards residential development and conservation (e.g., Spain 1993; Theodori and Luloff 2000; Pendall 1999).

Appropriate quantification of preferences for specific development and conservation tradeoffs—among different resident groups—can help determine the suitability of specific growth management options in rural communities (Spain 1993; Kelsey 1998), and enable researchers to better understand how policy tradeoffs influence the welfare of different groups. Moreover, as the actions of zoning boards, conservation commissions, and town councils regarding rural land use policies may be influenced by common stereotypes regarding constituents' preferences, information regarding potential differences between actual and assumed preferences of different resident groups may be highly relevant to local policy decisions (e.g., Pendall 1999).

This paper provides a systematic, quantitative examination of whether stated preferences for particular residential development and conservation tradeoffs differ according to length of residency in a rural community, and explores implications of these findings for common assumptions regarding development and conservation preferences. We examine preferences within the context of alternative proposals to develop rural lands for residential purposes in southern New England. Results are based on preferences estimated from a multi-attribute contingent choice survey of residents from four Rhode Island rural communities.

Heterogeneity—according to length of town residency—is incorporated using Lagrangian Interpolation Polynomials to shift regression coefficients (Tyrrell 1983). This approach models the influence of independent variables (i.e., policy attributes) as a polynomial function of residence time. This allows estimated coefficient values to shift as a continuous function of residence time, rather than imposing the familiar and often unrealistic discrete coefficient shifts characteristic of dummy variable approaches.

The Contingent Choice Model

A Random Utility Model with Homogeneous Preferences

We begin with a simple model in which preferences do not depend on length of residency in a particular rural community. In the present context, respondents from four Rhode Island rural communities were asked to consider alternative development options for a hypothetical, 400 acre tract of forested land located in their local town, an area which comprises just over 1% of the land area in each of the four towns. Respondents were provided with two development options, a "current development plan" and an "alternate development plan," where each plan could differ across a set of spatial and non-spatial attributes. These attributes characterized land use features and amenities identified by focus groups and interviews with growth management practitioners.

To model a respondent's choice, 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):

$$U(\cdot) = U(X_c, Y\text{-}F_c) = v(X_c, Y\text{-}F_c) + \varepsilon_c \tag{1}$$

where

X_c = a vector of variables describing attributes of development or conservation plan c;

Y = disposable income of the respondent.

F_c = the change in mandatory taxes paid by the respondent under development plan c;

$v(\cdot)$ = a function representing the empirically measurable component of utility;

ε_c = a term representing econometric error.

If the respondent compares the current development plan ($c = A$), to the alternate development plan ($c = B$), then the change in utility (dU) may be modeled as

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

The theoretical model assumes a respondent assesses the difference between utility under the two plans and indicates the sign of dU by either choosing the current development plan ($dU>0$) or the alternate development plan ($dU<0$). 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).

Although the literature offers no firm guidance regarding the choice of specific functional forms for dv, in practice linear forms are often used (although, see Layton 2001). Assuming a linear form

$$dv = v(X_A, F_A)\text{-}v(X_B, F_B) = \beta_x(X_A\text{-}X_B) + \beta_f(F_B\text{-}F_A), \quad (3)$$

where β_x is a conforming vector of coefficients associated with the vector of attribute differences $(X_A\text{-}X_B)$ and β_f as a scalar coefficient associated with the tax difference $(F_B\text{-}F_A)$. The parameter vector β_x may be interpreted as the marginal utility of various development or conservation attributes of a development plan, while β_f quantifies the marginal utility of income. The absence of income (Y) from (3) reflects the fact that disposable income is assumed unaffected by rural development, aside from direct deductions associated with the cost of each plan, and hence subtracts out of the linear model for dv.

Incorporating Preference Heterogeneity Using Lagrangian Interpolation Polynomials

As specified, (3) implies homogeneous preferences; neither β_x nor β_f may vary according to length of residency. An heterogeneous preferences model (e.g., Swallow et al. 1994) would allow parameters to vary across residency groups, thereby allowing the marginal utility of land use attributes and income to vary. A common approach to such models is the use of dummy variables to allow systematic, but discrete, variations in slope and intercept coefficients; this approach imposes fixed preferences on predefined residency groups, with discrete preference shifts between groups. For example, one might define a dummy variable to distinguish those with less than ten years of town residency from longer-term residents. This would allow different slope and intercept parameters for the two groups, but would impose constant preferences within each group. The model would constrain all change in preferences to occur in one discrete shift, occurring at the threshold between ten and eleven years of residency.

Formally, this more common approach to heterogeneity would redefine *dv* in (3) to provide a separate estimate of utility for each group of respondents. In the simplest case, the approach would define a dummy variable D_{t*} to equal one for respondents whose residency is t* years or more, and equal to zero otherwise. Then, *dv* would become:

$$dv = \beta_X^{\leq t*} (1 - D_{t*})(X_A - X_B) + \beta_f^{\leq t*} (1 - D_{t*})(F_B - F_A) + \beta_X^{>t*} D_{t*} (X_A - X_B) + \beta_f^{>t*} D_{t*} (F_B - F_A) \quad (4)$$

where ($\beta_X^{\leq t*}$, $\beta_f^{\leq t*}$) represents the marginal utility parameters for respondents whose residence time is less than or equal to t*, and ($\beta_X^{>t*}$, $\beta_f^{>t*}$) represents these marginal utilities for respondents with residence times greater than t*.

An alternative approach, following Tyrrell (1983), specifies the effect of each attribute of an alternative (i.e., independent variable) as a polynomial function of a continuous variable. For the case of residence time, such a polynomial function would be

$$P_a(t) = \alpha_{a0} + \alpha_{a1} t + \alpha_{a2} t^2 + \ldots + \alpha_{an} t^n \quad (5)$$

where *a* indexes an independent variable corresponding to one of the columns of matrix ($X_A - X_B$, $F_B - F_A$), $P_a(t)$ is the value of the polynomial corresponding to variable *a*, *t* represents the residence time of the respondent (or, more generally, the value of a continuous variable with respect to which heterogeneity will be modeled), and *n* represents the degree of the polynomial chosen by the analyst. The α_{ai} are unknown parameters determining the value of the polynomial corresponding to independent variable (attribute) *a*.

We use the polynomials in (5) to replace model (4) with a more general, and more flexible, model that smoothly modifies the basic utility function for individuals whose residence time is *t*. Thus, the polynomial-based model causes the analyst to index *dv* by *t*, such that

$$dv_t = \underline{P}(t)(X_A - X_B) + P_f(t)(F_B - F_A) \quad (6)$$

where $\underline{P}(t)$ is a row vector whose elements are defined by (5), conforming to matrix ($X_A - X_B$). In comparing to the systematically-varying slopes approach represented by (4), one sees that model (4) is a special case of model (6) where the polynomial parameters are replaced by constant parameters such that[2]

$$[\underline{P}(t), P_f(t)] \quad \begin{array}{l} \rightarrow [\beta_X^{\leq t^*}, \beta_f^{\leq t^*}] \text{ for } t \leq t^* \\ \rightarrow [\beta_X^{>t^*}, \beta_f^{>t^*}] \text{ for } t > t^*. \end{array} \tag{7}$$

The function $P_a(t)$ takes anchor values γ_{ai} at $n+1$ unique reference points r_i, where $i \in (0,1,2,\ldots,n)$ identifies these reference points. The degree of the estimable polynomial, n, depends on the number of reference points ($n+1$) chosen by the researcher. These reference points r_i represent residence times $t=r_i$ at which coefficients γ_{ai} will be estimated, thereby anchoring the polynomial function at these reference residence times, or points along the continuous variable. That is, $P_a(r_i)= \gamma_{ai}$. The reference residence times are typically chosen to aid in policy analysis or assessment of the implications of the modeling. This framework implies a system of equations

$$\underline{R}_{n+1}\, \alpha_a = \gamma_a \tag{8}$$

where $\underline{R}_{n+1}$ is a square $(n + 1, n + 1)$ matrix with rows $[1, r_i, r_i^2, \ldots, r_i^n]$ corresponding to the n+1 reference points; α_a is a column vector $[\alpha_{a0}, \alpha_{a1}, \alpha_{a2}, \ldots, \alpha_{an}]'$; and γ_a is a column vector consisting of elements $\{\gamma_{ai}\}$ for all $i \in \{0, 1, 2, \ldots, n\}$. Thus, equation (8) is replicated for each attribute a for which one intends to estimate heterogeneity in preferences. Combining (5) and (8) allows a restatement of unknown parameters α_a (Tyrell 1983; Shchigolev 1965):

$$\alpha_a = \underline{R}_{n+1}^{-1}\, \gamma_a. \tag{9}$$

By defining $T(t)'$ as the vector $[1, t, t^2, \ldots, t^n]$, the polynomial functions then become:

$$P_a(t) = T(t)'\, \alpha_a = T(t)'\, \underline{R}_{n+1}^{-1}\, \gamma_a = \mathbf{L(t)'}\, \gamma_a\,, \tag{10}$$

where row-vector **L(t)’** contains $n+1$ elements based on each of the reference residence times incorporated in $\underline{R}_{n+1}$. Equation (10) defines the marginal utility represented by $P_a(t)$, for residence time t, as an interpolation of its values at the reference points established in γ_a. This interpolation uses Lagrangian Interpolation Polynomials (LIPs) as given by Tyrrell (1983):

$$L_i(t) = \prod_{k \neq i} \frac{(t - r_k)}{(r_i - r_k)} \quad \text{for } i=(0,1,2,\ldots,n). \tag{11}$$

which defines the $n+1$ elements of **L(t)’**. The LIPs in (11) take on known values at each of the reference points, residence times r_i. In particular, LIP $L_j(t) = 1$ when t equals reference point r_j, while $L_j(t) = 0$ when t equals some other reference point r_i, for $i \neq j$. For t falling between any two reference points, the LIPs will take on interpolated values, yielding an estimated marginal utility for the attribute through equation (10). Equation (11) also implies that $\sum_i L_i(t) = 1$.

Using LIPs, one obtains a more flexible model of *dv* allowing systematically estimated marginal utilities depending upon reference parameters that are estimated directly and conveniently interpreted:

$$dv_t = \Sigma_a \Sigma_{i=0,n} \gamma_{ai} [L_i(t) (X_{Aa} - X_{Ba})] + \Sigma_{i=0,n} \gamma_{fi} [L_i(t) (F_B - F_A)] \qquad (12).$$

Here, one interprets the γ_i's as the marginal utility of attribute *a* (or of income, for γ_f) for an individual with residence time t equal to r_i. The interpolation function (LIPs) allows an interpolation of preference functions estimated for the reference individuals to obtain an estimated preference function for individuals whose residence times fall between the times for reference individuals. The structure of (12) appears similar to a model in which dummy variables are used to split the sample. However, unlike dummy variables, LIPs only take on (0,1) values at the reference points. Model (12) (following (10) above) implies that the influence of any model attribute, for an individual with residence time t, may be specified as an LIP-weighted sum of the $n+1$ estimated anchor coefficient values. By comparison, in the usual systematically-varying slopes model, exemplified by (4), preferences are modeled by discrete changes in marginal utilities based on the arbitrary definition of specific groups of individuals.

For example, the parameters γ_{fi} $(i=0...n)$ represent the marginal utility of income. The model estimates the value of γ_{fi} at reference points $0,1,...n$, generating estimates γ_{f0}, γ_{f1}, … , γ_{fn}. These estimates represent the marginal utility of income for residents whose length of residency corresponds exactly to the associated reference point. For residents whose length of residency does not correspond exactly to one of the reference points, the interpolated coefficient value is equal to $\gamma_{f0}(L_0(t))+ \gamma_{f1}(L_1(t))+...+ \gamma_{fn}(L_n(t))$. This allows a nonlinear influence of residence time on the marginal utility of income. Parallel interpretations apply to coefficients for all independent variables (Tyrrell 1983).

The Survey

The "Rhode Island Rural Land Use" survey was designed to assess rural residents' tradeoffs among attributes of residential development and conservation. The following analysis is based on surveys returned from Burrillville, Exeter, West Greenwich, and Coventry, four Rhode Island communities located in the rural western half of the state; survey data aggregate results from these four communities. Survey development and implementation required over twenty-four months, and involved background research; interviews with growth management experts, policy makers, and local residents; and focus groups. Intensive pretesting was conducted to ensure that the survey language and format could be easily understood by respondents, and that respondents shared interpretations of survey scenarios (cf. Johnston et al. 1995). Focus groups led to a survey format in which most information was presented on stylized maps of hypothetical development plans.

Attributes distinguishing management plans (i.e., the current versus alternate management plan) were chosen based on focus groups and expert interviews, and characterized protected open space, residential development, unprotected undeveloped land, scenic views, wildlife habitat, public access, recreational facilities, traffic, and taxes (see Table 1). Respondents were asked to evaluate hypothetical descriptions of residential development and conservation plans that could vary in terms of housing density, size (acres), location, proximity to main roads, spatial layout, and proximity to preserved open space, among other factors. Open space and other land uses were also characterized by a range of attributes, including size and proximity to developed areas.

Prior to presenting respondents with development choices, the survey provided background information on the community and its current land use, and reminded respondents of tradeoffs implicit in development choices. Contingent choice instructions and questions were then presented, in which respondents were given the choice to vote for the "current" or the "alternate" development plan, 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 this parcel as undeveloped and forested prior to the choice of development plans.

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 that "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, and is likely to gain approval for a particular development. However, town planners may seek to influence the configuration of the development, delaying required permits unless design changes are made. As a result of this interaction, town officials may exert some control over the ultimate form of development.

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 resulted in 128 unique contingent choice questions divided among 43 different survey booklets (three questions per booklet).[3] Surveys were mailed to 4000 randomly selected residents of the four Rhode Island towns in Spring 2000, following the total survey design method (Dillman 2000).

Of 3702 deliverable surveys, 2157 were returned, providing 6062 (94% of the potential 6471) complete and usable responses to dichotomous choice questions. Of these, 5774 observations included information regarding length of residency. Resident groups were defined based on responses to the survey question: "How long you have lived in your current town?" The question was open-ended, and specified that the response be given in years. Approximately 41% of all usable observations (2402) indicated ten or fewer years of residency, 35% (2042) indicated between eleven and thirty years of residency, and 17% (998) indicated greater than thirty years of residency.

The Econometric Model

Based in part on results of focus groups, reference points for length-of-residency were set at 0, 10, and 30 years. This results in three LIPs (cf. equation (11)), implying a quadratic polynomial function. Based on (11), the three LIPs are given by

$$L_0(t) = \frac{(t-10)(t-30)}{(0-10)(0-30)}, \quad L_1(t) = \frac{(t-0)(t-30)}{(10-0)(10-30)}, \quad L_2(t) = \frac{(t-0)(t-10)}{(30-0)(30-10)}, \tag{13}$$

where t represents the length of residency for each observation. Combined with (12), these LIPs provide the basis for empirical estimation.

As the final data set is comprised of three responses per survey respondent, there is a possibility of correlated errors across responses (Alberini et al. 1997; Poe et al. 1997). That is, for a single respondent, θ may violate the typical iid assumption, even though responses across different respondents are independent. This may be modeled by splitting θ into two components: $\widetilde{\theta}$ that is iid across all respondents and for each individual respondent, and an individual-specific component γ_h that represents systematic variation or heterogeneity related to unobserved characteristics of respondent h. The latter component, γ_h, is denoted a 'random effect' (Alberini et al. 1997; Hsiao 1986). Accordingly, equation (2) becomes

$$dU_h = dv_h - (\widetilde{\theta} + \gamma_h) \tag{14}$$

where the subscript h indexes individual respondents. If the γ_h are assumed normally distributed across respondents, and we retain the prior assumption regarding the logistic distribution of $\widetilde{\theta}$, the model may be estimated as a random effects logit model (Pendergast et al. 1996; Haefele and Loomis 2001).

Model Results

Initial models were estimated to assess whether (12) should be amended to incorporate quadratic interactions with demographic attributes such as age, education, and income, allowing additional flexibility to incorporate potential preference heterogeneity associated with these attributes. Likelihood ratio tests assessing the joint significance of these appended interactions fail to reject the null hypothesis of zero collective influence for quadratic interactions including a respondent's age (χ^2=50.6, df=51; p=0.49), and a dummy variable indicating respondents with at least a four-year college education (χ^2=54.5, df=51; p=0.34). Likelihood ratio tests *reject* the null hypothesis of zero collective influence for interactions involving a dummy variable identifying respondents with income below $40k ($\chi^2$=77.81, df=51; p=0.01). However, likelihood ratio tests *fail* to reject the null hypothesis of zero collective influence for interactions between the low-income dummy variable and all model attributes *except* the change in mandatory taxes (i.e., the payment vehicle) (χ^2=48.42, df=48; p=0.46). Based on these results, the final model includes quadratic interactions between the low-income dummy and the tax difference, but excludes other demographic interactions.

Results for the final random-effects logit model are presented in Table 2. Parameter estimates prefixed with L_0, L_1, and L_2 correspond to estimated parameter values at the reference points of 0, 10, and 30 years of residency, respectively. The model is statistically significant at $p<0.01$ (-2LnL χ2=1947.90, df=54).[4] A log-likelihood ratio test of the unrestricted model versus a restricted model in which homogeneous preferences are imposed (over all residency groups) for all model attributes indicates that the restrictions have a statistically significant impact on the model at $p<0.01$ (χ^2=61.02, *df* = 36). Signs of parameter estimates correspond with expectations derived from focus groups. For example, respondents preferred development plans characterized by: i) larger areas of open space, both isolated and adjacent to roads and developments (*iso_open; adj_open*); ii) smaller areas of developed land (*size_dif*); iii) lower housing densities (*dense_dif*); iv) improved habitat for large mammals (*lg_mammal*), birds (*com_bird; uncom_bird*), and wetland species (*wet_sp*); v) low visibility development (*lowvis*), and; vi) lower annual taxes (*taxdif*).

Wald tests (Judge et al. 1988) of individual parameter estimates reject homogeneity in preferences for five out of sixteen development plan attributes ($p<0.10$); these results are summarized by Table 3. To reduce table size, test results are shown only for variables for which homogeneity in preferences according to length of residency can be rejected at $p<0.10$. Results shown in Table 3 indicate that although factors associated with length of residency influence respondents' consideration of certain rural land use attributes, they do not influence their consideration of the entire set of potential resource changes. That is, the length of time that one has lived in a rural community may or may not influence utility gain (or loss) from rural development or conservation, depending on the particular land use attributes affected.

The five attributes for which homogeneity in preferences may be rejected (Table 3) include *develop_road* (indicating developments adjacent to main roads), *sm_mammal* (habitat quality for small mammals), *traf_light* (indicating the presence of traffic lights), *adj_open* (acres of open space adjacent to developments and roads), and *taxdif*×*lo_inc* (interaction between the payment vehicle and a dummy variable identifying households with annual income < $40,000). Model results for each attribute are summarized below. For the attributes with marginal utilities affected by factors associated with length of residency, we interpret the results in Tables 2 and 3 as follows:

1. *Develop_road*—All resident groups prefer developments to be isolated from main roads. That is, residents rate on-road developments lower than off-road developments. This effect diminishes as length of residency increases[5]; the placement of developments adjacent to main roads has a more negative influence on utility for newer residents.
2. *Sm_mammal*—As length of residency increases, relative preferences favoring improvements in small mammal habitat decline. At the first reference point (r_0) small mammal habitat improvements have a positive but statistically insignificant effect on utility. At the ten year reference point (r_1) small mammal habitat improvements have a negative but insignificant impact. At the thirty year reference point (r_2) improvements in small mammal habitat have a negative and statistically significant ($p<0.05$) impact on utility.
3. *Traf_light*—All resident groups have positive preferences for the presence of traffic controls (i.e., traffic lights), although this effect cannot be shown to be significant at the first reference point (r_0). As length of residency increases, the positive marginal utility associated with the presence of traffic lights increases.
4. *Adj_open*—This variable indicates the quantity of preserved open space adjacent to residential developments or roads. All groups have positive marginal utilities associated with this type of open space, but marginal utility declines as length of residency increases.
5. *Taxdif*—This is the change in unavoidable community taxes, per household/year, associated with particular development or conservation plans. All groups have negative preferences for tax increases, and the coefficient estimate associated with *linear* (i.e., not interacted with income) tax increases cannot be shown to differ as a function of length of residency. However, the estimated effect of low income (i.e., those with incomes less than $40k; Table 1) on the marginal utility of tax increases changes as a function of length of residency. At the first reference point (r_0) the effect of

low income on the marginal utility of tax increases is not statistically significant. At the ten year reference point (r_1) low income has a negative and significant ($p<0.05$) impact on the marginal utility of tax increase (i.e., the negative marginal utility associated with tax increases is larger in magnitude for those with incomes less than $40k). At the thirty year reference point (r_2) low income has a negative and significant ($p<0.05$) impact on the marginal utility of tax increase. Comparing coefficient estimates at the three reference points, the effect of low income on the marginal utility of tax changes *increases* as length of residency increases.

Estimated coefficient differences for these five attributes (Table 3) illustrate that—with the exception of *adj_open*—similar magnitude preference shifts occur between reference points zero and one (a ten year difference between 0 and 10 years of residency), and between points one and two (a twenty year difference between 10 and 30 years). This implies that preferences change more rapidly, on a per-year basis, during early years of residency, with more moderate changes in later years. For *adj_open* (open space adjacent to roads and developments), the estimated coefficient difference between 10 and 30 years of residency is just over twice that of the difference between 0 and 10 years (-0.0012 versus -0.0005). This result implies, again on a per-year basis, that preferences for adjacent open space change at a more constant rate as length of residency increases. Thus, for *adj_open*, the quadratic LIP implies a near linear effect of factors associated with length of residency, while in other cases the effect appears non-linear.

Welfare Implications

Although parameter estimates of these five variables in most cases differ across the three length of residency reference points, statistically significant differences in parameter estimates may not always lead to significant differences in respondents' willingness to pay (WTP) for attribute changes. Moreover, changes in marginal WTP for other attributes may be caused by changes in the marginal utility of tax changes alone. To address such concerns, WTP estimates are calculated for all model attributes. Marginal WTP is calculated at the reference points of 0, 10, and 30 years. Resulting differences are tested for statistical significance.

WTP is calculated using Hanemann's (1984) approach, in which the mean WTP for a marginal change in the a^{th} attribute is equal to -γ_a/γ_f, where γ_a is the parameter estimate corresponding to the a^{th} attribute, and γ_f is the parameter estimate corresponding to the money cost of the program. This basic approach is extended to incorporate the interaction between *taxdif* and the low income indicator (dummy) variable (*lo_inc*), such that WTP differences between length of residency reference points, for the a^{th} attribute are calculated as

$$\frac{-\gamma_{a,Li}}{\gamma_{f,Li} + (\gamma_{f\times lo\_inc,Li} \times lo\_inc)} - \frac{-\gamma_{a,Lj}}{\gamma_{f,Lj} + (\gamma_{f\times lo\_inc,Lj} \times lo\_inc)} \quad \text{for } i \neq j, \qquad (15)$$

where *i,j = (0,1,2)* correspond to length of residency reference points 0, 10, and 30, respectively, and (15) is calculated based on the sample mean value for *lo_inc* (Table 1). Results are shown in Table 4. Standard errors and t-statistics for WTP are generated following Park et al. (1991) and Krinsky and Robb (1986).[6] To minimize table size, only those attributes for which statistically significant ($p<0.10$) WTP differences could be established are illustrated.

Table 4 illustrates significant ($p<0.10$) WTP differences associated with five of sixteen attributes. Compared to newer residents, longer-term residents are willing to pay (1) less to *prevent* the placement of developments adjacent to main roads; (2) more for the addition of traffic signals to development plans, and; (3) less for open space adjacent to developments and roads (Table 4; Figures 1, 3). Moreover, longer-term residents are willing to pay to *reduce* habitat quality for small mammals (e.g., squirrels); WTP is of opposite sign, but not statistically significant for newer residents (Table 4; Figure 2). Finally, WTP associated with *develop2*—identifying plans that incorporate developments split into two distinct parts—differs between those at the first (r_i=0) and second (r_i=10) length of residency reference point, with newer residents willing to pay relatively greater amounts to *avoid* this spatial development attribute.

The LIP approach also allows calculation of estimated marginal WTP for the full range of residency durations, including the range from zero to thirty years (cf. (12)). These results are illustrated graphically for *develop_road* and *sm_mammal* (Figures 1-2). Figures 1-3 illustrate both the direction of WTP changes for each attribute, and characterize the types of marginal shifts in WTP that may be modeled using LIPs. As illustrated, LIPs allow marginal changes in WTP as a function of residence time, rather than the discrete preference shifts imposed by the use of dummy variables to shift coefficients.

Implications for Common Assumptions Concerning Preferences and Length of Residency

Despite significant WTP differences for five model attributes, preferences and WTP for the majority of attributes addressed by the survey cannot be shown to differ according to length of residency. Contrary results for five model attributes notwithstanding, this general finding of preference homogeneity suggests that many of the common assumptions regarding the impact of length of residency on development and conservation preferences may be at least somewhat overstated. However, preference shifts are supported for some rural community attributes. Model results therefore support limited conclusions regarding preference shifts related to length of residency, and their implications for common assumptions regarding the impact of length of residency on development and conservation preferences.

Preferences for Growth Management Outcomes

Survey results show little support for the common hypothesis (e.g., Dubbink 1984) that newer residents have stronger preferences for restrictions on new development. Parameter estimates and WTP associated with most attributes that characterize residential developments (e.g., housing acreage, housing density) cannot be shown to differ as a function of residence duration. Similarly, preferences for most conservation attributes cannot be shown to differ across groups.

Although preferences for development and conservation in general appear largely homogeneous, results show some evidence that preferences for scenic attributes may differ according to length of residency, at least partially supporting the common hypothesis that newer residents have stronger preferences for maintaining scenic attributes of rural communities (e.g., Spain 1993). For example, according to survey results (Table 4) newer residents have a higher WTP to prevent the location of new developments adjacent to main roads (i.e., in a more visible location).[7] Similarly, compared to longer-term residents, newer residents have a higher WTP for open space located adjacent to roads and developments (Table 4); preferences for open space located at a distance from roads and developments (and hence less visible) cannot be shown to differ according to length of residency. Despite these findings, preferences for low-visibility development (*lowvis*) cannot be shown to differ across groups. Hence, although results show some evidence of differences in preferences for scenic attributes, these findings do not hold for all such attributes. However, where differences are found, they are generally consistent with the lay hypothesis that newer residents have a stronger preference for maintaining scenic integrity.

Preferences for Roads and Community Services

Although the survey does not emphasize changes in community infrastructure, it does characterize a small number of attributes associated with community services. These include the provision of recreational sports fields, public access to preserved open space, and traffic control devices (i.e., traffic lights). In preliminary models, the presence and size of recreational fields could not be shown to have a significant impact on the model for any resident group; these attributes were subsequently dropped. Likewise, the provision of public access to preserved open space was dropped due to a clear lack of statistical significance for all resident groups. These findings fail to support assumptions that newer residents have stronger preferences for many types of recreational services (e.g., Spain 1993), at least for the recreational attributes addressed by the present survey instrument. Preferences for traffic controls reveal a significant increase in WTP among those with longer residency, although all groups retain a positive WTP. This may indicate that longer-term residents have a relatively stronger preference for traffic infrastructure and controls, or may indicate a relatively stronger preference for more rapid travel (fewer traffic controls) among newer residents.

Preferences for Wildlife Habitat

Prior research suggests that negative reactions to smaller mammals often viewed as nuisance species (e.g., prairie dogs in plains states) increases with long-term proximity to these species (Zin and Andelt 1999). Our results are consistent with this finding; the negative influence of residence time on WTP for small mammals suggests that certain species—such as squirrels—may be increasingly viewed as nuisance species (Heigh et al. 2001; Zin and Andelt 1999) as length of residency in rural communities increases. This apparent difference may be related to different levels of experience with such species. Newer immigrants from more urbanized settings, where such species may be more rare, may view smaller mammals with indifference; the positive aspects of stewardship for such species offsets nuisances caused by their presence.

However, typical longer-term residents—who have lived in close proximity to these species for many years—may view them simply as a common nuisance (Zin and Andelt 1999).

Preferences for habitat improvements for other species types—including large mammals, birds, and wetland species—cannot be shown to differ across length of residency groups. Similar findings of homogeneity in preferences for wildlife are reported by Brooks et al. (1999) and Kilpatrick and Walter (1997), although these works do not make explicit reference to length of residency (however, Brooks et al. (1999) report that the community in which a respondent was raised has no impact on preferences). In general, although results support heterogeneity in preferences for small, largely nuisance species, the more predominant finding of preference homogeneity fails to support assumptions of large-scale differences in preferences for wildlife habitat improvements in relation to length of residency.

Preferences for Tax Changes

The parameter estimate associated with tax changes (*taxdif*) cannot be shown to differ across length of residency groups. However, that associated with the interaction between *taxdif* and *lo_inc* (identifying low income residents) differs across all three groups. As shown by Tables 2 and 3, the magnitude of this parameter estimate increases continuously from -0.0013 at zero years of residence to 0.0046 at thirty years of residence; differences between parameter estimates at the zero, ten, and thirty year reference points are statistically significant at $p<0.01$ (two-tailed test). This suggests a *greater* effect of low income on the marginal utility of income among longer-term residents, at least partially supporting the lay hypothesis that longer-term residents (at least in lower income brackets) place greater importance on tax and cost-of-living changes (e.g., Spain 1993; Dubbink 1984). Although in theory this change could lead to statistically significant changes in WTP for all development and conservation attributes included in the model (Swallow et al. 1994), in this particular case we can only establish significant differences in WTP for those attributes whose parameter estimates also have statistically significant shifts between length of residency reference points; the one exception is *develop2* (cf. Tables 3, 4). Hence, although there is evidence of greater weight being given to tax changes among those with both increased length of residency and lower incomes, these changes do not, in general, lead to large scale and statistically significant changes in WTP for development and conservation attributes. However, they do influence the magnitude and significance of WTP differences associated with attributes independently associated with statistically significant coefficient shifts (Table 3).

Conclusion

This paper applies a technique based on Lagrangian Interpolation Polynomials to assess preference heterogeneity associated with length of residency in Rhode Island rural communities. Unlike more common approaches to modeling heterogeneous preferences, LIPs allow marginal, nonlinear changes in the effect of each model attribute, while using no more degrees of freedom than similar models in which dummy variables are used to shift regression coefficients (Tyrrell 1983).

Model results support the notion that preferences may differ according to length of residency in rural communities. However, significant preference shifts only occur for a small number of development and conservation attributes; for most attributes the null hypothesis of preference homogeneity cannot be rejected. Although results offer limited support to common assumptions regarding differences in preferences between newer and more established rural residents, the bulk of model results suggest that sweeping statements regarding such preference shifts may be—in some cases—overstated. Rather, model results suggest that preference changes, where they occur, are associated with a relatively small number of rural development and conservation attributes.

Model results do not suggest that all residents, regardless of length of residency, have identical preferences over all potential policy changes. Rather, they suggest only that wide-scale heterogeneity cannot be established for the set of development and conservation attributes addressed by the survey, within the four rural Rhode Island towns surveyed. Certainly, there is anecdotal evidence that preferences for other rural attributes—including agricultural attributes (American Farmland Trust 1997)—may differ across resident groups. Where such differences occur, models allowing for heterogeneous preferences can provide critical information on differential welfare implications of policy changes across identifiable subpopulations (Swallow et al. 1994).

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

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)	2.7001 (44.3667)
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)	-3.7894 (76.0422)
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)	-1.1778 (90.8236)
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)	0.0019 (0.9821)
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).	0.0001 (1.2311)
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).	-0.0238 (1.2444)
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).	0.0445 (1.7470)
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).	-0.0139 (1.7316)
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).	-0.0277 (1.7348)
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.	0.0016 (0.7059)
Taxdif	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)	-0.3753 (155.317)
Lowvis	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 different photographs characterizing different development visibility levels; four of these photographs are characterized as	Difference between dummy variables for CDP and ADP.	0.4075 (0.4914)

	low visibility development.		
Edgearea	The difference between the edge-area ratio of residential development shown in the "current development plan" and the edge-area ratio of residential development shown in the "alternate development plan". 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 ft. (e.g., a 1 unit x 1 unit square block is equivalent to 20 acres or ~871,180 square feet, with an edge-area ratio of 4). (Range: -14.85 to 8.5)	0.0260 (3.7059)
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.	0.0152 (0.4273)
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.	-0.0089 (0.6041)
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.	0.0005 (0.7199)
Lo_inc	Dummy variable identifying those respondents with reported household income below $40,000 per year.	Dummy variable (0,1)	0.2061 (0.4045)
Age	Reported age of survey respondent, in years.	Years	48.4654 (13.7095)
Hi_edu	Dummy variable identifying those respondents with at least a four-year college education	Dummy variable (0,1)	0.3313 (0.4707)

Table 2. Results: Random-Effects Logit Model

Reference Point	Variable Name	Parameter Estimate	Std. Error	Z	Prob > |z|
L_0 (0 yrs.)	intercept	-0.1398	0.0644	-2.1700	0.0300
L_1 (10 yrs.)	intercept	-0.0833	0.0365	-2.2800	0.0230
L_2 (30 yrs.)	intercept	-0.0479	0.0582	-0.8200	0.4110
L_0	edgearea	0.1029	0.0251	4.1000	0.0001
L_1	edgearea	0.0880	0.0145	6.0600	0.0001
L_2	edgearea	0.0884	0.0224	3.9500	0.0001
L_0	develop2	-0.2633	0.1802	-1.4600	0.1440
L_1	develop2	-0.0337	0.1003	-0.3400	0.7370
L_2	develop2	-0.0651	0.1570	-0.4100	0.6780
L_0	develop4	-0.3414	0.1286	-2.6500	0.0080
L_1	develop4	-0.2632	0.0734	-3.5800	0.0001
L_2	develop4	-0.2313	0.1175	-1.9700	0.0490
L_0	iso_open	0.0052	0.0015	3.5700	0.0001
L_1	iso_open	0.0047	0.0008	5.6800	0.0001
L_2	iso_open	0.0049	0.0013	3.6600	0.0001
L_0	adj_open	0.0058	0.0009	6.8200	0.0001
L_1	adj_open	0.0053	0.0005	10.9000	0.0001
L_2	adj_open	0.0041	0.0008	5.1900	0.0001
L_0	develop_road	-0.3218	0.1033	-3.1200	0.0020
L_1	develop_road	-0.1823	0.0582	-3.1300	0.0020
L_2	develop_road	-0.0372	0.0921	-0.4000	0.6870
L_0	lg_mammal	0.0918	0.0518	1.7700	0.0760
L_1	lg_mammal	0.1259	0.0294	4.2900	0.0001
L_2	lg_mammal	0.1511	0.0475	3.1800	0.0010
L_0	sm_mammal	0.0721	0.0512	1.4100	0.1590
L_1	sm_mammal	-0.0064	0.0289	-0.2200	0.8240
L_2	sm_mammal	-0.0923	0.0457	-2.0200	0.0440
L_0	com_bird	0.0724	0.0368	1.9700	0.0490
L_1	com_bird	0.0876	0.0208	4.2100	0.0001
L_2	com_bird	0.1204	0.0332	3.6300	0.0001
L_0	uncom_bird	0.0656	0.0361	1.8200	0.0690
L_1	uncom_bird	0.0249	0.0205	1.2200	0.2240
L_2	uncom_bird	-0.0090	0.0324	-0.2800	0.7800
L_0	wet_sp	0.0781	0.0376	2.0800	0.0380
L_1	wet_sp	0.0512	0.0213	2.4000	0.0160
L_2	wet_sp	0.0202	0.0336	0.6000	0.5490
L_0	dense_dif	-0.7309	0.0769	-9.5000	0.0001
L_1	dense_dif	-0.7861	0.0456	-17.2300	0.0001
L_2	dense_dif	-0.8814	0.0727	-12.1200	0.0001
L_0	size_dif	-0.0066	0.0009	-7.3300	0.0001
L_1	size_dif	-0.0068	0.0005	-13.0300	0.0001
L_2	size_dif	-0.0071	0.0008	-8.6500	0.0001
L_0	traf_light	0.0122	0.0904	0.1400	0.8930
L_1	traf_light	0.1415	0.0512	2.7600	0.0060
L_2	traf_light	0.3130	0.0800	3.9100	0.0001
L_0	lowvis	0.1761	0.0887	1.9900	0.0470

L_1	lowvis	0.2459	0.0508	4.8400	0.0001
L_2	lowvis	0.2469	0.0797	3.1000	0.0020
L_0	taxdif	-0.0051	0.0005	-10.4700	0.0001
L_1	taxdif	-0.0049	0.0003	-17.3100	0.0001
L_2	taxdif	-0.0048	0.0005	-10.6300	0.0001
L_0	taxdif×lo_inc	0.0013	0.0011	1.2000	0.2310
L_1	taxdif×lo_inc	-0.0017	0.0007	-2.5600	0.0100
L_2	taxdif×lo_inc	-0.0046	0.0009	-5.2300	0.0001
	-2LnL	6055.40		χ^2 =1947.89	0.0001
	ln(σ_v)	-2.19	0.79		
	σ_v	0.33	0.13		
	ρ	0.10	0.07		
	χ^2 for LR test (ρ=0)			χ^2 =1.89	0.0850

Table 3. Model Attributes With Significant Differences in Estimated Coefficients Between Length of Residency Reference Points L_0, L_1, and L_2 (0, 10 and 30 years)

Attribute	Residency Reference Points Compared	Estimated Coefficient Difference	χ^2 for Null Hypothesis (Difference = 0)	Prob > | χ^2| (Wald Test)
Develop_road	γ_0 minus γ_1	0.1395	2.77	0.0961
	γ_1 minus γ_2	0.1451	2.85	0.0913
	γ_0 minus γ_2	0.2846	3.01	0.0825
Sm_mammal	γ_0 minus γ_1	-0.0785	3.62	0.0573
	γ_1 minus γ_2	-0.0859	4.03	0.0448
	γ_0 minus γ_2	-0.1644	4.10	0.0429
Traf_light	γ_0 minus γ_1	0.1293	3.07	0.0798
	γ_1 minus γ_2	0.1715	5.33	0.0210
	γ_0 minus γ_2	0.3008	4.46	0.0347
Adj_open	γ_0 minus γ_1	-0.0005	0.56	0.4543
	γ_1 minus γ_2	-0.0012	3.06	0.0801
	γ_0 minus γ_2	-0.0017	1.69	0.1933
Taxdif×Lo_inc	γ_0 minus γ_1	-0.0030	14.36	0.0002
	γ_1 minus γ_2	-0.0029	11.34	0.0008
	γ_0 minus γ_2	-0.0059	13.47	0.0002

Table 4. Model Attributes With Significant Differences in Estimated Willingness to Pay (WTP) Between Length of Residency Reference Points L_0, L_1, and L_2 (0, 10 and 30 years)[a]

Attribute	Residency Reference Points Compared	Estimated Difference in Marginal WTP	T-Statistic for Null Hypothesis (WTP Difference = 0)	Prob > | t| (two-tailed)
Develop_road	WTP at L_0 minus L_1	-31.93	-1.82	0.0691
	WTP at L_1 minus L_2	-28.85	-1.91	0.0564
	WTP at L_0 minus L_2	-60.78	-1.94	0.0527
Develop2	WTP at L_0 minus L_1	-48.83	-1.66	0.0972
	WTP at L_1 minus L_2	4.19	0.16	0.8729
	WTP at L_0 minus L_2	-44.64	-0.83	0.4067
Sm_mammal	WTP at L_0 minus L_1	16.05	1.82	0.0691
	WTP at L_1 minus L_2	14.68	1.93	0.0539
	WTP at L_0 minus L_2	30.73	1.96	0.0503
Traf_light	WTP at L_0 minus L_1	-24.06	-1.55	0.1215
	WTP at L_1 minus L_2	-26.83	-1.95	0.0515
	WTP at L_0 minus L_2	-50.89	-1.82	0.0691
Adj_open	WTP at L_0 minus L_1	0.18	1.09	0.2760
	WTP at L_1 minus L_2	0.32	2.33	0.0200
	WTP at L_0 minus L_2	0.50	1.73	0.0839

[a] WTP differences for other variables cannot be shown to be different from zero at $p<0.10$.

Figure 1. Marginal Willingness to Pay to *Avoid* Development on Main Roads (Negative of Marginal WTP for *develop_road*)

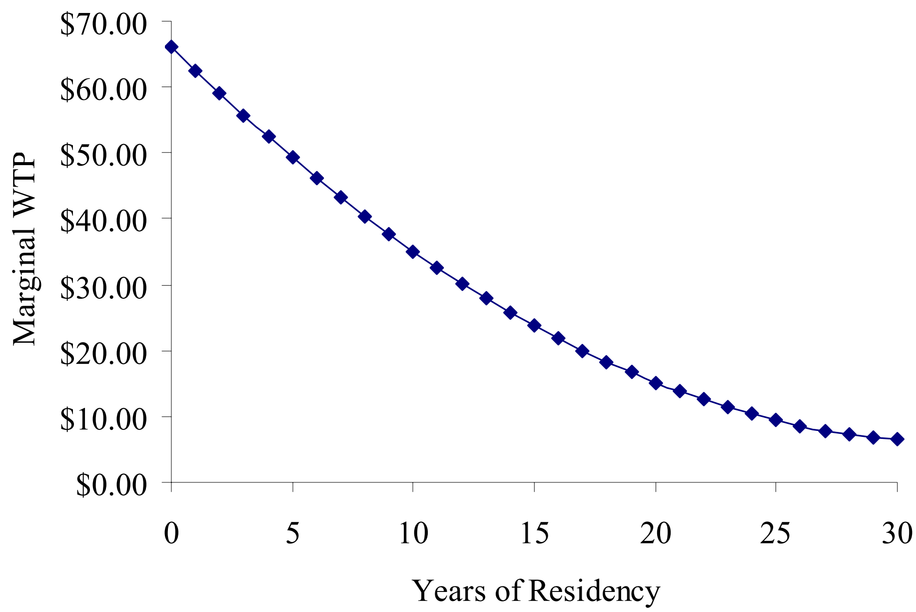

Figure 2. Marginal Willingness to Pay for Habitat Improvements for Small Mammals (e.g., Squirrels, Mice)

Endnotes

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[1] Typical models of heterogeneous preferences address such factors as gender, age, income, and location relative to urban centers (e.g., Swallow et al. 1994).

[2] If residence time is used to define more than two residency groups in the systematically-varying slopes model, then (4) and (7) would be modified accordingly.

[3] The experimental design was conducted by Don Anderson of StatDesign, Inc., Evergreen, CO.

[4] The estimated value of ρ indicates that panel-level variance components (i.e., random effects) account for 10.1% of total variance; a chi-square test fails to reject the null hypothesis (ρ=0), implying that a panel-data model (e.g., random-effects logit) is appropriate.

[5] Although the parameter estimate remains positive for all groups (indicating a negative marginal utility), it is insignificant for those at the thirty-year reference point.

[6] We randomly draw 1000 sets of coefficient estimates from the estimated distribution of the γ parameters, with means shown in Table 2, and the estimated variance-covariance matrix. WTP is calculated for each of the 1000 draws, resulting in an empirical distribution of WTP for each scenario. This distribution is used to calculate standard errors and t-statistics in Table 4.

[7] Estimated WTP for *develop_road* is negative; hence respondents are willing to pay to prevent the presence of developments adjacent to main roads.