Systematic Influences of Policy Implementation and Conservation Agents on Willingness to Pay for Land Preservation

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Abstract

Economists frequently assess willingness to pay (WTP) for land preservation outcomes independent of information regarding policy implementation. The public, however, may not only be concerned with the consequences of land management, but also may have systematic preferences for policy procedures applied to achieve management goals. This paper examines relationships between WTP for land preservation outcomes and attributes of the policy process, considering stated preferences for farm and forest preservation in two Northeastern states. The approach departs from traditional welfare assessments in that it does not constrain attributes of the policy process to be utility-neutral. Results indicate that utility is influenced by policy process attributes, even after controlling for the influence of land use outcomes often correlated with specific policy techniques. Results suggest that even comprehensive specification of land use outcomes by stated preference instruments may be insufficient to prevent systematic shifts in WTP related to unspecified, yet assumed, policy process attributes.

Introduction

Farm and forest preservation may be accomplished using a variety of policy techniques, and implemented by a range of public and private agents (American Farmland Trust 1997).[1] Economists, however, frequently assess willingness to pay (WTP) for preservation outcomes independent of information regarding the policy process or with little or vague reference to techniques of policy implementation. This follows the standard neoclassical purchase model, in which utility and WTP are assumed to be determined solely by policy outcomes, independent of the policy process leading to those outcomes (Bulte et al. 2005; Kahneman et al. 1993). Following this implicit framework, stated preference (SP) analyses of land preservation typically suppress most information regarding policy implementation, or assesses welfare contingent upon a single, often vaguely described policy process (Johnston et al. 2003; e.g., Halstead 1984; Beasley et al. 1986; Ready et al. 1997; Bowker and Didychuk 1994; Duke and Ilvento 2004).

This common practice notwithstanding, recent evidence suggests that individuals may have systematic preferences for methods used to achieve policy outcomes in general (e.g., Bosworth et al. 2006; Bulte et al. 2005; Mansfield and Smith 2002), and land use outcomes more specifically (e.g., Inman and McLeod 2002; McLeod et al. 1998; McLeod et al. 1999; Johnston et al. 2003; Rosenberger et al. 1996). For example, Bosworth and Cameron (2006) show that WTP for mortality reductions vary according to whether those reductions are achieved using prevention or treatment mechanisms. Bulte et al. (2005) show that WTP to decrease wildlife reductions depends on whether reductions result from man-made or natural events. Regarding

[1] The land preservation *policy process* is a choice of preservation *technique* and implementing *agent*. Duke and Lynch (2006) identify 28 techniques used to preserve farm and forest land. The survey described in this paper focused on three of the most common, and thus familiar, techniques: conservation easements (described to respondents as "preservation contracts"); fee simple purchase ("outright purchase"); and enhanced zoning protections ("conservation zoning"). The survey also distinguished two types of agents implementing preservation techniques: state and local governments; and nongovernmental organizations, such as the Nature Conservancy or land trusts.

land use policy, Johnston et al. (2003) find that positive values for particular land use outcomes do not guarantee support for policies necessary to obtain those outcomes, while Inman and McLeod (2002) report preferences for public versus private land management. Focus groups of McLeod et al. (1998), moreover, suggest that residents' preferences can extend into such areas as fairness in enforcement of zoning regulations and the number of zoning variances granted. Despite such evidence, however, the published literature thus far provides no systematic, quantitative information on how WTP for farm and forest preservation may be influenced by the attributes of the policy process or details of policy implementation.

The omission of policy details from SP analysis of land use preferences is related to a fundamental and perhaps mistaken assumption that attributes of the policy process are utility-neutral. This assumption, if incorrect, can have significant implications both for the validity of welfare estimates and for the use of these estimates for policy guidance. For example, SP surveys that partially or completely omit information on policy implementation may cause respondents to assume that certain unanticipated policy techniques are applied. If these techniques are not utility-neutral, methodological misspecification (Mitchell and Carson 1989) may occur, leading to bias in resulting welfare estimates. Alternatively, if welfare estimates are contingent upon a single, non-utility-neutral policy technique, their application to policy would be limited to instances in which very similar or identical policy techniques are applied. Neither possibility is reflected in the current literature, which often compares WTP for outcomes irrespective of the attributes of the associated policy process.

This paper examines relationships between WTP for land preservation outcomes and attributes of the policy process, considering stated preferences for farm and forest preservation in two Northeastern states. The approach departs from traditional applied welfare assessments in that it does not constrain the attributes of the policy process to be utility-neutral. The model is constructed upon a more flexible representation of utility, designed to capture systematic changes in welfare related to the policy techniques used to obtain environmental outcomes. The associated choice experiment survey allows estimation of the systematic effects of policy implementation on utility, thereby providing welfare measures that reflect policy process information and avoiding potential bias associated with the omission of such details.

A Conceptual and Theoretical Model of Land Use Policy Preference

Systematic preferences for land preservation policy process attributes may emerge for at least two reasons. First, process attributes may *appear* to influence utility if they serve as proxies for unobserved land use outcomes. Such patterns may occur in both stated preference research and in actual processes used to create policy. For example, in the absence of information regarding public access, respondents might assume—correctly in many cases—that conservation easements are less likely to provide access than the fee simple technique (American Farmland Trust 1997). Individuals might also associate particular policy processes with increased or decreased probability of long-term preservation success. Still others might associate certain policy techniques with an increased realization of rents or personal benefits associated with environmental policies (Mansfield and Smith 2002). Such patterns lend themselves to a more traditional interpretation of utility, in which policy process attributes are not truly valued, but rather proxy for omitted yet nonetheless utility-relevant land use outcomes.

A second possibility, however, is that respondents might indeed maintain systematic preferences for particular policy tools apart from any measurable land use outcome. For example, some respondents might maintain a systematic preference for government involvement in land preservation—apart from any observable outcome of that intervention (Inman and

McLeod 2002; Johnston et al. 2003). Residents might also believe that certain policy actions represent an inappropriate use of public (or private) authority or funds. Such preferences might manifest in a change in utility associated with government-implemented policies, apart from any land use outcome of those policies (cf. Inman and McLeod 2002; McLeod et al. 1999). Beyond preferences for public versus private involvement, individuals might maintain altruistic preferences for consumption bundles realized by others (McConnell 1997), leading to varying support for land use policies anticipated to generate particular distributions of costs and benefits.[2] In other instances respondents may show clear preferences for the distribution of program costs across different groups, aside from any effects related to their personal household costs (Mansfield and Smith 2002). To the extent that such preferences (e.g., altruism) are of the type that should legitimately be incorporated in benefit cost analysis (Freeman 2003, p. 150), associated WTP measures represent a legitimate component of welfare analysis that is not associated with traditionally measured land use outcomes.

The former case—in which policy process attributes proxy for missing land use outcome attributes (e.g., public access provisions)—is most appropriately addressed though more complete specification of the vector of relevant land use outcome attributes, based on evidence from appropriate survey design methods (Kaplowicz et al. 2004; Johnston et al. 1995). That is, the apparent utility effects of policy process attributes would indicate that utility-relevant outcomes have not been sufficiently specified in survey scenarios—a potential source of bias in SP welfare estimation. The latter case, however, represents a situation in which utility is

[2] This paper distinguishes *land use* outcomes typically represented in survey instruments from other attributes that may or may not be appropriately characterized as policy "outcomes". For example, as a semantic matter, one might define altruistic preferences as related to a measure of policy "outcome," in this case related to benefit distributions associated with particular policy tools. However, even if such attributes are defined as outcomes, they are nonetheless independent of the typical *land use* outcomes typically represented in stated preference research. Moreover, if certain distributions are unique features of specific policy techniques, it may be difficult to distinguish preferences for the policy from preferences for the distributional outcome. In either case, such preferences are not appropriately captured by stated preference instruments that omit details of the policy process.

systematically influenced by policy process attributes, even after accounting for the full set of land use outcomes that enter the utility function. Such effects are denoted 'pure' policy preferences. In such cases, WTP estimates associated with land use outcomes alone (i.e., in the absence of information regarding policy implementation) will at best provide misleading or partial welfare guidance. Moreover, the omission of utility-relevant policy process attributes may generate statistical biases in WTP related to the methodological misspecification of valuation contexts (i.e., respondents' unobserved yet potentially systematic assumptions regarding applied policy process attributes).

The Theoretical Model

The theoretical model is derived from the standard random utility specification in which utility is divided into observable and unobservable components (Hanemann 1984). Given the emphasis on pure policy preferences, a critical element of the model is the experimental control of utility-relevant land use attributes often omitted from SP analyses, yet potentially associated with particular policy techniques (e.g., public access attributes). Without this control, that which appears to be a systematic preference for process attributes may instead be a preference for omitted land use outcomes. The theoretical model hence distinguishes between land use outcomes assumed to be independent of the policy process attributes in question and those assumed to be related to process attributes.

To model individual *i*'s choices among preservation programs, we define a utility function including outcomes and policy process attributes of preservation plan *j* and the net cost of the plan to the respondent (Hanemann 1984; McConnell 1990),

$$U_{ij}(\cdot) = U_{ij}(\mathbf{X_{ij}}, \mathbf{W_{ij}}, Y_i - F_{ij}) = v(\mathbf{X_{ij}}, \mathbf{W_{ij}}, Y_i - F_{ij}) + \varepsilon_{ij} \qquad (1)$$

where

$\mathbf{X_{ij}}$	=	a vector of variables describing land use outcomes of preservation program *j*;
$\mathbf{W_{ij}}$	=	a vector of variables describing the policy process of preservation program *j*;
Y_i	=	disposable income of respondent *i*;
F_{ij}	=	the cost to the respondent of preservation plan *j*, through a mandatory payment vehicle;
$v_{ij}(\cdot)$	=	a function representing the empirically measurable component of utility;
ε_{ij}	=	the unobservable or random component of utility, modeled as econometric error.

The vector, $\mathbf{X_{ij} = [X_{ij1} \mid X_{ij2}]}$, is further partitioned such that $\mathbf{X_{ij1}}$ is a sub-vector representing land use outcomes assumed independent of $\mathbf{W_{ij}}$, or delivered equally regardless of the details of policy implementation. Examples of attributes in $\mathbf{X_{ij1}}$, depending on the policy context, might include the number of acres and type of land conserved.[3] In contrast, $\mathbf{X_{ij2}}$ represents land use outcomes assumed to be related to at least one element of $\mathbf{W_{ij}}$, or whose delivery depends on the specific attributes of policy implementation. Attributes in $\mathbf{X_{ij2}}$ might characterize such amenities as public access, which is likely to vary depending on preservation techniques used. The elements in $\mathbf{X_{ij1}}$ and $\mathbf{X_{ij2}}$ are likely to vary according to the policy context.

Given the above specification, individual *i* chooses among three policy plans, (*j*=*A*,*B*,*N*). The individual may choose option *A*, option *B*, or may reject both options and choose the status quo (neither plan, *j*=N). A choice of neither plan would result in zero preservation and no preservation policy, $\mathbf{X_{ij}} = \mathbf{W_{ij}}=0$, and zero household cost, $F_{ij}=0$. The model assumes that

[3] Although one could easily think of counter-examples in which the number of acres that could be conserved would depend on the techniques used for preservation.

individual i assesses the utility that would result from available choice options ($j=A,B,N$) and chooses that which offers the greatest utility. Given (1), individual i will choose plan A if

$$U_{iA}(\mathbf{X_{iA}},\mathbf{W_{iA}}, Y_i\text{-}F_{iA}) \;\geq\; U_{ik}(\mathbf{X_{ik}},\mathbf{W_{ik}}, Y_i\text{-}F_{ik}) \quad \text{for } k=B,N, \tag{2}$$

such that

$$v_{iA}(\mathbf{X_{iA}},\mathbf{W_{iA}}, Y_i\text{-}F_{iA}) + \varepsilon_{iA} \;\geq\; v_{ik}(\mathbf{X_{ik}},\mathbf{W_{ik}}, Y_i\text{-}F_{ik}) + \varepsilon_{ik.} \tag{3}$$

If the ε_{ij} are assumed independently and identically drawn from a type I extreme value distribution, the model may be estimated as a conditional logit model (Maddala 1983; Greene 2003).

The partitioning of $\mathbf{X_{ij} = [X_{ij1} \mid X_{ij2}]}$ is not necessary for model estimation. However, the specification is useful to understand potential ramifications of omitting $\mathbf{X_{ij2}}$ or $\mathbf{W_{ij}}$ from an SP scenario. First, assume that a valuation scenario includes $\mathbf{X_{ij1}}$ and $\mathbf{X_{ij2}}$, but omits $\mathbf{W_{ij}}$. If $\partial v(\cdot) / \partial \mathbf{W_{ij}} \neq 0$ and respondents make systematic assumptions concerning elements of $\mathbf{W_{ij}}$ based on the correlated elements of $\mathbf{X_{ij2}}$ present in the survey scenario, the result will be biased, inconsistent estimates for *all model parameters*, including those associated with $\mathbf{X_{ij1}}$ (Greene 2003).[4] If the analyst includes $\mathbf{W_{ij}}$ in survey scenarios but omits $\mathbf{X_{ij2}}$, the results are analogous. The problem lies in the assumption by the analyst that choices depend *only* on attributes incorporated in the SP scenario. However, the assumed correlation of $\mathbf{X_{ij2}}$ and $\mathbf{W_{ij}}$ may lead to choices that depend on values for elements of $\mathbf{X_{ij2}}$ and $\mathbf{W_{ij}}$ that are *assumed* by respondents, despite their omission from the SP scenario and associated statistical model. The result is a combination of methodological misspecification (the behavioral implication) and bias in associated parameter and welfare estimates (the statistical implication).

[4] The result is omitted variables bias in a discrete choice model, in which observed choices depend on an assumed set of values for policy process variables that are nonetheless omitted from the statistical model. Yatchew and Griliches (1984) demonstrate that such omitted variables result in bias and inconsistency across the full range of estimated parameters in discrete choice models, regardless of the orthogonality of included and omitted variables.

The implication of this model is that appropriate estimation of WTP—including marginal WTP for specific land use attributes that may not be correlated with omitted policy process attributes ($\mathbf{X}_{ij1}$)— may depends on an appropriate specification of utility-relevant policy process attributes, $\mathbf{W}_{ij}$, in SP scenarios. Omission of these attributes will bias estimated model parameters. The crucial hypotheses, then, is whether $\partial v(\cdot) / \partial \mathbf{W}_{ij} = 0$, i.e., whether attributes of the policy process are utility-neutral.

The Data

To test this hypothesis, a stated preference model is estimated for land preservation preferences using choice experiment data. The resulting random utility model provides a systematic assessment of the impacts of policy attributes on WTP, holding associated land use outcomes constant. The data are drawn from the *Mansfield* and *Preston Land Preservation Surveys* in CT and the *Georgetown* and *Smyrna Land Preservation Surveys* in DE. Surveyed communities were selected based on a number of factors, including the presence of similar and increasing development pressures, the lack of a major urban center in close proximity, and the existence of substantial areas of undeveloped (farm and forest) land. The combination of data from two non-adjacent states allows a least preliminary assessment of the robustness of results across regions.

Survey development required over 18 months of background research, interviews with land use experts and stakeholders, and 14 focus groups (Johnston et al. 1995) including cognitive interview sessions (Kaplowicz et al. 2004). Extensive pretests were conducted in focus groups and interviews to ensure that the survey language and format could be easily understood by respondents and that respondents shared interpretations of survey terminology and scenarios.

Focus groups led to a self-administered, mail survey design, following the choice experiment framework (Opaluch et al. 1993; Adamowicz et al. 1998).

Prior to the administration of choice experiment questions, the survey provided extensive background information on such features as the details of land use and land change in respondents' local area, tradeoffs implicit in land conservation and reminders of budget constraint, and techniques used to preserve farm and forest land. The survey also provided instructions and information on the subsequent choice experiments, including details of certain attributes. This included potential attribute levels that might occur in choice questions, following guidance in the literature to provide visible choice sets (Bateman et al. 2004).

The choice experiment asked respondents to consider alternative preservation options for hypothetical parcels of farm or forest land located in their community. Respondents were provided with two preservation options that would each preserve a single parcel of land of varying attributes, "Option A" and "Option B," as well two status quo options that would result in no policy change. The first status quo option stated simply, "I would not vote for either program," following standard language in choice experiment surveys (Bennett and Blamey 2001). The second option stated, "I support these programs in general, but my household would/could not pay for either Option A or B." This latter option was included based on focus group results and findings of prior research (e.g., Loomis et al. 1999; Brown et al. 1996) as an outlet for those who might wish to express symbolic support for land preservation, yet nonetheless would not pay for either of the provided options. Specifically, it was designed to ameliorate the potential quandary facing "individuals who would not pay the bid amount, but nevertheless want to register [symbolic] support for provision of the public good" (Loomis et al. 1999). For purposes of estimation the two status quo options—both indicating a choice of no preservation—were combined into a single choice category.[5]

Each respondent was provided with three choice experiment questions and was instructed to consider each as an independent, non-additive choice. Attributes characterized land use outcomes identified by focus groups, interviews, and background research as significant to choices among land preservation options. These included land use outcome attributes assumed to be in vector $\mathbf{X}_{ij1}$ (attributes provided approximately equally by a wide range of policy processes) and those in vector $\mathbf{X}_{ij2}$ (attributes whose provision often varies according to the specific preservation method applied). Attributes characterized such features as the type of land preserved, the number of acres, the provision and type of public access, the likelihood of development of unpreserved parcels, and the cost of preservation to the respondent's household.

Choice questions also specified elements of $\mathbf{W}_{ij}$, including the specific *method* that would be used to preserve each parcel in question, as well as the *agent* that would be responsible for implementing the technique. Techniques included fee simple purchase, conservation easements, and conservation zoning. Implementing agents for the easement and fee simple techniques included the state government or local land trusts.[6] The survey provided detailed information on each of these policy attributes prior to administration of choice questions. Table 1 describes the attributes distinguishing hypothetical preservation options.

The experimental design was constructed by the University of Delaware STATLAB using a fractionated D-optimal design tailored to choice experiment data (cf. Kuhfeld and Tobias 2005). The design is significantly larger than typical main effects plans designed for linear regression (500 unique sets of three choice questions), and allows for estimation of a wide range of main effects and interactions with relatively high efficiency. The survey was implemented

[5] Fundamental model results are unchanged by this treatment of the responses.
[6] Given that zoning in Connecticut and Delaware is implemented at the local level, this method was always associated with local government.

from October 2005 to January 2006. Surveys were mailed to 3000 randomly selected residents of the four CT and DE communities (750 surveys per community), following Dillman's (2000) survey design method. Of the 2763 deliverable surveys, 1136 were returned, for an average response rate of 41.1%. Returned surveys provide 3309 complete and usable choice responses.

The Empirical Model

Results are based on a pooled discrete choice model combining observations from both states. To allow for preference heterogeneity across the two states, however, two models are estimated—one that constrains parameter estimates to be equal across the two states, and another that allows for systematic differences in parameter estimates using fixed effects. In addition, the Swait-Louviere procedure (Swait and Louviere 1993) is applied to account for potential differences in the scale parameter across the CT and DE data.

As the final data are comprised of three responses per survey, there is a possibility that responses provided by individual respondents may be correlated even though responses across different respondents are considered *iid*. Moreover, conditional logit (CL) models are subject to the restrictive independence from irrelevant alternatives (IIA) property. For both reasons, researchers are increasingly considering mixed logit (ML) models for SP applications (Greene 2003; McFadden and Train 2000; Hensher and Greene 2003). ML models allow for coefficients on attributes to be distributed across sampled individuals, according to a set of estimated parameters and researcher-imposed restrictions (Hu et al. 2005). While ML requires a greater number of researcher choices regarding model specification (e.g., the specification of fixed versus random parameters, the assumed distribution and correlation of random parameters, etc.), they have much greater flexibility and can indeed approximate any random utility model (Greene

2003; McFadden and Train 2000; Hensher and Greene 2003). For comparison, both CL and ML specifications of the final model are presented.

Although the most flexible ML specifications allow for a random distribution of the entire parameter vector, in practice one may experience difficulties in convergence when large numbers of random parameters are incorporated (e.g., Layton 2000; Johnston et al. 2003). Here, the inclusion of large numbers of random parameters led to repeated convergence failure, despite various specifications of the model and simulation procedure. Accordingly, the ML model is estimated following Layton (2000) with only the parameter on program cost random across respondents. Following common practice, the parameter is estimated with a lognormal distribution and sign-reversal on the cost variable (Hensher and Greene 2003).[7] The model is estimated using maximum likelihood for mixed logit with Halton draws applied in the likelihood simulation.

Results

Results for three models are illustrated in table 2, including two CL specifications and one ML specification. Model one is an unrestricted CL model, with dummy variables allowing for systematic variation in estimated parameters across the CT and DE samples.[8] Model two is a restricted CL model in which a single set of parameters is estimated across the pooled data. Both models are statistically significant at better than $p<0.01$. A Swait-Louviere test (Swait and Louviere 1993) fails to reject the null hypothesis of equal variances (or scale) across the CT and

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[7] Preliminary models with *cost* distributed normally and with a triangular distribution underperformed (in terms of model fit, log likelihood, and variable significance) the model including lognormally distributed cost. An advantage of the lognormal distribution is that it constrains the parameter on program cost to be negative (or positive for sign-reversed cost), implying a positive marginal utility of income. Hence, this distribution is often used for the payment vehicle in stated preference models. However, a disadvantage of the lognormal distribution is the characteristically "fat" right tail, which tends to lead to unrealistic mean WTP values calculated over the full distribution (Hensher and Greene 2003).

[8] Slopes are permitted to vary systematically for all linear (non-interaction) variables.

DE data (χ^2=0.95, p=0.33), while a likelihood ratio test of the restricted versus unrestricted model fails to reject the null hypothesis of equivalent parameter estimates across CT and DE samples (χ^2=8.13, p=0.36). The combination of these two tests provides no evidence of statistically significant preference heterogeneity or difference in scale between responses from the two states. Hence, subsequent discussion emphasizes results of the simpler pooled model.

Model three is an ML specification of the pooled model. As noted above, *cost* is specified random with a lognormal distribution and sign-reversal (i.e., cost data enters the model as a negative variable). A likelihood ratio test of the ML versus CL model (model three compared to model two) rejects the null hypothesis of a fixed coefficient vector (χ^2=1176.19, p<0.01), with the standard deviation on cost significant at p<0.01. Beyond statistical significance, however, the relatively large standard deviation on *cost* suggests substantial heterogeneity in the marginal utility of this attribute. Given the superior performance of the ML model relative to the CL model, subsequent discussion emphasizes ML results (model three).

Of 22 estimated parameters in the ML model, 17 are statistically significant at p<0.10 or better, with signs of significant parameters conforming to prior expectations, where expectations exist (table 2). Respondents prefer options that preserve a greater number of acres (*acres*>0), provide public access (*walking* and *hunting* >0) and target parcels at higher risk of development (*dev_not_30* and *dev_10_30* <0). Moreover, public access for walking and biking is preferred to public access for hunting (*walking* > *hunting*), supporting prior findings preference for public access differs according to the type of access provided, particularly in cases where certain types of access (e.g., hunting) may be assumed by respondents to have at least some negative consequences (e.g., McGonagle and Swallow 2005; Johnston et al. 2005).

Interestingly, while policy process attributes are statistically significant (see discussion below)—along with attributes characterizing public access, parcel size, development risk, and cost—land *type* attributes are not significant (*nursery*, *forest*, *idle*). This pattern is robust across a wide range of preliminary and final model specifications. These results suggest that while respondents value the preservation of farm and forest land, and distinguish between attributes of preservation programs, the type of farm or forest preserved is not a statistically significant determinant of program preferences. While these results may be subject to the specific land types considered, they support some prior work showing, for example, that WTP changes with the agricultural productivity and/or type of farmland (Duke and Ilvento 2004) but contradict other work (Kline and Wichelns 1996; Ozdemir et al. 2004).

Policy Process Attributes and Preservation Preferences

The model specification was designed such that the effects of both preservation techniques and preservation agents could be estimated and distinguished. Policy process attributes are incorporated as four binary (dummy) variables allowing for systematic variation in utility, relative to the default of preservation accomplished using state-implemented conservation easements (tables 1, 2). The associated parameters capture the potential (marginal) influence of these attributes on utility. Alternatives include conservation easements implemented by local land trusts using government block grants (*tr_contract*), fee simple purchase by the state (*st_purch*), fee simple purchase by land trusts using government block grants (*tr_purch*), and conservation zoning (*zoning*).[9] Associated parameter estimates indicate influence on utility, holding constant other attributes such as public access and household cost.

All four parameter estimates are statistically significant at $p<0.10$, indicating that attributes of the policy process have a statistically significant influence on the utility of land

[9] Land trust activities were described as involving government block grants to motivate the payment vehicle (taxes) in choice questions.

preservation options. Variation in both preservation *techniques* and *agents* can have a significant influence on marginal utility. For example, compared to the default of state-implemented conservation easements, there is a statistically significant decline in marginal utility associated with otherwise identical contracts implemented by land trusts. As noted in table 1, both techniques were described as generating preservation that was "contractually and permanently" guaranteed, regardless of the agency administering the programs. Nonetheless, choice model results show that estimated marginal utility for preservation conducted using land trust easements (*tr_contract*, $p<0.02$) is lower than that associated with otherwise identical state easements.

In contrast, preferences for fee simple purchase policies are virtually identical for land trust and state agents. Both *st_purch* ($p<0.07$) and *tr_purch* ($p<0.05$) are statistically significant, with parameter estimates that are statistically indistinguishable (-0.318 vs. -0.295). Interestingly, this suggests that respondents prefer state agencies to implement conservation easements but display *equal* preferences for fee simple purchase of farm and forest by public and private agents. These results indicate a fair degree of subtlety in respondents' preferences for—and ability to distinguish between—different types of preservation policies. That is, preference for publicly versus privately implemented preservation varies according to the type of preservation technique (fee simple versus easements) applied. Again, these results hold preservation likelihood and duration constant—in both cases preservation is described as being permanent and guaranteed.

Holding program cost and other attributes constant, the least preferred preservation technique is conservation zoning (*zoning*, $p<0.01$)—a result consistent with prior focus group findings.[10] Not only did focus group respondents associate zoning with the potential for additional restrictions on land use community-wide, but the survey noted that "[w]hile zoning can guarantee preservation in the short term, there is no guarantee that regulations will not be changed in the future so that land may be developed." Given the combination of the zoning impermanence and the potential for additional restrictions on personal land use, it is not surprising that marginal utility is lowest for programs including conservation zoning, *ceteris paribus*. As zoning is universally (at least in CT and DE) implemented at the local level, this technique was not allowed to vary according to implementing agency.

The statistical significance of the four policy process attributes is an important finding which—if applicable to a wide range of preservation contexts—calls into question the validity of both the utility specifications assumed by and the associated results of prior valuation research that suppresses information regarding policy implementation. Consequences could include omitted variables, associated bias in estimated parameters, and the possibility of inappropriate welfare and policy guidance to land preservation agencies. Results also suggest a fair degree of subtlety in respondents' policy preferences—with, for example, preferences for particular policy techniques depending on the entity implementing those techniques. This is another result not well reflected in the SP literature, yet of potential relevance for welfare estimation and policy guidance.

Willingness to Pay Implications

While the valuation literature places a primary concern on estimating WTP and welfare implications, in many instances the policy relevance of preferences may hinge directly on

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[10] Of course, in many instances zoning techniques may be less expensive than alternative means of land preservation. Hence, considering the combined utility associated with the variables *zoning* and *cost*, a cheaper zoning policy might be preferred to a more expensive purchase or easement policy.

marginal utilities (Johnston et al. 2003). For example, in some contexts, such as voting on land preservation or voicing concerns in public hearings, differences in marginal utilities may drive the dynamics of public input. Moreover, differences in marginal utilities may imply that WTP differences are relevant, even if these differences fail to meet preset statistical significance criteria. Despite these caveats, estimated changes in WTP remain an important means of policy assessment. Accordingly, this section presents WTP implications of the policy process parameters estimated above.

Although the ML model clearly outperforms the CL model, ML specifications complicate calculation of WTP and associated confidence intervals; the use of ML renders more elusive a unique "best" WTP estimate for welfare evaluation (Hensher and Greene 2003; Hu et al. 2005). Complications associated with the calculation of WTP with a random cost coefficient have led numerous researchers to specify fixed cost coefficients (Johnston et al. 2005), despite economic intuition and theory suggesting that the marginal utility of income (and hence program cost) should vary across respondents. Hensher and Greene (2003) highlight many of the challenges associated with the calculation of WTP within mixed logit models.

While recognizing the various approaches towards WTP calculation in mixed logit models and associated challenges, the increasingly applied method illustrated by Hensher and Greene (2003) is followed. This approach calculates WTP from mixed logit results assuming both a fixed and lognormally distributed cost parameter.[11] Even given this approach, an additional challenge is the "fat" tail of the lognormal distribution. This leads to unrealistic mean WTP values due to outliers in the unconstrained distribution: an almost universal challenge

[11] For additional details see Hensher and Greene (2003). The former approach is analogous to standard Krinsky and Robb (1986) resampling in conditional logit models, and ignores the estimated standard deviation (not the standard error) of *cost*. The latter approach is more complex, but incorporates the full range of distributional information included in the mixed logit model.

when dealing with lognormal distributions for WTP estimation (Hensher and Greene 2003). Here, mean WTP magnitudes over the lognormal cost distribution remain unrealistically large even if one truncates the top 10% of the distribution—a result of the large standard deviation on *cost*. For this reason, Hu et al. (2005) is followed and median WTP is presented,

Results are shown in table 3. WTP estimates are calculated for the policy process variables *st_purch*, *tr_purch*, *tr_contract*, and *zoning*. The second column presents marginal WTP point estimates and standard errors from CL results, for comparison with ML estimates. The third column illustrates (the mean of) median WTP and confidence intervals that account for the sampling variance of parameter estimates from mixed logit results, but not the estimated distribution of *cost* (cf. Hu et al. 2005). For these estimates, the standard approach of Krinsky and Robb (1986) is used, with 1000 draws from the mean parameter vector and associated covariance matrix used to estimate median WTP and empirical confidence intervals.[12] The fourth column illustrates (the mean of) median WTP calculated over both the sampling variance of parameter estimates and the lognormal distribution of *cost*, following the two-step simulation procedure detailed by Hu et al. (2005) and Hensher and Greene (2003).[13]

WTP results (table 3) correspond with marginal utility results (table 2), both indicating significant implications of policy process attributes for land preservation preferences. As expected, WTP results differ between the CL and ML models and also between the two ML

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[12] Given the lognormal distribution on *cost*, $\hat{\beta}_k / \exp(\hat{\beta}_{\cos t})$ provides an estimate of median WTP for the k^{th} attribute, where $\hat{\beta}_k$ is the parameter estimate for the k^{th} attribute and $\hat{\beta}_{\cos t}$ is the estimated parameter estimate on lognormal *cost*. In contrast, mean WTP would be calculated $\hat{\beta}_k / \exp(\hat{\beta}_{\cos t} + (\hat{\sigma}^2_{\cos t}/2))$, where $\hat{\sigma}_{\cos t}$ is the estimated standard deviation on *cost* from the ML model.

[13] This procedure involves 1000 draws from the mean parameter vector and associated covariance matrix (the *parameter simulation*), with an additional 1000 draws over the distribution of cost for *each* of the initial parameter draws (the *coefficient simulation*), for a total of 1,000,000 draws. WTP results in table 3 reflect the mean (over the *parameter simulation*) of median WTP calculated over the *coefficient simulation*.

simulations. Conditional logit WTP universally exceeds median WTP estimates from ML simulations. Confidence intervals suggest a substantial variation of median WTP estimates, which increases as a result of additional preference heterogeneity incorporated in the ML distribution of *cost*. In all cases, however, results show non-trivial WTP implications of policy process attributes that are in most cases statistically significant.

For three of the four attributes considered (*tr_purch*, *tr_cont*, *zoning*) empirical 95% confidence intervals do not overlap zero, even when results incorporate the full distribution of the ML random cost coefficient. For CL WTP estimates, similarly, standard errors imply that two of the four estimates (*tr_purch*, *zoning*) are statistically significant at $p<0.10$, with *st_purch* ($p<0.11$) narrowly missing significance at traditional levels. In terms of point-estimate magnitudes, welfare effects are not trivial, with alternative preservation techniques generating WTP differentials ranging from -$27.62 to -$107.70, depending on policy method, model, and simulation method. Interestingly, the largest WTP estimates are associated with state implemented conservation easements (the omitted default category). This result suggests that one of the more common techniques for land preservation (conservation easements) is also associated with the highest levels of individual WTP, holding all else constant. In addition, when costs are considered one may conclude that state conservation easements dominate the fee simple technique (by governments or trusts) because easements are generally less expensive than full purchase.

Implications and Discussion

As noted by Inman and McLeod (2002, p. 93), "governments are unlikely to succeed in implementing land protection programs without support of their constituents." They, and other authors (e.g., Johnston et al. 2003, McLeod et al. 1999; Rosenberger et al. 1996) emphasize the relationships between policy techniques that are applied and constituents' support for land preservation. Further supporting the importance of the policy process to public preferences is evidence from the hedonic literature that property value impacts of open space depend on policy techniques used (e.g., conservation easements, fee simple purchase) to prevent development (Irwin 2002; Ready and Abdalla 2005). Such evidence notwithstanding, the dominance of the neoclassical purchase model has led researchers to suppress details of policy implementation in stated preference research, or at most to specify preservation as subject to a single, invariant policy process. The associated argument is that utility should be measured over "outcomes, not over what induced [those] outcome[s]" (Bulte et al. 2005).

Results from the current model highlight possible limitations of the standard approach. Choice model results illustrate the potential welfare implications associated with attributes of policy process, after controlling for possibly confounding factors such as public access, cost, land type, and likelihood of (preservation) permanency.[14] Results indicate that preferences can extend both to the type of preservation techniques applied as well as the agents that implement those techniques.

There are at least three potential explanations for the statistical significance of policy process attributes, each of which, at a minimum, implies some adjustment in SP methods for farm and forest valuation. First, despite extensive efforts to ensure that potentially confounding land use outcomes were controlled by the survey and experimental design, it is nonetheless possible that respondents may have viewed policy process attributes as proxies for heretofore unsuspected land use outcome attributes—a variant of methodological misspecification (Mitchell and Carson 1989; Johnston et al. 1995). If such is the case, despite our explicit efforts to eliminate such possibilities in survey and experimental design, this suggests that current

[14] The exception, of course, is zoning, which cannot be reasonably divorced from the possibility of future change.

specifications of land use outcomes in SP surveys are likely inadequate and that additional research is required to better identify welfare-relevant outcomes of land use policy.

Second, it is possible that respondents' choices reflect a genuine individual WTP for policy process attributes, yet one that is not appropriate for inclusion in neoclassical welfare evaluation based on Pareto optimum allocations (cf. Freeman 2003, p. 150). For example, if certain policy process attributes are preferred due to *nonpaternalistic altruism*[15] or related concerns, the associated WTP—while measurable—would be irrelevant for welfare analysis (Lazo et al. 1997; McConnell 1997). In such cases—despite the welfare irrelevance of WTP measures—it is nonetheless critical to account for such factors in SP analysis to avoid statistical biases in discrete choice models and associated WTP estimates. Moreover, given that WTP for policy process attributes would be irrelevant for social welfare estimation in this case, it is critical to ensure that welfare estimates for land use preservation do not incorporate inappropriate WTP associated with assumed policy techniques.

A final possibility is that model results reflect a genuine and welfare-relevant WTP for policy process attributes. For example, individuals might have systematic preferences for public versus private control of undeveloped lands related to strongly-held views regarding the appropriateness of certain types of public or private intervention (cf. Inman and McLeod 2002). Individuals might also prefer certain types of policy techniques (e.g., easements over fee simple purchase) due to a *paternalistic* concern for the consumption bundles of others (McConnell 1997)—for example a desire for landowners to retain the right to use their land for private purposes. If such preference patterns hold, then policy process attributes are indeed welfare-relevant in their own right, and should either be incorporated (or at least controlled for) in

[15] Nonpaternalistic altruism is defined by Freeman (2003, p. 150) as a case "where one individual cares about the general well-being of others but does not have any preferences regarding the composition of consumption bundles of others."

applied welfare analysis.

Like many research efforts, the present analysis perhaps raises more questions than it answers. Statistical results of the present analysis cannot unambiguously establish which of the above patterns apply here, nor which are more likely to influence farm and forest valuation more broadly. Nor do results indicate the extent to which similar results hold for other policy contexts, or for other potential case studies. However, results clearly reveal statistically significant preference and WTP patterns associated with both land use preservation policies and agents who implement those policies, *ceteris paribus*. Results also suggest caution in the comparison of welfare results across different policy contexts—a critical issue for benefits transfer—as WTP may not be directly comparable where different policy processes are applied to land preservation. Finally, model results imply the potential benefit of additional research into the implications of the policy process for welfare estimation and benefit cost analysis. While our case study applies solely to farm and forest preservation, it is possible that such effects may apply more broadly, with implications for benefit cost analysis in a wide range of policy contexts. At a minimum, these findings suggest that researchers should consider the possibility that policy process attributes may not be utility-neutral, and recognize the potential consequences of suppressing related preferences in stated preference analysis.

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Table 1. Variables and Descriptive Statistics

Variable	Description	Mean (Std. Dev.)[a]
environmental	Binary (dummy) variable identifying respondents who report membership in environmental organizations.	0.189 (0.391)
age	Age of respondent, in years.	54.332 (15.637)
protest	Binary (dummy) variable identifying responses that show clear evidence of being protests.	0.004 (0.062)
college	Binary (dummy) variable identifying respondents with at least a four-year college degree.	0.400 (0.490)
CT	Binary (dummy) variable identifying respondents from Connecticut (omitted default is respondents from Delaware).	0.567 (0.496)
neither	Alternative specific constant (binary) identifying the status quo option (omitted default is Option B).	0.333 (0.471)
age_neither	Multiplicative interaction between *age* and *neither*.	18.111 (27.158)
env_neither	Multiplicative interaction between *environmental* and *neither*.	0.063 (0.243)
prot_neither	Multiplicative interaction between *protest* and *neither*.	0.001 (0.036)
coll_neither	Multiplicative interaction between *college* and *neither*.	0.133 (0.340)
option_A	Alternative specific constant (binary) identifying Option A (omitted default is Option B).	0.333 (0.496)
acres	Number of acres preserved (single parcel).	62.893 (70.337)
nursery	Binary (dummy) variable indicating that the parcel is an active nursery (omitted default is a food or dairy farm).	0.132 (0.338)
forest	Binary (dummy) variable indicating that the parcel is forest (omitted default is a food or dairy farm).	0.132 (0.339)
idle	Binary (dummy) variable indicating that the parcel is idle (non-active) farmland (omitted default is a food or dairy farm).	0.137 (0.343)
st_purch	Binary (dummy) variable indicating that preservation is accomplished through fee simple purchase of the parcel, implemented by the state (omitted default is preservation by state-implemented conservation easements).	0.219 (0.413)
tr_purch	Binary (dummy) variable indicating that preservation is accomplished through fee simple purchase of the parcel, implemented by the land trusts, using block grant funds from the state (omitted default is preservation by state-implemented conservation easements).	0.223 (0.416)
tr_con	Binary (dummy) variable indicating that preservation is accomplished through conservation easements, implemented by land trusts, using block grant funds from the state (omitted default is preservation by state-	0.072 (0.257)

	implemented conservation easements).	
zoning	Binary (dummy) variable indicating that preservation is accomplished using conservation zoning (omitted default is preservation by state-implemented conservation easements).	0.079 (0.270)
walking	Binary (dummy) variable indicating that the preserved parcel would offer public access for walking and biking (omitted default is no public access).	0.154 (0.361)
hunting	Binary (dummy) variable indicating that the preserved parcel would offer public access for hunting (omitted default is no public access).	0.139 (0.346)
dev_not_30	Binary (dummy) variable indicating that the parcel, if not preserved, would likely remain undeveloped for at least 30 years (omitted default is development likely in less than 10 years).	0.226 (0.418)
dev_10_30	Binary (dummy) variable indicating that the parcel, if not preserved, would likely be developed in 10 to 30 years (omitted default is development likely in less than 10 years).	0.217 (0.412)
age_not30	Multiplicative interaction between *age* and *dev_not_30*.	12.256 (29.391)
age_dev10_30	Multiplicative interaction between *age* and *dev_10_30*.	11.740 (23.526)
cost	Unavoidable household cost of preservation (state/town taxes and fees), with sign reversal.	-43.921 (62.521)

[a] Includes zeros for the 'status quo' option.

Table 2. Conditional and Mixed Logit Results

Variable	**Model One** Conditional Logit, Unrestricted Parameter Estimate (Std. Error)	**Model Two** Conditional Logit, Restricted Parameter Estimate (Std. Error)	**Model Three** Mixed Logit, Restricted Parameter Estimate (Std. Error)
neither	-0.5969 (0.2553)	0.1012 (0.2193)	-1.1886 (0.3437)***
env_neither	-0.5770 (0.1018)***	-0.5876 (0.1009)***	-0.5975 (0.2168)***
age_neither	0.0130 (0.0034)*	0.0130 (0.0033)*	0.6492 (0.0057)
prot_neither	2.9498 (1.048)***	2.9359 (1.048)***	4.0113 (0.9563)***
coll_neither	-0.6731 (0.0791)***	-0.6815 (0.0779)***	-1.0343 (0.1666)***
option_A	0.1761 (0.0764)**	0.1054 (0.0486)**	0.1149 (0.0399)***
acres	0.0014 (0.0006)**	0.0019 (0.0004)***	0.0023 (0.0005)***
nursery	-0.0905 (0.1192)	-0.1172 (0.0766)	-0.0800 (0.0881)
forest	-0.1594 (0.1215)	-0.0559 (0.0776)	-0.0039 (0.0904)
idle	-0.0024 (0.1170)	-0.0130 (0.0760)	0.1181 (0.0906)
st_purch	-0.2732 (0.1803)	-0.1972 (0.1185)*	-0.2954 (0.1604)*
tr_purch	-0.3779 (0.1807)**	-0.2009 (0.1187)*	-0.3176 (0.1580)**
tr_con	-0.3092 (0.2048)	-0.1628 (0.1315)	-0.3912 (0.1662)**
zoning	-0.5843 (0.2028)***	-0.4099 (0.1314)***	-0.5017 (0.1653)***
walking	0.4876 (0.1402)***	0.5666 (0.0922)***	0.8672 (0.1292)***
hunting	0.2052 (0.1444)	0.2530 (0.0944)***	0.3399 (0.1273)***
dev_not_30	-0.2700 (0.2443)	-0.3921 (0.2339)*	-0.5126 (0.2421)**
dev_10_30	-0.2087 (0.2502)	-0.2405 (0.2413)	-0.4839 (0.2891)*
age_not30	0.0066	0.0067	0.0090

	(0.0042)	(0.0042)	(0.0043)**
age_dev10_30	0.0045 (0.0043)	0.0043 (0.0043)	0.0091 (0.0052)*
cost (sign-reversal)	0.0051 (0.0008)***	0.0038 (0.0005)***	--
cost (lognormal, sign-reversal)	--	--	-4.5099 (0.3679)***
cost (standard deviation)	--	--	7.3350 (0.7600)***
CT × neither	0.2566 (0.2408)	--	--
CT × option_A	-0.1212 (0.0992)	--	--
CT × acres	0.0007 (0.0008)	--	--
CT × nursery	-0.0477 (0.1558)	--	--
CT × forest	0.1771 (0.1583)	--	--
CT × idle	-0.0142 (0.1542)	--	--
CT × st_purch	0.1251 (0.2394)	--	--
CT × tr_purch	0.3020 (0.2399)	--	--
CT × tr_con	0.2547 (0.2673)	--	--
CT × zoning	0.2993 (0.2663)	--	--
CT × walking	0.1459 (0.1862)	--	--
CT × hunting	0.0910 (0.1910)	--	--
CT × dev_not_30	-0.1983 (0.1317)	--	--
CT × dev_10_30	-0.0733 (0.1355)	--	--
CT × cost	0.0021 (0.9752)**	--	--
-2 Log Likelihood χ^2	552.098***	535.829***	1712.016***
Pseudo-R^2	0.078	0.075	0.241
Chow Test: Equal Scale Parameter (CT and DE)	χ^2=0.95, *p*=0.33	--	--
Likelihood Ratio Test: Restricted vs. Unrestricted Model	--	χ^2 = 16.628, *p* = 0.36	--

Likelihood Ratio Test: Mixed vs. Conditional Logit Model	--	--	χ^2 = 1176.188, p < 0.001
Observations (N)	3309	3309	3309

* p<0.10
** p<0.05
*** p<0.01

Table 3. Willingness to Pay Implications of Policy Process Attributes: Simulation Results[a]

Attribute	WTP (conditional logit)[b]	Mean of Median WTP (mixed logit, using median of price coefficient only)[c]	Mean of Median WTP (mixed logit, using entire distribution of price coefficient)[c]
State Purchase (*st_purch*)	-51.81 [31.82]	-27.62 (-75.14, 1.76)	-28.88 (-91.41, 2.02)
Trust Purchase (*tr_purch*)	-52.80 [31.96]	-30.40 (-79.83, -0.64)	-31.71 (-99.30, -0.60)
Trust Contract (*tr_cont*)	-42.78 [35.06]	-37.05 (-92.62, -4.81)	-38.64 (-116.28, -4.65)
Conservation Zoning (*zoning*)	-107.70 [36.88]	-47.98 (-108.35, -12.20)	-49.78 (-132.18, -11.19)

[a] Marginal WTP calculated relative to the default of preservation implemented by the state using conservation easements.

[b] Numbers in brackets are standard errors calculated using the delta method (Greene 2003).

[c] Numbers in parentheses are the bounds on empirical 95% confidence intervals from WTP simulations. Because the empirical distributions of WTP simulations from the mixed logit model are skewed and non-normal, empirical 95% confidence intervals are presented in lieu of standard errors.