Optimizing Farmland Preservation Choices Across Communities and Jurisdictional Scales: To What Extent are Amenity Values and Selection Criteria Transferable?

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Abstract

This paper assesses the potential for function based benefit transfer to inform farmland preservation policy, with emphasis on distinctions between welfare estimation and policy prioritization. Data are drawn from a parallel choice experiments implemented in six communities and statewide in Connecticut. The analysis provides a range of empirical results of potential significance for policy, but two findings are of particular relevance. First, results suggest that transfer errors in WTP for farmland preservation are comparable to those found in other policy contexts, even across similar sites. Results also suggest, however, that welfare based policy rankings are strongly correlated across sites, even when dollar denominated transfer errors are substantial. This latter, robust finding underscores the risk of broad generalizations regarding transfer validity, and suggests that benefit transfer may be well suited to some uses.

JEL Codes: Q24, Q51

Introduction

Despite over two decades of stated preference (SP) research measuring farmland amenity values, little published work addresses the transferability of welfare estimates across policy contexts. Systematic, quantitative comparison of public preferences for farmland preservation across regions has been hindered by differences in land types, policy contexts and other welfare-relevant attributes across studies (Bergstrom and Ready 2005). As a result, the potential transferability of amenity values across sites—and implications for preservation policy—remain largely unknown. Agencies seeking welfare guidance for farmland preservation, yet unable to commission site-specific primary research, are left to consider possibilities for benefit transfer with little evidence regarding potential transfer validity or transfer errors that might be expected.

Notwithstanding the significant but largely qualitative insight available from Bergstrom and Ready (2005) and findings of unpublished work (e.g., Ozdemir et al. 2004), the authors are aware of only one published, quantitative assessment of benefit transfer applied to farmland preservation (Johnston and Duke 2008). This largely methodological analysis assesses methods for the transfer of preservation values across states and jurisdictional scales (i.e., the size of the area within which a preservation policy is implemented). Results suggest that the choice of transfer method can have significant implications for transfer error, with some function-based transfer methods generating average percentage errors that are quite small (e.g., <16%) by typical standards (Rosenberger and Stanley 2006), and other methods generating errors that are likely unacceptable for most applications. The relevance of this contribution aside, Johnston and Duke (2008) fail to address issues related to common cases in which function based transfers are implemented across similar jurisdictions within the same state. Transfers of this type ought to be in great demand by policymakers, and one anticipates a relatively low transfer error. Indeed, limited evidence from different contexts suggests that the in-state transfer error will be lower than otherwise similar across state transfers (Loomis 1992; VandenBerg, et al 2001). More broadly, prior work fails to provide methodical evidence regarding: (1) the *magnitude of transfer errors* likely in farmland preservation policy contexts; (2) *whether benefit transfer is suitable for policy guidance* in such contexts: and (3) *what type(s) of guidance may (or may not) be provided* by benefit transfer with an acceptable likelihood of validity.

Outside of the farmland valuation literature, most transfer assessments conduct statistical comparisons of an original study result and a transfer estimate or quantify various measures of transfer error (Rosenberger and Stanley 2006).[1] Although the literature provides significant evidence regarding conditions likely to be associated with reduced transfer errors and greater validity, e.g., use of function-based transfers, transfer over similar sites, transfers within smaller jurisdictions (Johnston 2007; Loomis 1992; VandenBerg et al. 2001; Parsons and Kealy 1994; Piper and Martin 2001; Rosenberger and Loomis 2001; Rosenberger and Phipps 2007; Morrison et al. 2002), it also finds that transfer errors can vary substantially across different resource types and policy contexts (Rosenberger and Stanley 2006; Rosenberger and Phipps 2007). Hence, notwithstanding insight available from existing work, the potential for accurate, reliable transfer of farmland amenity or preservation values remains largely unknown.

The Role of Benefit Transfer in Farmland Preservation Policy—Implications for Validity

In cases where decision-makers seek monetized benefit measures of resource policies—for example as a precursor to benefit cost analysis—standard assessments of transfer error

[1] Unlike standard policy applications of benefit transfer, in which primary study results are unavailable for the policy site in question, formal tests of transfer performance are typically conducted for cases in which actual values have been estimated for policy sites, thereby allowing formal tests of convergent validity and quantification of transfer errors.

provide guidance about the suitability of using the transfer to inform policy or about the bounds of a sensitivity analysis. In other cases, however—including many relevant to farmland preservation—policymakers may desire only a means to prioritize preservation options based on public preferences (Duke and Aull-Hyde 2002; Jiang et al. 2005; Messer 2006). Here, the emphasis is not on the convergent validity of values *per se*, but rather on the transferability of resultant policy rankings—results that may remain transferable even if welfare estimates fail convergent validity tests or are associated with substantial transfer errors. This prioritization role of benefit transfer has received less attention in the literature, yet is particularly relevant for the context of land preservation (Duke and Johnston 2008; Jiang et al. 2005).

These two possible uses of transfer results within farmland preservation policy—welfare quantification versus policy prioritization—imply that traditional tests of transfer error may provide only partial, and possibly misleading, insight regarding the suitability of benefit transfer for applied use. Consider an example in which willingness to pay (WTP) for $k = 1 \ldots K$ preservation options at policy site X is a monotonic transformation of WTP for the same set of K options at study site Y. Here, an appropriately conducted benefit transfer from site Y to X would predict *policy rankings* with zero error, although WTP *transfer errors* could be substantial. Ranking approaches are common in the preservation decision making of planners. Economists typically do not investigate benefit ranking strategies of any type because they are difficult to reconcile with cost data and thereby inform policy efficiency. However, an examination of preservation parcel selection strategies shows that the benefit rankings are often treated separately from the cost-side decisions. As a result, prioritization based on rankings provides the same practical value as welfare estimates. This paper suggests the possibility of relative gains in accuracy from transferring rankings and thus suggests a potential policy improvement by expanding the use of benefit transfer.

More broadly, when considering benefit transfer between two or more sites, there is no necessary mathematical relationship between the size of average transfer error in estimated welfare over a set of policy options and the correlation of welfare-based policy rankings over the same set of options. Appropriate guidance regarding transfer validity and error requires knowledge of the purpose of the underlying transfer. In one of the few available assessments of such issues, Jiang et al. (2005, p. 496) argue that benefit transfer "is suitable for ranking the public's preference for … preserving … coastal access sites, even if transfer of WTP estimates performs unsatisfactorily." However, this assessment considers only a single policy and study site (Massachusetts and Rhode Island) and a single resource type (land for coastal access), leaving unclear broader empirical relationships between the ability of benefit transfer to approximate WTP versus predict policy priorities.

Can Benefit Transfer Appropriately Inform Farmland Preservation Policy?

This paper provides a systematic assessment of the capacity of benefit transfer to inform farmland preservation, recognizing that the preservation policy may require varying types of decision support. The analysis draws from function based transfer of CE welfare estimates (Morrison and Bergland 2006), in which WTP for farmland preservation is conditional on multiple preservation attributes. The data are drawn from a suite of CEs addressing farmland preservation in seven Connecticut jurisdictions (Johnston and Duke 2007a,b; 2008; Johnston, Duke and Kukielka 2007). These include data drawn from six independent but parallel surveys implemented in different Connecticut communities and a seventh statewide survey of

Connecticut residents. A high degree of parallelism across CEs ensures that results are not confounded by uncontrolled methodological differences (cf. Bergstrom and Ready 2005).

Various transfer possibilities and assessments of benefit transfer performance are drawn from CE benefit functions, estimated from mixed logit random utility models. Assessment of transfer performance is conducted over multiple sites—including those at divergent policy scales (i.e., statewide versus community preservation, cf. Johnston and Duke 2008)—and using different transfer methods to enhance the comprehensiveness and relevance of findings. Of particular emphasis are potential divergences between the welfare quantification and policy prioritization performance of function-based transfers, with a goal of identifying those purposes for which benefit transfer is best suited within the context of farmland preservation.

Framework for Choice Experiment Benefit Transfer

Choice experiments (CEs) ask respondents to evaluate alternative goods or programs (often including a status quo option) that may differ across a variety of attributes, and choose the option that offers the greatest utility (Adamowicz et al. 1998). Unlike contingent valuation—which typically estimates values for a single or very small number of policy or good configurations—CEs generate an empirical estimate of a utility function. This function allows analysts to estimate utility theoretic values for a wide range of policy or environmental good options and to assess how these values change when policy configurations are altered. This ability of CEs to adjust for differences in the attributes of environmental goods or policies provides an increased capacity to adjust for differences between study and policy sites—thereby improving the potential accuracy of benefits transfer (Morrison et al. 2002; Jiang et al. 2005). The suitability of CEs for benefits transfer is discussed by Morrison et al. (2002), Johnston

(2007) and Jiang et al. (2005) among others.

Here, parallel CEs are applied to assess WTP for farmland preservation options in six different communities and statewide in Connecticut. In each case, respondents are asked to consider different preservation alternatives that would occur either within their home community or state, depending on survey version (community or statewide). The result is seven distinct benefit functions through which one may forecast WTP for different types of farmland preservation, each applicable to the jurisdiction within which the CE was implemented. Benefit transfer assessments quantify the capacity of the benefit function estimated in one jurisdiction or set of jurisdictions (the study site(s)) to approximate WTP estimates and policy rankings equivalent to those resulting from the original, site-specific benefit function of another jurisdiction (the policy site). Transfers follow standard methods from the literature, as summarized briefly in the following sections.

The Random Utility Model

Benefit functions and WTP are derived from a standard random utility framework in which utility is divided into observable and unobservable components (Hanemann 1984). We assume that the utility of household h from preservation program k, $U_{hk}(\cdot)$, is defined by

$$U_{hk}(\mathbf{X_k}, Y_h - Fee_{hk}) = v_{hk}(\mathbf{X_k}, Y_h - Fee_{hk}) + \varepsilon_{hk} \quad [1]$$

where

$\mathbf{X_k}$ = vector of variables characterizing outcomes and policy attributes of preservation program k;

Fee_{hk} = mandatory cost to the respondent of preservation plan k;

$v_{hk}(\cdot)$ = function representing the empirically measurable component of utility;

ε_{hk} = unobservable component of utility, modeled as econometric error.

The superscript $j = 1, 2...J$ references individual jurisdictions (or sites) for which distinct utility functions may be estimated. This allows J utility functions from [1]: $U^j_{hk}(\cdot)$ for $j = 1, 2...J$. In the present case, J=7, reflecting six community jurisdictions and one state jurisdiction with each community constitutes a disjoint set and is also a perfect subset of the state jurisdiction.

Given the above specification, household h in jurisdiction j chooses among three policy plans, (i=A,B,N) applicable to preservation in jurisdiction j. The household may choose option A, option B, or may reject both options and choose the status quo (neither plan, i=N). A choice of neither plan would result in zero preservation, no preservation policy $\mathbf{X_k}$=0, and zero household cost, $Fee_{hk}=0$. The model assumes that household h assesses the utility that would result from choice options (i=A,B,N) and chooses that which offers the greatest utility. That is, given [1], household h will choose plan A if

$$U^j_{hA}(\mathbf{X_A}, Y_h - Fee_{hA}) \geq U^j_{hz}(\mathbf{X}_z, Y_h - Fee_{hz}) \quad \text{for } z=B,N, \qquad [2]$$

such that

$$v^j_{hA}(\mathbf{X_A}, Y_h - Fee_{hA}) + \varepsilon_{hA} \geq v^j_{hz}(\mathbf{X}_z, Y_h - Fee_{hz}) + \varepsilon_{hz} \qquad [3]$$

If the ε_{hk} are assumed independently and identically drawn from a type I extreme value distribution, the model may be estimated as a conditional logit (CL) or mixed logit (ML) model (Maddala 1983; Greene 2003). Estimation of parallel models for allows for unique estimates of $\hat{v}^j_{hk}(\cdot)$ for $j = 1, 2...J$, from which welfare estimates may be derived following Hanemann (1984).

Methodology for Benefit Estimation and Transfer Assessments

Benefit transfer assessments draw from welfare measures derived from estimated utility functions, either alone or in combination. To simplify notation, average per household willingness to pay for farmland preservation program k in jurisdiction j is specified as $WTP_k^j(\mathbf{X_k})$, where WTP is derived from $\hat{v}_{hk}^j(\cdot)$ following standard approaches (e.g., Boxall et al. 1996). A simple two-site assessment of benefit transfer for preservation type k would compare $WTP_k^n(\mathbf{X_k})$ to $WTP_k^m(\mathbf{X_k})$ for $j = m, n$ and $m \neq n$. Site-to-site transfer in actual policy settings, however, requires that analysts identify the "best" or most similar study site for any given policy site—a selection that the literature has been somewhat reluctant to make when multiple study sites are available (Johnston 2007). Given the potential difficulty in identifying the most similar study site for benefit transfer, the performance of simple site-to-site function based transfer is contrasted with an alternative in which transfer estimates are derived as a mean value over all commensurate study sites (cf. US EPA 2007).

To formalize the latter method, assume that $j=n$ identifies a policy site for a given assessment and $j=s$ ($s = 1 \ldots J\text{-}1$) identifies the remaining $J\text{-}1$ sites for which WTP estimates are available for preservation type k. The transfer estimate of WTP for policy site n is calculated as

$$\widetilde{WTP}_k^n = \sum_{s=1}^{J-1} WTP_k^s \Big/ (J-1) \qquad [4]$$

where the tilde (~) identifies a benefit transfer estimate. This provides a single transfer estimate for each preservation type k, for each site j, where these estimates are calculated as the mean of WTP for the analogous preservation type k at all other commensurate sites.

Drawing from function based WTP transfer estimates—either transferred site-to-site or using [4], one may calculate a variety of statistics quantifying transfer performance. For example, using [4], one might conduct tests of the null hypotheses ($\widetilde{WTP}_k^n = WTP_k^n$). Past studies in the literature also frequently assess transfer error in terms absolute value percentage (e.g., Rosenberger and Stanley 2006), which following [4] is given by

$$\left| \left(\widehat{WTP}_k^n - WTP_k^n\right) / WTP_k^n \right| \qquad [5]$$

Alternatively, one might rank all *k=1…K* preservation types by $\widehat{WTP}_k^n$, contrasting this to analogous policy ranks that would result from ranking by WTP_k^n (cf. Jiang et al. 2005). This latter assessment, though less common in the literature, can provide a distinct and in many cases relevant perspective on transfer performance.

The Data

The data are drawn from six parallel CE surveys conducted in Connecticut communities and one survey conducted at the Connecticut statewide level. The community scale surveys addressed land preservation in each community jurisdiction (Brooklyn, Mansfield, Pomfret, Preston, Thompson, Woodstock) and were implemented over random samples of community residents. All sampled communities are located in the easternmost third of the state, with five of the six located in the rural northeastern quadrant. Four of the six communities are contiguous (Brooklyn, Pomfret, Thompson and Woodstock), with land use and U.S. Census data suggesting the greatest similarities among Brooklyn and Thompson (Johnston, Duke and Kukielka 2007). The statewide survey was a similar CE instrument targeted at statewide preservation in Connecticut and implemented over a random sample of state residents.

Survey development for all surveys combined required over 20 months and 15 focus groups, with design for various surveys occurring between 2003 and 2007. Survey design was parallel across all surveys, subject to modest differences required to maintain realism, salience and policy relevance; these are discussed below. Additional details on specific survey instruments and methods—suppressed here for the sake of conciseness—are provided by

Johnston and Duke (2007a,b; 2008) and Johnston, Duke and Kukielka (2007).

CEs asked respondents to consider alternative preservation options for hypothetical parcels located in their community or state, depending on survey version. Respondents were provided with two preservation options that would each preserve land with varying attributes, "Option A" and "Option B," as well two status quo options. The first status quo option stated, "I would not vote for either program." The second stated, "I support these programs in general, but my household would/could not pay for either Option A or B." This option was included based on focus groups and prior research (Loomis, Traynor, and Brown 1999; Brown et al. 1996) as an outlet for those who might wish to express symbolic support for preservation yet would not pay for either of the provided options. For purposes of estimation the two status quo options—both indicating a choice of no preservation—were combined into a single category.

Each respondent was provided with three or four choice questions, depending on survey version[2], and instructed to consider each as an independent, non-additive choice. Attributes characterized elements identified by focus groups as significant to choices among preservation options, including type of land preserved, number of acres, public access, development likelihood of unpreserved parcels, preservation method and household cost. Table 1 shows design attributes and levels that distinguished preservation options across different surveys. Experimental designs were constructed by the University of Delaware STATLAB based on a D-optimality criterion (Kuhfeld and Tobias 2005).

Survey implementation for the seven CEs took place between 2005 and 2007, in all cases following Dillman's (2000) tailored design method. Surveys were mailed to 400 randomly selected residents of Brooklyn, Pomfret, Thompson and Woodstock (1,600 total); 750 residents

[2] Surveys for Mansfield, Preston and Connecticut included three choice questions per survey. Other surveys included four choice questions per survey.

of Mansfield and Preston (1,500 total), and 1000 residents statewide. Of 4,287 combined deliverable community surveys, 1,857 were returned, for a response rate of 43.3%. Of 915 deliverable statewide surveys 288 were returned, for a response rate of 31.5%.

Reconciliation of Attribute Levels

To prevent respondent protests and confusion, it is crucial that survey scenarios are "perceived as realistic and feasible" (Bateman et al. 2002, p. 116); this also includes sufficient correspondence between realistic policy options in any jurisdiction and those described in CE scenarios. Hence, while the seven CEs maintain a high degree of parallelism and an identical choice format, some differences were incorporated to maintain realism and to match policy options considered most relevant in each jurisdiction. While this limits statistical analysis options (e.g., CE data cannot be pooled within a single statistical model), it also allows for a more realistic assessment of transfer potential. That is, although one would expect that a perfect match across attribute levels in all CEs would provide an ideal context for benefit transfer and testing, the current situation presents a more realistic context in which some policy attributes are defined similarly across surveys, but the definition of other attributes differs.

Primary differences between CE attribute levels are detailed in table 1. Preservation acreages, for example, are larger at the state scale. This reflects the fact that statewide farmland preservation programs generally target a greater number of acres than those implemented at the community scale—a fact recognized by focus group participants.[3] Similarly, program cost levels diverge across the two survey scales (community versus state) in response to pretest responses revealing differences in the range of household WTP, and payments perceived as realistic, as

[3] When presented with preliminary surveys showing statewide preservation programs that targeted small numbers of acres, focus group respondents often described such programs as either trivial or unrealistic.

related to the range of other question attributes.

Attribute levels for public access also differ. Focus groups for community surveys revealed that scenarios were viewed as most realistic if they allowed for different types of access on individual parcels. For example, the Mansfield and Preston experimental design incorporate three possible access levels (no access, access for walking and biking, access for hunting); the design for other communities includes only two levels (no access, access for passive recreation). At the state scale, in contrast, it was perceived as unrealistic that the state could mandate access for any specific activity on all preserved acres. Hence, the statewide survey characterizes public access as the percentage of preserved acres for which access is permitted (i.e., 100%, 50%, 0%).

Other differences between attribute levels in the seven CEs are detailed in table 1. As emphasized by Smith, van Houtven, and Pattanayak (2002) and Johnston et al. (2005), benefit transfer requires reconciliation of variables and attribute levels across study and policy sites. Accordingly, transfer assessments are only conducted here for preservation attribute levels present—in at least approximate form—in all seven CEs. In such cases, reconciliation matched closely paired attribute levels across CEs such that parallel comparisons could be made.[4]

For example, the public access attribute level "access for walking and biking" in the Mansfield and Preston surveys was reconciled with "access for passive recreation (hiking, bird watching, etc.)" in the other four community surveys, and with "access on 50% of preserved parcels" in the statewide survey. For purposes of benefit transfer these are all interpreted as moderate levels of public access. In contrast, we do not conduct or test benefit transfer for preservation options including attribute levels possible in some CEs but not possible—even in approximate form—in others (e.g., conservation zoning as a policy technique).

[4] For policy alternatives including attribute levels that could not be reasonably reconciled across choice experiments (e.g., "idle farmland" which only appears as a possible land type in three of the seven choice experiments), benefit transfers are neither conducted nor assessed.

Given attribute levels in the three different experimental designs (table 1), there are 24 unique combinations of preservation attributes for which per acre welfare measures may be compared across all models. This number is derived by including three farmland types (food/field, forestry/orchard/tree, dairy/livestock), two preservation methods (preservation contracts by state, outright purchase by state), two access types (no access, access for passive recreation/walking/biking) and two development risk levels (high development risk on unpreserved parcels, low development risk on unpreserved parcels)[5] represented in all designs, leading to 3×2×2×2=24 options for which welfare measures are compared across all CEs.

The Empirical Model

The literature offers no firm guidance concerning the most appropriate functional form for the observable component of respondents' utility. Although linear forms are common, others are also used depending on theoretical and empirical considerations. In the CEs modeled here, all attributes except the number of preserved acres characterize outcome or policy features of preserved land (table 2). The influence of these attributes on utility is expected to depend on the number of acres preserved. Given this expected conditionality and to avoid unrealistic results associated with linear terms in the utility function[6], all non-acreage preservation attributes (land type, preservation method, public access, development risk) enter choice models as multiplicative interactions with the number of acres preserved. Remaining attributes, including

[5] High development risk was defined as development being likely on unpreserved parcels within ten years if not preserved. The definition of low development risk differed somewhat across choice experiments (table 1). For example, in Mansfield and Preston low development risk was characterized as development that would be unlikely within 30 years, whereas in the other four communities low development risk was characterized as development that would be unlikely within 10 years. These distinctions highlight realistic differences among policy contexts that are likely to be encountered in benefit transfer.

[6] For example, a linear specification would predict a fixed utility impact of land attributes regardless of the number of acres preserved and could forecast a positive or negative utility change even if zero acres were preserved.

preservation acres, program cost and an alternative specific constant (ASC) for "neither plan" enter linearly. Hence, following [1], household utility from policy option k is given by

$$v_k(\cdot) = \beta_0^j(Neither) + \beta_1^j(Acres_k) + \sum_{n=2}^{N} \beta_n^j(Acres_k)(X_{kn}) + \beta_{N+1}^j(Fee_k), \qquad [6]$$

where *Neither* is the ASC for "neither plan," $Acres_k$ is the number of acres preserved by option k, X_{kn} are attributes of preserved acres, Fee_k is the unavoidable household cost of the plan, and the betas (β) are parameters to be estimated. The superscript j reflects the fact that parameters β^j may differ across jurisdictions.

The models are estimated using mixed logit (ML) with coefficients on the ASC (*Neither*) program cost (*Fee*), and acres preserved (*Acres*) specified as random. A normal distribution is assumed for the coefficients on *Neither* and *Acres*; a lognormal distribution is assumed for the coefficient on *Fee*, ensuring a positive marginal utility of income. Sign-reversal is applied to the cost variable prior to estimation. These conventions follow standard approaches (Hensher and Greene 2003; Hu, Veeman, and Adamowicz 2005). Following Johnston and Duke (2008), coefficients on multiplicative interactions are specified as fixed.[7]

Parallel ML models are estimated for each CE, subject to differences in attribute levels detailed above. Table 2 describes variables included in one or more estimated models, drawn directly from attribute levels in experimental designs (table 1). Note that the exact definition of model variables sometimes differs across models, as described above in the section addressing attribute reconciliation (table 2). As noted above, such divergences are common in benefit

[7] Although specific quantitative results presented here are based on a specific functional form and ML specification, preliminary models suggest that alternative functional forms (e.g., linear) and estimation methods (e.g., conditional logit) generate similar results. That is, the fundamental implications of the analysis are robust to changes in model specification. The present ML model is chosen for its superior performance and suitability for policy-relevant WTP estimation (cf. Johnston, Duke, and Campson 2007).

transfer applications. All models are estimated using maximum likelihood with Halton draws in the likelihood simulation. Tables 3 and 4 present ML results for each of the seven models.

The focus on benefits transfer implies an assessment of WTP convergent validity across models rather than detailed assessment of individual results for each model. Nonetheless, initial model assessments reveal value surface patterns corresponding to *ex ante* expectations. All models are statistically significant at $p<0.01$, with significant coefficients conforming to prior expectations. As expected, the significance and magnitude of many parameter estimates vary across different models, but models also reveal a number of parallel findings. These include consistent findings of positive marginal utility associated with public access. In all cases, ML models outperform their conditional logit counterparts, and estimated standard deviations of random parameters are most often statistically significant at $p<0.01$ or better.

Given that the estimated models involve random coefficients, welfare measures are simulated following Hensher and Greene (2003), as described by Johnston and Duke (2007a,b). We follow Hu, Veeman, and Adamowicz (2005) and Johnston and Duke (2007a, b) and present welfare estimates as the mean over the parameter simulation (1000 draws over all parameters, following the parametric bootstrap of Krinsky and Robb (1986)) of median WTP calculated over the coefficient simulation (1000 draws over random coefficients).[8] Additional details are provided by Johnston and Duke (2007a,b; 2008). Results reflect comparable estimates of WTP per household, per acre for multi-attribute farmland preservation policies.

Benefit Transfer Results

[8] This approach avoids unrealistic mean WTP estimates related to the long right-hand tail of the lognormal cost coefficient distribution (Hensher and Greene 2003). As noted by Hu, Veeman and Adamowicz (2005), there is no strong theoretical preference for either mean or median welfare measures.

Although transfer validity and error may be assessed over a variety of possible metrics (e.g., implicit prices, parameter estimates), compensating surplus (CS) estimates often provide the most policy relevant perspective on transfer performance (Morrison et al. 2002). Here, CS transfer error is assessed for cases in which each of the seven jurisdictions is considered the policy site for which welfare estimates are desired, but unknown. CS measures are derived from each empirical CE preference function following standard approaches (e.g., Boxall et al. 1996). Following common convention, transfer error is quantified as a percentage divergence of transfer estimates from a “true” value calculated from choice results for the jurisdiction assumed to be the policy site (Rosenberger and Stanley 2006). Errors in per acre WTP (either in dollars per acre or percentages) are presented as an average absolute value over all N=24 preservation types for which commensurable CS results may be generated across all CEs. For percentages, results are presented as trimmed means (10%) to offset the effects of a small number of outliers. These occur in relatively rare instances of near-zero actual WTP estimates, such that even very small magnitude transfer errors represent very large, outlying percentages.

As noted above, results for two different types of benefit transfer are illustrated in table 5. The first is the transfer of estimated mean WTP over all relevant study sites, for each preservation type and policy site, following [4] above. The second is a simple site-to-site function based WTP transfer, where we illustrate results of the best possible site-to-site transfer (i.e., the site-to-site transfer associated with the lowest transfer error for each of the seven assumed policy sites.) As a basis for comparison, table 5 also illustrates actual mean WTP/acre over all preservation types, for each assumed policy site.

In contrast to table 5, which characterizes (among other things) the best case site-to-site average transfer, table 6 provides transfer error results for all possible pair-wise combinations of policy and study sites. Because errors in table 6 are given as mean absolute value percentages, results vary across site pairs depending on which is designated the policy site.[9] Accordingly, table 6 illustrates 42 possible transfer error outcomes, with six different site-to-site transfers possible for each possible policy site.

Absolute Value Transfer Errors

In absolute value percentages, transfer errors appear comparable to those found previously in the literature for other resource types (table 5, cf. Rosenberger and Stanley 2006). The primary exception is the cross-jurisdiction (or cross-scale) transfer in which community scale WTP values are used to predict Connecticut state scale values. As expected and illustrated by tables 5 and 6, cross-scale transfers generate very large absolute value transfer errors (between 2167.89% and 9263.99%, depending on method).[10] These results validate prior findings of Johnston and Duke (2008) that unadjusted cross-scale transfers often produce unacceptable levels of transfer error. Here, large percentage errors for the state scale are due to the small size of WTP per acre calculated from state scale CE results (averaging $0.0077).

In contrast, transfer involving community-scale WTP generate average absolute value transfer errors ranging from 40.30% to 94.95% ($0.07 to $0.34 per acre) when considering the best case site-to-site transfers. In contrast, when transfer estimates are generated using mean values over all available study sites following [4], errors range from 72.53% to 337.75% ($0.25 to $0.45 per acre). These results, however, obscure the wider range of outcomes that may occur from a more typical site-to-site transfer (table 6), in which mean absolute value percentage errors

[9] For example, when considering two sites (*i* and *j*), percentage errors will generally differ depending on whether one transfers results from site *i* to site *j* or vice versa.
[10] The reason is that respondents are willing to pay much smaller amounts for preservation that will occur somewhere in their home state, compared to otherwise similar preservation that would occur somewhere within their home community. See Johnston and Duke (2008) for detailed discussion of related issues.

for community transfer vary from 40.30% to 865.01%. Hence, even among rural communities within relatively close geographical proximity (all within the rural eastern third of Connecticut), relatively substantial site-to-site average transfer errors are possible.

As expected, the best case site-to-site function based transfers outperform mean value transfers, often by a substantial margin (table 5). These findings highlight the potential importance of site similarity for low-error transfer of farmland preservation values, corresponding with prior findings in other policy contexts (Johnston 2007; Loomis 1992; VandenBerg, Poe, and Powell 2001; Piper and Martin 2001; Rosenberger and Loomis 2001; Rosenberger and Phipps 2007). Interestingly, the sites associated with the smallest site-to-site transfer errors in dollars per acre (table 5; Brooklyn, Pomfret and Thompson) are associated with the largest percentage transfer errors when mean value transfers are used (105.03% to 337.75%). These are also among the most similar jurisdictions in the data when assessed in terms of land use and demographic indicators (Johnston, Duke and Kukielka 2007). Such results highlight the variation in transfer performance that can result from modest changes in transfer methods, as well as the importance of providing multiple indicators of transfer performance (e.g., dollars per acre versus percentages).

As discussed by Bergstrom and DeCivita (1999), the required "degree of accuracy of benefits transfer depends in part on how the results will be used." Hence, the types of transfer errors shown here may or may not preclude applied use of benefit transfer to guide farmland preservation policy, depending on the degree of accuracy required (cf. Bergstrom and DeCivita 1999; Desvousges, Naughton and Parsons 1992). While low-error transfers are achievable (table 5), the magnitude of possible errors in some instances (table 6) suggests that policymakers should be aware of the error potential which may result from the use of benefit transfer for welfare quantification and should account for such issues when determining acceptable uses. For example, jurisdictions wishing solely to establish positive WTP for farmland preservation—and for which specific welfare point estimates are less critical—may find such average transfer errors to be acceptable. For other potential uses, such as formal benefit cost analysis (BCA), acceptability may depend on the degree of accuracy required and the margin between estimated benefits and costs (i.e., whether transfer errors could determine the qualitative outcome of BCA).

Benefit Transfer for Policy Prioritization

In contrast to the above analysis, which emphasizes the role of function based benefit transfer for welfare estimation, transfer results may also be used to rank policy proposals (Jiang et al. 2005) or establish broad policy priorities (Bergstrom and DeCivita 1999). As noted above, policy prioritizations may remain transferable even if welfare estimates are associated with substantial transfer errors. Notwithstanding the two-site assessment of Jiang et al. (2005) and qualitative discussions of such issues by a variety of authors (e.g., Bergstrom and DeCivita 1999; Desvousges, Naughton and Parsons 1992), the literature provides relatively little empirical insight into the validity of benefit transfer for such purposes.

To assess the potential capacity of benefit transfer to quantify farmland preservation priorities, the N=24 preservation policy options addressed above are ranked (1 to 24) based on average per household WTP for each option, with unique rankings calculated for each policy site. These actual rankings are compared to those from other sites (which could be transferred to the site in question), providing 21 site-to-site comparisons of actual versus transferred rankings. Following Jiang et al. (2005), correlations among policy rankings for each possible site pair are calculated using Spearman's rank correlation coefficient (ρ). Results are shown in table 7.

As shown by table 7, welfare based policy rankings across sites are highly correlated. The average correlation (ρ) across all sites is 0.83, with $\rho > 0.9$ for 7 out of 21 transfers. Moreover, the average correlation between Connecticut state policy rankings and those of the six community sites is 0.74, suggesting that state scale results may be used to gain fairly accurate insights into community level policy priorities (table 7) despite the large magnitude WTP transfer errors found for cross-scale transfers (table 6). Indeed, the lowest correlation found in any of the 21 possible site pairs is 0.57, suggesting that even in the worst case estimated, the transfer of WTP based policy rankings can provide significant and policy relevant insight.

In contrast to results of tables 5 and 6, which provide mixed results regarding the suitability of benefit transfer for welfare estimation in the context of farmland preservation, results shown in table 7 suggest clear suitability of benefit transfer results to prioritize policy options. These results are particularly unambiguous for the geographically proximate and socioeconomically similar communities of Brooklyn, Pomfret, Thompson and Woodstock, for which the average pair-wise correlation among welfare based policy rankings is 0.96. That is, among these relatively similar communities (Johnston, Duke and Kukielka 2007) there is a near perfect correlation among welfare based policy priorities for farmland preservation.

The strength of these correlations is particularly notable given the magnitude of absolute value transfer error in per acre WTP among the same communities, which—while not excessive by standards of the benefit transfer literature—nonetheless ranges from 40.30 to 310.28%. The contrast of these empirical outcomes provides perhaps the most pertinent general finding of the analysis—the intended use of benefit transfer is a critical factor when assessing transfer validity. Here, benefit transfer cannot generally be relied upon to provide highly precise estimates of WTP for farmland preservation, although transfer errors are low in some instances. However, the same transfers predict policy rankings with a high degree of accuracy. This result is robust across a wide array of study and policy sites, even at divergent policy scales.

Conclusions

This paper seeks to provide quantitative insight regarding the potential for function based benefit transfer to appropriately inform farmland preservation policy, with a particular emphasis on distinctions between the capacity of transfer to quantify welfare change and the capacity of the same transfers to prioritize policy options. Transfer performance is assessed over 24 preservation options and seven possible sites, including six sites at the community jurisdictional scale and one site at the state scale. Two possible transfer methods are considered (i.e., transfer of mean WTP values over same-scale study sites versus more common site-to-site transfer). For all sites, WTP estimates are generated from comparable CE methods.

As in most empirical assessments, there are a variety of analyses that are omitted and many topics that remain unexplored. For example, the analysis applies only to jurisdictions within a single state and does not adjust welfare estimates for differences in population attributes across sites. Moreover, while the analysis eliminates many potential transfer challenges related to the comparison of welfare estimates generated by fundamentally different non-market valuation methodologies (cf. Johnston et al. 2001; Bergstrom and Ready 2005), some assumptions are required to reconcile the full range of attribute levels across all sites. Although such situations are ubiquitous in applied transfers (Smith et al. 2002; Johnston et al. 2005), they should nonetheless be kept in mind when interpreting empirical results.

Such limitations notwithstanding, the analysis offers a range of findings of potential relevance to welfare analysis. Two findings are of particular relevance. First, when benefit transfer is used for welfare estimation, transfer errors in WTP for farmland preservation are similar to those found in other policy contexts (Rosenberger and Stanley 2006), even when considering similar sites. Even the lowest error site-to-site transfers generate mean absolute value percentage errors in excess of 40%, suggesting that such transfers are most suitable in cases where broad welfare guidance—as opposed to precise WTP point estimates—are required.

The second primary finding is more promising, and underscores the risk of generalizations regarding transfer validity. That is, welfare based policy rankings, or priorities, are highly correlated across sites, even when dollar denominated transfer errors are substantial. In one-third of assessed cases, site-to-site correlations between policy ranks exceed 0.9, and the average correlation in policy ranks over all sites exceeds 0.8. These findings are robust across site pairs and suggest that—at least for the case of farmland preservation—benefit transfer can provide accurate indications of policy rankings. The transferability of policy ranks holds true even for policies characterized by only marginal differences in one or more policy attributes, such as those commonly addressed within CEs.

The accuracy of transfers associate with policy rankings suggests a potentially underappreciated use of the results in planning. In applied settings, the very precise and accurate WTP estimates provided by economists are most likely not used as intended, i.e., in combination with precise and accurate cost data to make efficient management decisions or to cost effectively select among a set of possible provision opportunities. Indeed, the benefit transfer literature suggests that precision will rarely reflect accuracy when transfers are attempted. If planners do not intend to use benefit transfer studies for efficiency or cost effectiveness determinations, then the results in this paper suggest that planners will best rely on the straightforward results of policy rankings. This is especially true in management problems, such as preservation parcel selection where selection criteria tend to separate, or maintain incommensurability, between the benefit and cost sides of decision making.

Model results further suggest that the common sentiment of the literature—that benefit transfer may be at most suited for the establishment of "broad priorities" (Bergstrom and DeCivita 1999)—may be understated for the case of farmland preservation. Here, we find that benefit transfer is in most all cases well suited even for the establishment of specific policy rankings. Hence, if jurisdictions primary goal for valuation is the prioritization of farmland preservation policy options, benefit transfer may provide a cost-effective, accurate alternative.

References

Adamowicz, W., P. Boxall, M. Williams, and J. Louviere. 1998. "Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation." *American Journal of Agricultural Economics* 80(1): 64-75.

Bateman, Ian J., Richard T. Carson, Brett Day, Michael Hanemann, Nick Hanley, Tannis Hett, Michael Jones-Lee, Graham Loomes, Susana Mourato, Ece Ozdemiroglu, David W. Pierce, Robert Sugden, and John Swanson. 2002. *Economic Valuation with Stated Preference Surveys: A Manual*. Northampton MA: Edward Elgar.

Bergstrom, John C. and Paul De Civita. 1999. "Status of Benefits Transfer in the United States and Canada: A Review." *Canadian Journal of Agricultural Economics* 47(1): 79-87.

Bergstrom, John C. and Richard C. Ready. 2005. "What Have We Learned from 20 Years of Farmland Amenity Valuation Research?" In Western Regional Research Publication W-1133, Benefits and Costs of Resource Policies Affecting Public and Private Land. Eighteenth Interim Report, comp. Stephen Schultz. Fargo, ND: North Dakota State University.

Boxall, Peter C., Wiktor L. Adamowicz, Joffre Swait, Michael Williams and Jordan Louviere. 1996. "A Comparison of Stated Preference Methods for Environmental Valuation." *Ecological Economics* 18(3): 243-253.

Brown, Thomas C. 1993. Measuring Nonuse Value: A Comparison of Recent Contingent Valuation Studies, W-133 Sixth Interim Report University of Georgia. Athens, GA: Department of Agriculture and Applied Economics.

Desvousges, William H., Michael C. Naughton and George R. Parsons. 1992. Benefit Transfer: Conceptual Problems in Estimating Water Quality Benefits Using Existing

Studies. *Water Resources Research* 28 (3): 675-83.

Dillman, Don A. 2000. *Mail and Internet Surveys: The Tailored Design Method*. New York, NY: John Wiley and Sons.

Duke, J.M. and Rhonda Aull-Hyde. 2002. Identifying public preferences for land preservation using the analytic hierarchy process. *Ecological Economics* 42(1-2):131-45.

Duke, J.M. and R.J. Johnston. 2008. Multifunctionality and Land Use Policy: An Application of Nonmarket Valuation to Urban Fringe Farm and Forest Preservation, in Goetz, S. and F. Brouwer, eds. *New Perspectives on Agri-Environmental Policies: A Multidisciplinary and Transatlantic Approach*. Oxford, UK, Routledge Publishers, in press.

Greene, W.H. 2003. *Econometric Analysis*, 5th ed. Upper Saddle River, NJ: Prentice Hall.

Hanemann, W. Michael. 1984. "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses." *American Journal of Agricultural Economics* 66(3): 332-341.

Hensher, David A. and William H. Greene. 2003. "The Mixed Logit Model: The State of Practice." *Transportation* 30(2): 133–176.

Hu, Wuyang, Michele M. Veeman and Wiktor L. Adamowicz. 2005. "Labeling Genetically Modified Food: Heterogeneous Consumer Preferences and the Value of Information." *Canadian Journal of Agricultural Economics* 53(1): 83-102.

Jiang, Yong, Stephen K. Swallow and Michael McGonagle. 2005. "Context-Sensitive Benefit Transfer Using Stated Choice Models: Specification and Convergent Validity for Policy Analysis." *Environmental and Resource Economics* 31(4): 477–499.

Johnston, Robert J. 2007. Choice Experiments, Site Similarity and Benefits Transfer. *Environmental and Resource Economics* 38(3): 331-351.

Johnston, Robert J., Elena Y. Besedin, Richard Iovanna, Christopher Miller, Ryan Wardwell, and Matthew Ranson. 2005. "Systematic Variation in Willingness to Pay for Aquatic Resource Improvements and Implications for Benefit Transfer: A Meta-Analysis." *Canadian Journal of Agricultural Economics* 53(2-3): 221-248.

Johnston, Robert J., Joshua M. Duke and Tammy W. Campson. 2007. "The Value of Farm and Forest Preservation in Connecticut." Technical Report, Department of Agricultural and Resource Economics, University of Connecticut, Storrs, CT.

Johnston, Robert J. and Joshua M. Duke. 2007a. "Willingness to Pay for Agricultural Land Preservation and Policy Process Attributes: Does the Method Matter?" *American Journal of Agricultural Economics* 89(4) 1098-1115.

Johnston, Robert J. and Joshua M. Duke. 2007b. "Benefit Transfer Equivalence Tests with Non-Normal Distributions." *Environmental and Resource Economics*, in press.

Johnston, R.J. and J.M. Duke. 2008. Willingness to Pay for Land Preservation Across States and Jurisdictional Scale: Implications for Benefit Transfer. *Land Economics*, in press.

Johnston, Robert J., Jessica Kukielka and Joshua M. Duke. 2007. "Public Preferences and Willingness to Pay for Farmland Preservation in Connecticut Rural Communities: Case Studies of Brooklyn, Pomfret, Thompson and Woodstock." Final Report to the Eastern Connecticut Resource Conservation and Development Area, Tolland, CT.

Johnston, Robert J., James J. Opaluch, Thomas A. Grigalunas, and Marisa J. Mazzotta. 2001. "Estimating Amenity Benefits of Coastal Farmland." *Growth and Change* 32(summer): 305-325.

Krinsky, Itzhak. and A. Leslie Robb. 1986. On Approximating the Statistical Properties of Elasticities. *Review of Economics and Statistics* 68(4): 715-719.

Kuhfeld, Warren F. and Randall D. Tobias. 2005. "Large Factorial Designs for Product

Engineering and Marketing Research Applications." *Technometrics* 47(2): 132-141.

Loomis, John B. 1992. "The Evolution of a More Rigorous Approach to Benefit Transfer: Benefit Function Transfer." *Water Resources Research* 28(3): 701-705.

Loomis, John, Kerri Traynor, and Thomas Brown. 1999. "Trichotomous Choice: A Possible Solution to Dual Response Objectives in Dichotomous Choice Contingent Valuation Questions." *Journal of Agricultural and Resource Economics* 24(2): 572-583.

Maddala, G.S. 1983. *Limited Dependent and Qualitative Variables in Econometrics*. Cambridge, UK: Cambridge University Press.

Messer, K.D. 2006. The conservation benefits of cost-effective land acquisition: A case study of Maryland. Journal of Environmental Management 79:305-315.

Morrison, Mark, Jeff Bennett, Russell Blamey, and Jordan Louviere. 2002. "Choice Modeling and Tests of Benefit Transfer." *American Journal of Agricultural Economics* 84(1): 161-170.

Morrison, Mark and Olvar Bergland. 2006. "Prospects for the Use of Choice Modelling for Benefit Transfer." *Ecological Economics* 60(2): 420-428.

Ozdemir, Semra, Kevin J. Boyle, Mary Ahearn, Anna Alberini, John Bergstrom, Larry Libby and Michael P. Welsh. 2004. Preliminary Report: Farmland Conservation Easement Study for the United States, Georgia, Ohio and Maine Samples. Working Paper, Department of Resource Economics and Policy, University of Maine.

Parsons, George R. and Mary J. Kealy. 1994. "Benefit Transfer in a Random Utility Model of Recreation." *Water Resources Research* 30(8): 2477-2484.

Piper, Steven and Wade E. Martin. 2001. "Evaluating the Accuracy of the Benefit Transfer Method: A Rural Water Supply Application in the USA." *Journal of Environmental*

Management 63(3): 223–235.

Rosenberger, Randall S. and Loomis, John B., 2001. "Benefit Transfer of Outdoor Recreation Use Values: A Technical Document Supporting the Forest Service Strategic Plan (2000 Revisions)." General Technical Report RMRS-GTR-72. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Rosenberger, Randall S. and Timothy T. Phipps. 2007. "Correspondence and Convergence in Benefit Transfer Accuracy: A Meta-Analytic Review of the Literature." In *Environmental Values Transfer: Issues and Methods*, eds. Stale Navrud and Richard Ready. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Rosenberger, Randall S. and Tom D. Stanley. 2006. Measurement, Generalization and Publication: Sources of Error in Benefit Transfers and Their Management. *Ecological Economics* 60(2): 372-378.

Smith, V. Kerry, George van Houtven and Subhrendu K. Pattanayak. 2002. "Benefit Transfer via Preference Calibration: Prudential Algebra for Policy." *Land Economics* 78(1): 132–152.

U.S. EPA Science Advisory Board. 2007. Advisory on EPA's Issues in Valuing Mortality Risk Reduction (EPA-SAB-08-001). U.S. EPA, Office of the Administrator, Washington, DC, October 2007.

VandenBerg, Timothy P., Gregory L. Poe, and John R. Powell. 2001. "Assessing the Accuracy of Benefits Transfers: Evidence from a Multi-site Contingent Valuation Study of Groundwater Quality." In *The Economic Value of Water Quality*, eds. Bergstrom, John C., Kevin J. Boyle, and Gregory L. Poe. Northampton, MA: Edward Elgar.

TABLE 1
ATTRIBUTES AND LEVELS FOR CHOICE EXPERIMENT DESIGN

Attribute	Levels for Choice Experiments		
	Mansfield, Preston	Brooklyn, Pomfret, Thompson, Woodstock	Connecticut Statewide
Acres preserved	One parcel 1. 20 2. 60 3. 100 4. 200	One parcel 1. 20 2. 60 3. 100 4. 200	Multiple parcels 1. 1,000 2. 5,000 3. 8,000 4. 10,000
Land type	1. Active Farmland a. Nursery b. Food Crop c. Dairy or Livestock 2. Farmland (idle) 3. Forest	1. Active Farmland a. Food/Field Crop b. Tree Farm, Nursery or Orchard c. Dairy or Livestock	1. Active Farmland a. Nursery b. Food Crop c. Dairy or Livestock 2. Farmland (idle) 3. Forest
Policy technique and implementing agency	1. Preservation Contracts a. By State b. By Land Trusts using Block Grants 2. Outright Purchase a. By State b. By Land Trusts using Block Grants 3. Conservation Zoning	1. Preservation Contracts a. By State b. By Town 2. Outright Purchase c. By State d. By Town	1. Preservation Contracts a. By State b. By Land Trusts using Block Grants 2. Outright Purchase a. By State b. By Land Trusts using Block Grants 3. Conservation Zoning
Public access	1. No Access Allowed 2. Access for Walking & Biking 3. Access for Hunting	1. No Access Allowed 2. Access for Passive Recreation (hiking, bird watching, etc.)	1. No Access Allowed 2. Access on 50% of parcels 3. Access on 100% of parcels
Development risk	1. Development likely in less than 10 years if not preserved 2. Development likely in 10-30 years if not preserved 3. Development NOT likely within the next 30 years	1. Development likely in less than 10 years if not preserved 2. Development NOT likely within 10 years if not preserved	1. Development likely in less than 10 years if not preserved 2. Development likely in 10-30 years if not preserved 3. Development NOT likely within the next 30 years
Cost	1. $5 2. $15 3. $30 4. $50 5. $100 6. $200	1. $5 2. $15 3. $30 4. $60 5. $120 6. $200	1. $10 2. $30 3. $50 4. $100 5. $200 6. $300

TABLE 2
VARIABLES AND DESCRIPTIVE STATISTICS

Variable	Description	Mean Value [a] (std. dev)		
		Mansfield, Preston	Connecticut State	Brooklyn, Pomfret, Thompson, Woodstock
Neither	Alternative specific constant (dummy) identifying the status quo option.	0.33 (0.47)	0.33 (0.47)	0.33 (0.47)
Acres	Number of acres preserved.	62.68 (70.01)	4001.18 (3958.15)	62.87 (70.34)
*Acres*Nursery*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preserved land is an active nursery, orchard or tree farm (omitted default is a crop or food farm in all models).	12.71 (40.54)	840.78 (2441.58)	20.34 (49.50)
*Acres*Forest*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preserved land is forest (omitted default is a crop or food farm in all models).	12.49 (40.21)	825.49 (2433.69)	N/A
*Acres*Idle*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preserved land is idle farmland (omitted default is a crop or food farm in all models).	12.93 (40.73)	798.82 (2364.06)	N/A
*Acres*Livestock*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preserved land is idle farmland (omitted default is a crop or food farm in all models).	12.68 (40.41)	834.50 (2444.37)	20.82 (50.10)
*Acres*Trust Easement*	Multiplicative interaction between *Acres* and a 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 conservation zoning).	6.64 (29.53)	419.22 (1795.87)	N/A
*Acres*State Purchase*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preservation is accomplished through fee simple purchase implemented by the state (omitted default is preservation by conservation zoning for Connecticut, Mansfield and Preston; and by town purchase in all other models).	20.92 (50.44)	1278.43 (2908.46)	15.15 (43.91)
*Acres*Trust Purchase*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preservation is accomplished through fee simple purchase implemented by the land trusts, using block grant funds from the state (omitted default is preservation conservation zoning).	20.42 (49.08)	1427.84 (3046.66)	N/A

*Acres*State Easement*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preservation is accomplished through conservation easements, implemented by the state (omitted default is preservation by conservation zoning for Connecticut, Mansfield and Preston; and by town purchase in all other models).	7.27 (31.59)	412.16 (1751.07)	16.48 (45.08)
*Acres*Town Easement*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preservation is accomplished through conservation easements, implemented by the town (omitted default is preservation by town purchase in all other models).	N/A	N/A	15.99 (45.00)
Acres Moderate Access*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preserved land would offer moderate levels of public access. This is defined as access for walking and biking in Mansfield and Preston surveys, passive recreation (hiking, bird watching, etc.) in Brooklyn, Pomfret, Thompson and Woodstock, and access on 50% of preserved parcels in the state survey (omitted default is no public access).	14.38 (42.54)	812.16 (2393.19)	31.34 (58.66)
*Acres*High Access*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that preserved land would offer high levels of public access. This is defined as access for hunting in the community survey, and access on 100% of preserved parcels in the state survey (omitted default is no public access).	12.37 (39.12)	903.14 (2510.63)	N/A
*Acres*Low Risk*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that the land, if not preserved, would likely remain undeveloped for at least 30 years in Mansfield, Preston and Connecticut, and 10 years in other town surveys (omitted default is development likely in less than 10 years).	20.54 (49.27)	1390.98 (3045.31)	31.70 (58.81)
*Acres*Medium Risk*	Multiplicative interaction between *Acres* and a binary (dummy) variable indicating that the land, if not preserved, would likely be developed in 10 to 30 years (omitted default is development likely in less than 10 years).	19.81 (48.49)	1225.88 (2817.58)	N/A
Fee	Unavoidable household cost of preservation (state/town taxes and fees), with sign reversal.	-44.27 (63.10)	-75.63 (100.52)	-48.48 (66.42)

[a] Includes zeros for the 'neither' option.

TABLE 3
MIXED LOGIT RESULTS

	Mansfield	Preston	Connecticut
Neither (ASC)	-0.881176	0.036615	-2.281580
	(0.251521)***	(0.212398)	(0.416581)***
Fee (lognormal, sign reverse)	-4.646902	-4.916210	-4.386175
	(0.240229)***	(0.300003)***	(0. 247121)***
Acres	-0.001324	0.000126	-0.000138
	(0.002531)	(0.002895)	(0.000058)**
*Acres*Livestock*	0.000959	-0.002509	0.000066
	(0.001831)	(0.002029)	(0.000039)*
*Acres*Nursery*	-0.003334	-0.003905	-0.000007
	(0.001795)*	(0.002143)*	(0.000036)
*Acres*Forest*	0.001386	-0.001162	0.000084
	(0.001918)	(0.002200)	(0.000038)**
*Acres*Idle*	-0.000139	-0.003473	0.000046
	(0.001888)	(0.002143)*	(0.000037)
*Acres*Trust Easement*	0.003781	0.001010	0.000212
	(0.002622)	(0.003104)	(0.000060)***
*Acres*State Purchase*	0.003130	0.001659	0.000050
	(0.002448)	(0.002690)	(0.000052)
*Acres*Trust Purchase*	0.005175	0.002064	0.000091
	(0.002743)*	(0.002735)	(0.000051)*
*Acres*State Easement*	0.00004537	0.001881	0.000119
	(0.002595)*	(0.003078)	(0.000060)**
*Acres*Moderate Access*	0.009017	0.010064	0.000146
	(0.001939)***	(0.002224)***	(0.000043)***
*Acres*High Access*	0.001234	0.003210	0.000154
	(0.001911)	(0.002061)	(0.000040)***
*Acres*Low Risk*	-0.001688	-0.002262	-0.000078
	(0.001267)	(0.001477)	(0.000026)***
*Acres*Moderate Risk*	0.000553	-0.000144	-0.000029
	(0.001308)	(0.001547)	(0.000027)
Std. Dev. Neither	2.134109	1.493563	2.676576
	(0.351132)***	(0.309013)***	(0.639147)***
Std. Dev. Acres	0.006070	0.009784	0.000185
	(0.002254)***	(0.002267)***	(0.000047)***
Std. Dev. Fee	2.025942	1.764552	2.279037
	(0.353774)***	(0.476884)***	(0.334477)***
Log-Likelihood Chi-Square	343.51***	253.8073***	410.3218***
Pseudo-R^2	0.15	0.14	0.22
N	1031	844	850

Note: Single (*), double (**) and triple (***) asterisks denote p-values of 0.10, 0.05 and 0.01, respectively.

TABLE 4

MIXED LOGIT RESULTS

	Brooklyn	Pomfret	Thompson	Woodstock
Neither (ASC)	-1.988609	-2.418904	-2.364678	-1.650343
	(0.394494)***	(0.492988)***	(0.486742)***	(0.551168)***
Fee (lognormal, sign reverse)	-3.413865	-3.880831	-3.007622	-4.848428
	(0.327497)***	(0.190251)***	(0.282305)***	(0.274804)***
Acres	-0.001816	0.007466	-0.004013	0.000124
	(0.002692)	(0.002246)***	(0.002960)	(0.002387)
*Acres*Livestock*	0.002551	0.000149	0.003455	0.002009
	(0.001934)	(0.001447)	(0.002488)	(0.001572)
*Acres*Nursery*	0.000149	-0.001518	-0.000351	-0.000518
	(0.002071)	(0.001594)	(0.002314)	(0.001865)
*Acres*Town Easement*	0.003689	0.000773	0.000911	0.001851
	(0.002242)*	(0.001898)	(0.002554)	(0.001950)
*Acres*State Purchase*	0.003859	-0.000614	0.005386	0.003352
	(0.002402)*	(0.001990)	(0.003124)*	(0.002225)
*Acres*State Easement*	0.002389	-0.001433	0.001288	0.000169
	(0.002211)	(0.001663)	(0.002661)	(0.002150)
*Acres*Moderate Access*	0.012513	0.007163	0.014880	0.007934
	(0.001685)***	(0.001004)***	(0.002060)***	(0.001187)***
*Acres*Low Risk*	-0.003231	-0.005687	-0.003444	-0.004210
	(0.001328)**	(0.001101)***	(0.001651)**	(0.001267)***
Std. Dev. Neither	1.113933	3.605814	2.129666	4.501873
	(0.694976)*	(0.558110)***	(0.781311)***	(0.672797)***
Std. Dev. Acres	0.008346	0.009340	0.014663	0.007446
	(0.003206)***	(0.002561)***	(0.003733)***	(0.002504)***
Std. Dev. Fee	3.007745	1.585942	2.818022	1.249420
	(0.374002)***	(0.244358)***	(0.369410)***	(0.255989)***
Log-Likelihood Chi-Square	452.19***	547.35***	456.00***	380.50***
Pseudo-R^2	0.32	0.28	0.33	0.24
N	650	879	629	716

Note: Single (*), double (**) and triple (***) asterisks denote p-values of 0.10, 0.05 and 0.01, respectively.

TABLE 5

BENEFIT TRANSFER ASSESSMENTS

Assumed Policy Site for Benefit Transfer	Mean WTP/acre: Actual (std. dev.)[a]	Average Absolute Value Transfer Error, Mean over Study Sites: $/acre [b]	Average Absolute Value Percent Transfer Error, Mean over Study Sites: 10% trimmed mean [b]	Average Absolute Value Transfer Error, Lowest Error Study Site: $/acre [c]	Average Absolute Value Percent Transfer Error, Lowest Error Study Site: 10% trimmed mean [c]
Mansfield	$0.81 ($0.51)	$0.45	72.53%	$0.29 (Preston)	68.43% (Preston)
Preston	$0.63 ($0.75)	$0.42	88.38%	$0.29 (Mansfield)	82.59% (Brooklyn)
Brooklyn	$0.26 ($0.22)	$0.25	143.13%	$0.07 (Thompson)	40.30% (Thompson)
Pomfret	$0.20 ($0.23)	$0.29	105.03%	$0.10 (Brooklyn)	52.53% (Brooklyn)
Thompson	$0.19 ($0.17)	$0.33	337.75%	$0.07 (Brooklyn)	94.95% (Brooklyn)
Woodstock	$0.55 ($0.65)	$0.31	75.02%	$0.34 (Preston)	70.06% (Brooklyn)
Connecticut State	$0.0077 ($0.0081)	$0.46	4850.57%	$0.19 (Thompson)	2167.89% (Thompson)

[a] WTP and transfer error statistics are calculated over N=24 possible preservation types for which comparable results may be calculated across all choice experiment models (see discussion in main text).

[b] For all policy sites, transfer estimates are calculated as the mean WTP value over all other community preference functions (Mansfield, Preston, Pomfret, Brooklyn, Thompson, Woodstock). Because of the lack of similarity in jurisdictional scale between state and community policy contexts (Johnston and Duke 2008), WTP estimated for the state model is not used to calculate transfer estimates at the community level.

[c] Best case errors derived as the smallest average absolute value transfer error found across all potential study sites; it is the best transfer found (in terms of minimum percentage error) over all possible study sites in the current set. Site providing lowest-error transfer is identified in parentheses.

TABLE 6

SITE-TO-SITE FUNCTION TRANSFER:

AVERAGE ABSOLUTE VALUE PERCENTAGE ERROR, PER ACRE WTP [a]

	Policy Site						
Study Site	Conn. State	Mansfield	Preston	Pomfret	Brooklyn	Thompson	Woodstock
Conn. State	--	99.33%	98.38%	96.41%	98.44%	97.70%	98.76%
Mansfield	9623.99%	--	162.08%	274.79%	381.91%	865.01%	134.41%
Preston	8425.67%	68.43%	--	202.56%	315.30%	793.08%	89.52%
Pomfret	3484.10%	87.12%	83.99%	--	146.18%	310.28%	76.30%
Brooklyn	2757.37%	72.28%	82.59%	53.28%	--	94.95%	70.06%
Thompson	2167.89%	79.44%	91.20%	52.53%	40.30%	--	74.95%
Woodstock	9035.40%	71.29%	128.71%	178.83%	369.55%	465.78%	--

[a] 10% trimmed mean in absolute percentage transfer error calculated over N=24 comparable preservation options for each site.

TABLE 7

WTP-BASED POLICY RANKINGS ACROSS SITE PAIRS: SPEARMAN RANK CORRELATIONS

	Spearman Rank Correlation Coefficient (ρ)						
	Conn. State	Mansfield	Preston	Pomfret	Brooklyn	Thompson	Woodstock
Conn. State	--						
Mansfield	0.96	--					
Preston	0.76	0.88	--				
Pomfret	0.69	0.81	0.85	--			
Brooklyn	0.77	0.85	0.79	0.96	--		
Thompson	0.57	0.70	0.75	0.92	0.95	--	
Woodstock	0.67	0.78	0.81	0.98	0.98	0.97	--