An Empirical Assessment of Convergent Validity of Benefit Transfer in Contingent Choice: Introductory Applications with New Criteria

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Abstract Benefit transfer has been an important, practical policy tool appealing to government agencies, especially when time or budget is constrained. However, the existing literature fails to support convergent validity of benefit transfer using the stated-preference method. This empirical study examines the convergent validity of benefit transfer using the choice modeling method, a potentially promising technique compatible with the heterogeneity of the transfer contexts. Based on a survey designed for Rhode Island (RI) and modified only slightly for Massachusetts (MA), regarding coastal land management, four convergent validity tests were conducted on the benefit transfer from RI to MA. Although results fail to support convergent validity in all aspects, the empirical tests show benefit transfer using the choice modeling method maybe acceptable, and even empirically reliable depending on the policy objectives and the context.
Key words: benefit transfer, contingent choice method, choice experiment, convergent validity, land management

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I. Introduction

In a review of the impact of economic research on environmental policy, Cropper (2000) argues there are major gaps in the set of benefit values needed to evaluate environmental policies, although many high-quality empirical studies exist. The large demand for benefit valuation raises the importance of being able to transfer benefit estimates from an original study area to a different area of interest in environmental and resource decisions, especially when budget or time is constrained.

The transfer method is a general term for applying information derived from existing studies to a new area of interest, which is at least not intended by the original use of the information. In environmental economics and management, perhaps because it is more frequently employed to estimate benefits associated with environmental amenity, the transfer method is conventionally called benefit transfer although sometimes it is not really used for benefit valuation. As an economical, relatively simple policy tool, the transfer method has been of interest to both academia and government agencies for a long time. If we focus on its application to benefit valuation, the history of the transfer method can be traced back to the 1960s use of the unit day value method to estimate recreational benefits. In the 1980s, several government agencies, including U.S. Water Resources Council, U.S. Forest Service, and U.S. EPA, recommended benefit transfer techniques for benefit value estimation (U.S. Water Resources Council 1983, USDA Forest Service 1990, U.S. EPA 1983). More recently, *Water Resources Research* dedicated a special issue in 1992 to benefit transfer, triggering a comprehensive discussion on various aspects of the arts and science of this method.

One critical issue associated with the transfer method is how valid and reliable the transfer results are for their intended use. If the transfer results are invalid or subject to large error from the original study area to the new application-area, policy decisions based on these transferred information may be misleading. Bergstrom and DeCivita (1999) examine the status of transfer methods being used for benefit estimation in the United States and Canada. In terms of the validity of benefit transfer, they summarize that the major implication of transfer feasibility studies is that transfer of unadjusted values or value estimator models is not strongly supported (Loomis 1992; Loomis *et al* 1995; Downing and Ozuna 1995; VandenBerg *et al* 1995; Xu and Adamowicz 1996; Kirchhoff *et al* 1997). However, it is worth noting that the majority of these studies use the contingent valuation method for benefit estimation and as the basis of transfer, and the contingent valuation method doesn't explicitly account for possible variations in quality or quantity of environmental goods or services. Furthermore, some convergent validity tests are based on arbitrarily selected benefit valuations which may not conform to the basic principle — similarity — for benefit transfer recommended by most economists and government agencies (Boyle and Bergstrom 1992, Desvousges *et al*. 1992, Kask and Shogren 1994, NOAA 1994, Rosenberger and Loomis 2001, Piper and Martin 2001). Therefore, there may be arbitrary biases in these tests. In addition, those assessments of benefit transfer only focus on the benefit estimation behavior of transfer methods; therefore, there might exist other policy-related criteria which help more completely assess the usefulness of transfer methods for policy choice. This literature suggests that more rigorous convergent validity tests would use transfer models allowing for variations between the original study area and the application-area, would be conducted in a context consistent with the basic transfer rule, and would employ alternative policy-related criteria to completely assess the behavior of transfer methods. Also, such tests will serve to identify transfer-compatible benefit valuation techniques as well as some cautions and strategies required in the practice of transfer application using that technique.

Recently, with the increasing applications of stated-preference valuation methods, the choice modeling approach (Adamowicz *et al*. 1998) has gained attention as a potentially promising valuation technique compatible with the transfer context. To justify this recognition, Morrison *et al*. (2002) formally examine the performance of the choice modeling approach, finding that choice modeling is suitable for benefit transfer, particularly when the transfer involves implicit prices. Based on split sample tests, their results indicated that transfers across different case study sites were likely to be subject to less error than those across different populations.

In order to further test the advantage of choice modeling for transfer application including benefit estimation, we undertake another empirical test to examine its convergent validity. Specifically, a choice experiment questionnaire was designed for Rhode Island and modified only slightly for Massachusetts, USA, to identify residents' preference for coastal land management, so enabling a transfer from Rhode Island that could be compared to a Massachusetts model based on Massachusetts data.

This study offers several advantages. First, respondents of both Rhode Island and Massachusetts are presented the same survey instruments, which means the objects evaluated are the same, a favorable circumstance for testing transfer performance. Second, both states' residents are familiar with coastal activities, which fosters consistent perception of survey information. Third, since these two states are near to each other and both belong to the New England area, one may expect that both states' residents share a similar preference structure that plays an important role in transfer application. These advantages favor a rigorous convergence test that minimizes arbitrary biases. We evaluate convergent validity in a series alternate contexts for policy decisions.

In section 2, the choice modeling approach and its strength for benefit transfer are briefly discussed. Section 3 and 4 describes the survey methodology and survey data used for this study, followed by model estimation results in section 5. The convergent validity tests are conducted in section 6. Section 7 summarizes and concludes the empirical study.

II. Choice Modeling Approach

Choice modeling approach (also called stated choice method, contingent choice or choice experiment) originates from conjoint analysis, and gains extensive use in marketing and transportation research (McFadden 1986, Louviere 1991, Adamowicz *et al*. 1998). The choice modeling approach (CMA) asks respondents to state their choice among a set of alternatives. CMA appeals to researchers because it allows them to evaluate alternative environmental goods, each described by several attributes. Usually, these goods are identified from a fractional factorial design that systematically combines attributes that define the goods in order to enable efficient econometric estimation of a preference model for choices among goods (or among attribute sets). Like the contingent valuation method (CVM), CMA is consistent with utility theory, and thus the random utility model is applied to estimate respondents' preference structure. If cost or price is included as one attribute, the trade-offs that respondents would like to make when choosing an option can be measured in monetary units, and then used for benefit valuation.

Examples of environmental valuation using CMA are less abundant than CVM, but CMA studies include Opaluch *et al.* (1993), Adamowicz *et al.* (1994), Boxall *et al.* (1996), and Adamowicz *et al.* (1998). CMA may be superior to CVM, at least in terms of benefit transfer.

As well known, the validity of the class of stated-preference methods relies heavily on the accurate description of a particular environmental good and how respondents perceive the good (Freeman 1999). Any divergence between respondents' perception and researchers' survey intention can bias welfare estimates from either CVM or CMA. However, the choice context in CMA forces respondents to acknowledge alternative configurations of a good and to consider more carefully the description of each attribute. This more careful consideration reduces the potential for respondents to express values based on, for example, a broad class of environmental goods rather than on the particular version of that good being studied. Moreover, the choice context under CMA automatically causes respondents to consider substitutes for a particular environmental good. Finally, CMA enhances the ability of benefit transfer to comply with the similarity principle (Bergstrom and Stoll 1990, Loomis 1992, Parsons and Kealy 1994, NOAA 1994, Rosenberger and Loomis 2001, Piper and Martin 2001), because, unlike CVM, CMA is designed to quantify how values respond to changes in environmental goods. Therefore, when the focus of transfer analysis differs from the good valued in the original study, the analyst may evaluate the new attribute set within the range of the preference function estimated under CMA.

III. Survey Methodology

This study is based on a coastal land management survey administered in two coastal states in the New England area, Rhode Island (RI) and southeastern Massachusetts (MA), with the purpose of learning about preferences of residents for coastal land preservation and management. The main body of the survey questionnaire, regarding the choice of coastal land parcels to be preserved, is composed of three parts.

Part one involves three choice set questions, with each describing two kinds of coastal land parcels, generically labeled as A and B, differing with respect to land attributes. Respondents are presented with these questions and are asked to state their preferred choice among parcel A and B versus a *status quo* of not supporting the purchase of either parcel for preservation (appendix 1). Relevant attributes were identified through five focus groups and over twenty personal interviews. The coastal land is described by physical attributes, development situation, and management characteristics that likely affected people's preferences. Table 1 lists all these attributes as well as their levels.

Obviously, there are as many combinations of these attributes as up to $5\times4^3\times3^4\times2^4$ that constitute a universe of coastal land parcel alternatives. Considering the feasibility, one hundred and twenty eight parcel alternatives were selected to construct sixty four choice questions using a fractional factorial main effect design (Addelman and Kempthorne 1961), with some modifications to ensure that parcel descriptions were realistic (McGonagle 1996). Two randomly selected choice questions were included as the second and third choice questions in part one of each of 32 questionnaire versions, and a version was randomly assigned to each respondent. The first choice question was designed as a practice question and was the same for all respondents. Responses to this practice question are excluded from our analysis below.

Part two includes questions addressing respondents' attitudes and qualitative values toward coastal land management that would be used to develop the Coastal Attitude and Value Scale (CAVS). There are seventeen attitude statements in the CAVS rated on a five-point Likert scale, varying from "strongly disagree" to "strongly agree." Based on the CAVS, four continuous-valued attitude scales could be derived following the method of principal component analysis (PCA) from sociology and environmental psychology that converts the seventeen Likert scale responses to standardized-scores measuring different components of individual attitude (McGonagle 1996).

As in many surveys, the final part collects socio-economic characteristics that provide information about the profile of survey respondents.

The survey was administered to respondents who were intercepted at offices of the Department of Motor Vehicles of both states. Throughout the survey process, survey administrators rotated sampling locations to assure that the sample proportionally represented the population across different regions of the states.

In Rhode Island, 850 out of 949 (89%) respondents surveyed returned the questionnaire. Of those returned questionnaires, 636 (75%) provided usable responses to the questions included in the empirical analysis. Here, usable responses include answers to the choice questions, all 17 Likert-scale questions, and the socio-economic questions used below. The 636 respondents produced a total of 1250 choice observations, 98% out of a possible 1272. In Massachusetts, of 316 returned surveys, 205 (65%) provided usable responses for the empirical analysis, which generated 410 choice observations. Table 2 presents the average characteristics of respondents from both states.

IV. Model Results

Modeling framework

According to Random Utility Theory, individual choice is determined by the

relative magnitude of utilities derived from each option. Once a utility function is specified, the corresponding utility parameters as well as the probability of each choice *per se* can be estimated through a discrete choice model. In this article, two discrete choice models were applied to the survey data (Ben-Akiva and Lerman, 1985). Both models assume respondents chose the utility-maximizing alternative in each question, and the models estimate the probability that a respondent made the observed choice. Following common practice, one model is a multinomial logit model that employs the logistic function as the choice-probability distribution function. A property associated with the multinomial logit is independence of irrelevant alternatives (IIA) that results from the assumption of identically and independently distributed error terms. If sample data fail to support the IIA assumption, then the multinomial logit model is not suitable, at least in terms of the specified utility function for the choice process. The alternative model is the nested logit model that allows for divergence from IIA. The choice process in the nested logit model can be interpreted as following a hierachical tree structure. In our case, at the first level of the nested-logit choice process, respondents decide whether they prefer the purchase of coastal land for preservation or not. If yes, they proceed to the second level of decision: which parcel is preferred, parcel A or parcel B? If no, that means they complete the choice process with neither parcel being preserved. Involved in this tree structure are one limb, two branches, and three alternatives (Greene 1995).

To evaluate benefit transfers that might be done based on studies typically available, we developed five alternative models of respondent's utility. Each of these models represents alternative levels of detail or flexibility that may exist in the literature and that may aid a successful transfer. First, we estimated a simple parcel attribute model (PM) that omitted modeling respondent-specific effects on utility:

$$U_{PM} = ASC(neither) + \alpha(parcels) \quad (1)$$

where *neither* represents an alternative-specific dummy for the neither-parcel alternative, and *parcels* represents a vector of parcel attributes associated with the alternatives, while ASC and α are conforming vectors of parameters to be estimated. The parcel model sets a baseline level of analysis, allowing transfer based only on the description of the environmental goods (land parcel attributes). Second, we estimated a socioeconomic characteristics model that captured heterogeneity in preferences to the extent that heterogeneity is associated with age, gender, education, income, and type of town in which the respondent resides:

$$U_{SM} = ASC(neither) + \alpha(parcels) + \beta_1(socioeconomics)(neither) + \beta_2(socioeconomics)(parcels) \quad (2)$$

where *socioeconomics* is a vector of respondent characteristics, and β_1 and β_2 are corresponding parameters. The socioeconomic model represents a typical level of detail and adds some flexibility to adjust transfer estimates for differences in study populations based on widely available data (e.g., the U.S. Census data). Third, we estimated an attitudinal characteristics model that omitted socioeconomic characteristics but included the Likert-scale based environmental attitudes (CAVS) of respondents:

$$U_{AM} = ASC(neither) + \alpha(parcels) + \gamma_1(attitudes)(neither) + \gamma_2(attitudes)(neither) \quad (3)$$

where *attitudes* is a vector of CAVS variables and γ_1 and γ_2 are corresponding parameters. The attitude model could be implemented in a transfer context using a very inexpensive and straightforward survey to collect the necessary Likert-scale responses from the application-area's population. We used the attitude model in an effort to evaluate the importance of attitudinal variables relative to common socioeconomic variables in a benefit transfer. Our fourth model, then, combined both the socioeconomic and attitude models, producing a complete model:

$$U_{CM} = ASC(neither) + \alpha(parcels) + \beta_1(socioeconomics)(neither) + \beta_2(socioeconomics)(parcels) + \gamma_1(attitudes)(neither) + \gamma_2(attitudes)(parcels) \quad (4)$$

The complete model presumably allows for the most flexibility for benefit transfer in the sense that the utility model can be fully adjusted to socioeconomic characteristics and attitudes of people in the new, application-area. As can be seen, this model requires large amounts of information, which is expected to eliminate omitted variables bias but which may introduce spurious errors. Fifth, and finally, we presented and evaluated an empirical policy model:

$$\begin{aligned} U_{EM} = {} & ASC(neither) + \alpha(parcels) + \beta_1(socioeconomics)(neither) + \\ & \beta_2(socioeconomics)(parcels) + \gamma_1(attitudes)(neither) + \\ & \gamma_2(attitudes)(parcels) \end{aligned} \tag{5}$$

where only a subset of variables are included for *socioeconomics* and *attitudes* (as is made precise in Table 5 below). McGonagle (1996) and McGonagle and Swallow (2001) developed this model based on economic theory and prior intuition of researchers. For example, the respondents with a pro-environmental attitude were expected to have a stronger preference for parcels with unique ecological quality, and urban residents were allowed to have different preferences on urban parcel location relative to other respondents. The final specification of this empirical policy model was justified by statistical comparison with an overall unrestricted model that including all possible interactions between parcel attributes and respondent's characteristics (socioeconomic and attitudinal attributes). McGonagle (1996) offers the statistical details of all above model specifications.

Note that, here, the interactions between respondents' characteristics and coastal land attributes were constructed in the utility function to allow preference heterogeneity among respondents rather than specifying random parameter utility functions, since simply imposing an assumption of normally distributed utility parameters may not be superior to or more reasonable than assuming systematically varying preference parameters as specified with the interaction parts in the utility function (Anderson 2003). Moreover, computation cost also discouraged the use of random parameter models especially with the large amount of independent variables involved in the utility function. This analysis is representative of many studies using CMA, and therefore it simulates the type of results that may be most typically available for benefit transfers. Table 3 defines all the variables used in analyses.

Comparison of Model Performance

Table 4 compares modeling performance of multinomial logit and nested logit. As the results show, the nested logit model as a whole has a higher explanatory strength than the multinomial logit model based on adjusted R^2, although the latter is not significantly different from the former for most cases in terms of log-likelihood ratio. There are only two cases in which the equality of the nested logit model and the multinomial logit model is rejected, which means the multinomial logit model violates the IIA in these two cases, both for MA data. One is the parcel model, and the other is the socioeconomic model with the significant levels of 0.01 and 0.05, respectively. Consequently, only the estimates of nested logit model, the more general econometric model, are discussed here.

Table 5 gives the results of nested logit model estimation. As illustrated by the results, all five utility models are significant with varying explanatory powers. For both RI and MA data, the complete model performs best in terms of adjusted R^2. The second best model is the empirical model. The poorest model is the parcel model that does not account for the effects of people's socioeconomic and attitudinal characteristics on their choices. In fact, the parcel model is, *a priori*, expected not to do well for benefit transfer across populations without accounting for preference heterogeneity, which is usually the case of previous benefit transfer practices using CVM. Given that many economists believe the attitudes of respondents are more important in determining their behaviors than the socioeconomic characteristics are, it is surprising that the socioeconomic model outperforms the attitude model for the RI data. However, the MA data produces the opposite result, with the latter outperforming the former. Therefore, the results are mixed at least in this empirical study.

Summary of Model Results

We now summarize the implications of the basic preference modeling results in order to establish a foundation for examining benefit transfers. Further details are available in McGonagle (1996) or McGonagle and Swallow (2001) and Swallow and McGonagle (2003). In each RI model, the coefficients for neither dummy NDUM are negative and significant at 0.05 or 0.01 level, with an implication that RI respondents favor the purchase of coastal lands for preservation over the *status quo*. Consistent with utility theory, the coefficients for cost, whether collected as new taxes (COST_TI) or within existing taxes already paid (COST_TP), are negative and significant. Swallow and McGonagle (2003) provide a detailed analysis of these two cost variables. Among the physical attributes of coastal land parcels, both ecological uniqueness (ECOLGY) and scenic uniqueness (SCENIC) significantly increase respondents' utilities of preserving coastal lands. For the management attributes, the survey data suggest provision of restrooms (RSTRM) and walking trails (TRLS) increase utility of RI respondents, while the access level, as quantified by parking capacity, has no significant effect on average (but see McGonagle and Swallow (2001) for details).

Respondents may exhibit heterogeneity in preferences for both physical attributes and management features of coastal lands. This heterogeneity in preferences can be associated with observable socioeconomic or attitudinal characteristics. We use interactions in the utility function to model how marginal utilities of parcel attributes may vary systematically with respondent characteristics. As expected *a priori*, respondents identified as pro-environment (PENV) or pro-access (PACCS) have utilities favorable for coastal land preservation relative to those with average attitudes. For example, higher PENV reduces the utility of choosing neither parcel (negative coefficient on PENV_N) and increases utility from ecologically unique parcels and parcels with a low level of public access (positive coefficients on PENV_ECO and PENV_LOW, with negative coefficient on PENV_HI) (Table 5). Higher PACCS also reduces the utility of choosing neither parcel (negative coefficient on PACCS_N), while raising the utility from parcels with higher levels of public access (positive coefficient on PACCS_HI) (Table 5). Respondents who express generic opposition to new taxes gain less utility from ecologically or scenically unique parcels (negative coefficients on TAX_ECO and TAX_SCN), but are more likely to choose some parcel over neither if preservation costs are paid from existing taxes (negative coefficient on TAX_TP) (Table 5). Being a coastal resident reduces the utility of choosing neither parcel (CTWN_N) and increases the utility of parcels with low levels of access (CTWN_LOW). Being a low-income respondent increases the utility of scenic parcels (LOIN_SCN) and decreases the utility of choosing neither parcel when preservation comes from existing tax dollars (LOIN_TP).

RI and MA respondents display some differences in the utility structure, as illustrated by utility parameters, although they share the same utility effect for some variables such as NDUM, COST_TP, and PENV_N. For example, in terms of the physical attributes of land parcels, only ecological uniqueness (ECOLGY) and scenic uniqueness (SCENIC) have significant utility effects in RI on average, while in MA location attributes also play some role in respondents' choices. As table 5 shows, the coefficients for SLTPND, RSDNTL and COMRCL, are significant across MA models. That is, if the preserved coastal land is a salt pond or located at an area developed with commercial buildings rather than residential buildings, respondents' utilities on average will decrease. Even for ECOLGY and SCENIC, MA respondents do not demonstrate the same consistent utility effects across models as RI respondents do. As for the management variables, restroom (RSTRM) does not consistently show significant effects at the probability level of 0.05 across models for MA as compared to RI. Furthermore, the MA data demonstrates a more positive utility effect of a boat-ramp (RMP), as opposed to the RI data. In addition, the MA model doesn't reveal as many interaction effects reflecting preference heterogeneity as the RI model, which may have some implications for the subsequent convergent validity test of benefit transfer.

VI. Empirical Test of Transfer Method

Based on the above results, four types of convergent validity tests were conducted on benefit transfer from Rhode Island to Massachusetts. The tests use estimates of various quantities, such as willingness to pay (WTP) or utility value or ranking of alternative policy options (in this case alternative coastal parcels). These tests compare estimates transferred from the RI model to estimates obtained directly from MA data; and the following discussions define these estimates from the above sources as transfer estimates (from RI data) and direct estimates (from MA data), respectively. The analysis uses the 128 parcels incorporated in the actual survey to represent the available policy options. Note that all these convergent validity tests are based on the comparison using each transfer model versus its own direct model. Thus our approach asks how well a transfer model would do compared to a comparable or analogous, direct study.

The first validity assessment compares correlation between transfer and direct estimates of utility rankings for the 128 coastal land parcels. Using these utility rankings, this first analysis also evaluates the welfare consequence of using transfer estimates rather than direct estimates for policy choice. The second test compares the choices that transfer estimates predict for MA respondents to the choices MA respondents made in the survey. The choices of MA respondents were represented in two ways: (*i*) as actual survey choices made by MA respondents; and (*ii*) as choices predicted from the directly estimated, nested-logit model of MA preferences. The third convergent validity test concerns the implicit prices of certain parcel attributes. The last test compares WTP and its distribution between transfer estimates and direct estimates of alternative land parcels. Each of the four comparisons uses the five alternative utility models above; and, in cases involving socioeconomic or attitude variables, the transfer estimates use the mean value of those variables in the MA sample.

Convergent Validity of Land Parcels Ranking

A primary use for CMA results might be to establish policy rankings. In this case, CMA estimates of the typical respondent's utility function can support rankings of alternative coastal parcels that a public agency might purchase. If transfer estimates and direct estimates of rankings are strongly correlated, transfer methods may be considered suitable for policy because choice among alternatives may be reasonably accurate, even if money-measures of welfare benefits fail to converge.

We first assess correlation between transfer and direct estimates of the utility ranking for the 128 land parcels used in the survey. We use non-parametric correlation statistics, Spearman's ρ (Lapin 1993) and Kendall's τ (Sokal and Rohlf 1981). We find that the utility rankings are positively and significantly correlated, with $\tau \geq 0.49$ and $\rho \geq 0.67$ (Table 6). Based on Spearman's ρ, the attitude, socioeconomic, and empirical models perform best, while Kendall's τ indicates that the attitude model performs best with the empirical and socioeconomic models close behind. These results suggest that a land-conservation official in MA could use transfer method with some confidence if parcel ranking is the primary purpose of analysis[1].

However, economists are commonly interested in monetary estimates of welfare. Here, what is most likely to interest policy analysts would be the loss of benefits that could occur if

[1] For example, the conservation agent may be deciding how to spend a fixed budget that has previously been dedicated to coastal lands by, for example, public approval of a dedicated bond-issue.

transfer estimates mislead the selection of policies, which, in this case, means misleading parcel purchases. We now consider that the conservation official might use transfer-based rankings as a blueprint for purchasing several parcels in succession, beginning with the top-ranked parcel and continuing down the rankings.

We estimate the foregone benefits due to transfer error as the difference between the cumulative WTP for the set of parcels chosen using transfer estimates of ranking and the cumulative WTP for the set of parcels that would have been chosen using direct estimates. In these calculations, elaborated below, WTP is always calculated using the direct estimates. We evaluate this transfer error as a percentage of the cumulative WTP for the set of parcels that the official would have chosen using direct estimates. This assessment therefore does not compare whether the transfer model accurately estimates WTP for each parcel. Rather, we assess whether the transfer model leads to selection of policies (parcels) that provide a high degree of welfare benefits that would have been obtained if policy choices had derived from a direct study.

To elaborate more precisely, we use the transfer model to identify the set, T, of N parcels that provide the highest utility ranking based on that transfer model. We calculate WTP for each parcel r in set T, WTP_{Tr}, as the willingness to pay implied by the *direct* model for the typical respondent to obtain parcel r rather than no parcel (i.e., rather than the neither parcel alternative). The welfare benefit $W^T(N)$ when set T includes N parcels is estimated as:

$$W^T(N) = \Sigma_T \, WTP_{Tr} \qquad (6)$$

where the summation is over set T, the top-ranked parcels from rank 1 to rank N (r =1..N) based on the *transfer* model. We then use the direct model to identify the set, D, of N parcels that provide the highest utility ranking based on the direct model. We calculate WTP for each parcel r in set D, WTP_{Dr}, based on the *direct* model. The welfare benefit $W^D(N)$ when set D includes N parcels is estimated as:

$$W^D(N) = \Sigma_D \, WTP_{Dr} \tag{7}$$

where the summation is over set D, the top-ranked parcels from rank 1 to rank N (r =1..N) based on the *direct* model. In general, the sets T and D will only be identical if the utility ranks are perfectly correlated. If the utility rankings are more highly correlated, then set T will contain more parcels that are ranked highly by the direct model, so that the welfare benefit of selecting N parcels will be more similar to the benefit obtained if public officials used a direct model for policy choice. Policy officials desire to obtain set D, but due to transfer error they would obtain set T. Our measure of transfer error is standardized as a percentage of the potential welfare benefit of a set of N parcels,

$$Err(N) = 100 \, [W^D(N) - W^T(N)] / W^D(N) \tag{8}$$

and we examine the magnitude of error as N increases.

For each of the five utility models, we calculate Err(N) for all sets of size N where the transfer model yields a positive estimate of WTP for the N^{th} parcel. This determination of the maximum N to consider constitutes the only manner in which we use the transfer model to estimate WTP for the assessment of convergent validity under this criterion; in effect, the assessment assumes that a public official would refuse to spend funds on any additional parcels once the transfer-estimated WTP is non-positive for any remaining parcels.

Results are presented in Figure 1 for each of the five utility models. In no case does the estimated welfare loss exceed 47% of the estimated potential benefit to MA respondents. Moreover, after three parcels are chosen (N>3), the cumulative transfer error (welfare loss) never exceeds 35% for any of the utility models estimated. No single utility model consistently outperforms all others. Within the range 5 ≤ N ≤ 25, all models produce a cumulative transfer error below 25%, with the better-performing models reaching lows of 10-15%. However, the attitude model consistently produces a transfer-loss that is lower than one or more of the other models. At N ≥ 25, the transfer error rises back to between 20% and 33%, with the complete model generally showing the highest error. The empirical model produces transfer errors approximately at or below the level of most other models over the range 5 ≤ N ≤ 41.

Clearly, the policy context (size of N) affects the performance of the transfer method. The results in Figure 1 show that transfer method in CMA may produce surprisingly low welfare loss rates, particularly when identification of the upper quartile, or so, of policy options (parcels) is the goal. As a public official uses the transfer model to identify progressively less-highly ranked policy options, it performs less well, but still, in our judgment, quite satisfactorily. One somewhat surprising outcome is that the somewhat parsimonious models using attitude variables or the attitude and socioeconomic variables included in the empirical model frequently outperform the simple parcel model as well as the complete model and the model with only socioeconomic variables. This observation suggests that models that capture heterogeneity in respondents by including attitude measures in addition to common socioeconomic attributes may prove more satisfactory in transfer applications.

In the foregoing assessment, the policy context involves ranking a large number of alternatives and choosing to pursue the top N alternatives. In land conservation, a somewhat different context is common, wherein landowners apply to the conservation official for consideration of their parcel so that the official does not face a wide-open choice space. In this situation, a conservation official might review 10 or 30 applications from potentially cooperative landowners, but the official may only be able to approve, say, 5 of the applications for actual conservation. To assess the performance of transfer models in this modified context, we simulated policy choice occasions in which either 10 or 30 parcels were included in the choice set by random selection from the universe of 128 parcels. Using equations (6)-(8), we estimated the welfare loss that would occur if an official used the transfer model to identify or to choose the top five (N=5) from the available parcels, rather than using a direct model.

Results are presented in Figure 2 for the case with 10 parcels available. Here, the graph illustrates the cumulative frequency of choice occasions relative to transfer error (estimated percentage of benefits lost) by using the transfer model. In this context, the socioeconomic model, attitude model, and, surprisingly, the simple parcel model perform best (show the highest frequency of cases for the lower value of transfer error). These three models produce ≤30% welfare loss in 70% of the choice occasions. Similarly, Figure 3 presents results for the case with 30 parcels available. In this context, all five models produce ≤30% welfare loss in ≥80% of the choice occasions. However, unlike the previous case, the best-performing models are empirical model, attitude model, and the complete model.

Taken together, the results in Figures 1-3 show that, for simulated policy choice contexts, the transfer method may perform acceptably well, or, at least, frequently (70% of the time) with <30% welfare loss, which is a magnitude that may well fall within the econometric error bounds of stated-preference valuation generally. The various functional forms perform similarly. However, models that describe respondent heterogeneity through attitude attributes or through an empirically chosen set of attitude and socioeconomic attributes, may perform somewhat better for transfer. Yet even the parcel model, which makes no adjustments for respondent characteristics, performs well for transfer in many cases. Additional research could be focused on the degree to which transferring a model focused on policy attributes alone (e.g., the parcel model) is more reliable than transferring a model that attempts to do more, by incorporating both policy attributes and attributes of the human population.

Convergent validity of model predictions

The next assessments of convergent validity examine predictions of the individual respondent's choice. We first consider how well the transfer estimates predict respondent's choices in the actual survey questions, where respondents could choose among parcel A, parcel B, or neither parcel. Results in Table 7 show that the direct model for MA predicts between 52% and 63% of these choices correctly (column 2), while the transfer model predicts between 48% and 52% of these choices correctly (column 1). These results are favorable since a random prediction rate would be correct only 33% of the time and the ratio of correct prediction rates (transfer prediction rate divided by direct prediction rate) is high, at 0.77 for the complete model and >0.90 for the parcel model and attitude models. It seems noteworthy, however, that the attitude model and the empirical model provide the highest correct prediction of actual choices when transferred from RI to MA.

Next, we examine how the transfer estimates perform relative to the choices predicted by the direct estimates for MA. That is, for the choices predicted by the direct model, we calculate the percentage that have the same choice predicted by the transfer model. Table 7 (column 3) shows that the transferred parcel model reproduces the predictions of the direct parcel model best, at 73%, while the transferred complete model reproduces its direct counterpart least well, at 61%. This level of correspondence in prediction could be considered high because it exceeds the ability of the direct models to correctly predict actual survey choices (cf., column 2 and 3, Table 7). In these results, the empirical and attitude models, along with the parcel model, come closest to making the predictions that would have been made by an analogous direct model.

Still, because the transfer estimates of the attitude and empirical models produce the highest correct prediction of choices by MA respondents, we believe the results of this assessment tend to favor using models that include attitude variables or empirically selected attitude and socioeconomic variables in transfer applications. If these models are unavailable due to limitation of corresponding information required, results would slightly favor using the simple parcel model.

Convergent validity of implicit price of policy variables

The parcel attributes can be interpreted as policy variables that can direct policymaking. In some cases, policymakers are interested in people's preference for these policy variables or the trade-off between them. If some cost variable is included in the utility function, the preference for parcel attributes or trade-offs can be measured in monetary units, interpreted as implicit price of parcel attributes, derived from marginal rate of substitution. The implicit price is calculated as follows:

$$IP = \frac{MU_v}{MU_m} = -\frac{\beta_v}{\beta_m} \tag{9}$$

where MU_v represents marginal utility of non-monetary attribute v, MU_m represents marginal utility of monetary attribute m, β_v represents the coefficient of non-monetary attribute variable, and β_m represents the coefficient of monetary variable.

The convergent validity test of implicit prices is to compare transfer estimates with direct estimates. Here five choice attributes were selected for comparisons of their implicit prices. These choice attributes included two physical attributes of coastal land and three management attributes, since they were not only significant in respondents' choicemaking, but also important policy variables of interest to policymakers. Noticeably, these implicit prices are point estimates subject to sample variance. Therefore, the Krinsky and Robb bootstrapping procedure (1986) was used to generate confidence interval estimates of implicit price for comparison[2].

Compared to the convergent validity test of choice prediction, it is hard to draw conclusions on the convergent validity of implicit price of individual policy variables. The difficulty comes from the large standard error of the direct estimates of these implicit prices, particularly for the direct model. In table 8, most of the transfer estimates of these implicit prices are positive and significant (90% confidence interval). For example, the implicit price for Ecological uniqueness is significant across transfer models except for the socioeconomic model. Walking trails is the only attribute with significant implicit price for all functional forms of the transfer models, while low public access level is the only one that is not significant across models. For Scenic uniqueness and law enforcement, the results are mixed. The parcel, attitude, and empirical models find the scenic uniqueness and law enforcement significant, but the socioeconomic and complete models do not.

In contrast, the implicit prices based on the direct estimates are subject to large sample error, and generate wide confidence intervals that substantially overlap confidence intervals from the transfer estimates. Consequently, the hypothesis of convergent validity of implicit price based on the transfer estimates cannot be rejected on statistical grounds. However, one should be cautious to conclude that the benefit transfer of implicit prices is convergently valid, since the test is not very robust due to the wide confidence intervals on direct estimates. In this sense, benefit transfer of implicit prices of policy variables is, at least in this case, not recommended. One possible reason for the wide confidence intervals on direct estimates might be that the preference of MA residents over coastal land preservation is more diffuse than the preference of

[2] Based on modeling estimates on coefficient and standard error parameter, we conducted 1,000 times repetitive sampling , and calculated the corresponding ratios, using Gauss program.

RI residents. As mentioned previously, MA respondents' preference not only diverges to some degree from that of RI respondents, but also is not as consistent across the functional forms as it was for RI.

Convergent validity of WTP for Policies

In many benefit transfers, the project or program to be evaluated involves a bundle of policy variables, such as land type, location, and management patterns in our application. This section compares transfer and direct estimates of the distribution of WTP to preserve a parcel using 128 parcels drawn from the survey. For each parcel, WTP is defined by:

$$WTP = -\frac{1}{\beta_m}(V_p - V_n) \qquad (10)$$

where V_p denotes the typical respondent's utility derived from land protection of parcel p, V_n denotes the typical respondent's utility for not protecting any parcel, and β_m denotes the coefficient of the monetary variable in the utility function. Table 9 compares the distribution of transfer estimates and direct estimates.

The first column (Table 9) presents the result of one sample Kolmogorov-Smirnov (KS) test (Lapin 1993) that is employed to test the hypothesis of normal distribution of respondents' WTP. The test indicates that the normal hypothesis is not rejected for all sets of WTP estimates. The second column lists the result of paired sample correlation between transfer-based WTP and direct estimates of WTP. As the result shows, there is significant correlation between two sets of WTP across the models. That is, the benefit function transfer can reveal respondents' relative preference over a series of coastal land management policies to certain degree.

The third and fourth columns summarize the mean WTP and paired sample comparison, respectively. Except for the socioeconomic model, the mean WTP demonstrates a correlation between transfer estimates and direct estimates. More importantly, there are two features worth mentioning. First, the benefit transfer underestimates WTP of MA people since the paired sample test shows the difference in WTP estimates is significantly non-negative. That is, benefit transfer in this empirical study is conservative in light of direct estimates of MA respondents' WTP for coastal land management. Second, transfer models display a varying degree of differences in predicting respondents' WTP for given land parcels. In contrast to above validity tests, the complete model is the best one in WTP prediction, while the parcel attribute model is the worst. The theoretical and attitude models rank at the second and third, respectively. Combined with the previous results, this test implies that the behavior of transfer methods depends on the purpose and context.

VII. Conclusion

Transfer methods remain of interest to public decision-makers because there is a large gap between the knowledge available to afford decision-making and the wealth of decisions that require such information. While the existing literature fails to support the convergent validity of the transfer method as applied to benefit estimation, the existing demand for benefit information implies a demand for examining alternative approaches that may reduce errors associated with transfers. The choice modeling approach to stated-preference valuation has been suggested as particularly adaptable to multiple policy contexts, and may therefore be relatively suitable for benefit transfer applications.

This study conducts an empirical assessment of convergent validity in the transfer of a choice-modeled utility and valuation function from Rhode Island (RI) to Massachusetts (MA), USA, as applied to protecting coastal sites for the purposes of providing public access. The study attempts to shed light on the role of different model specifications in the ability to transfer models confidently. While our results are mixed, it appears that a simple model (in this case, a model that retains only land-parcel characteristics), that omits variables that identify heterogeneity in the respondent population, may often provide relatively valid transfer results. However, a model that includes the effects of respondents' environmental attitudes, or that includes effects of those attitudes along with common socioeconomic attributes, may often outperform other models. We believe our results tend to support the use of attitude variables intended to capture heterogeneity in public preferences.

This study contributes to the literature of benefit transfer in three aspects. First, rather than focus mainly on comparing benefit estimations, the study develops a different set of criteria for evaluating benefit transfer by considering some of the potential contexts in which decision-makers (land conservation officials) might actually use a transfer model. In particular, a choice-model of stated preferences is often intended for use in ranking alternative policy choices. For the application in our example data, the preference model is suitable for ranking the public's preference for purchasing and preserving a subset of all possible or all available coastal access sites. When the preference model is applied to transfer practice, our results, using 128 parcels described in the stated-preference survey, show that transfer estimates produce a preference ranking that is significantly correlated with the preference ranking that would have been produced by a comparable direct study. Moreover, if conservation officials were to use a transfer model to identify the top N of 128 parcels, the transfer model offers the opportunity to gain ≥ 70% of the benefits that would be obtained by using a direct model; for several functional forms, if officials were choosing between 5 and 26 coastal sites for priority protection, the transfer models appear to yield as much as 85% to 90% of the estimated potential benefits. Alternatively, we simulated policy choices in which the conservation official's task was to prioritize 5 parcels from a set of either 10 or 30 parcels that might be proposed by landowners. In that context, the transfer models can identify the 5 parcels that provide ≥70% of the potential benefits in ≥80% of the choice opportunities. While not all analysts will agree that such results are especially encouraging, we believe that these examples encourage future assessments of benefit transfer to focus the evaluation within the relevant policy context.

Second, by the virtue of choice modeling approach for predicting individual choice, we are able to assess its performance for transfer application in this aspect. Our results do show that transfer models perform reasonably well in predicting choices that respondents in the target area made in a stated-preference survey. Given the required information burden in connection with the behavior of alternative models for choice prediction, the advantage of the attitude model and the empirical model suggests that some information about respondents' attitudes as well as their socio-economic backgrounds is desirable for successful transfer application in such case, while a highly detailed model requiring large amount of information may not be necessary.

Third, this study examines the behavior of choice modeling approach to stated preferences as applied to the traditional context of benefit transfer. More broadly, however, the present evaluation of benefit transfer does not simply focus on the straightforward transfer of willingness-to-pay estimates from the original study site (RI) to the target area (MA). The results do show statistically significant correlation between the transfer-models' estimates of WTP and estimates derived directly from data obtained from the target population. Nevertheless, the convergent validity of the magnitude of WTP estimates transferred to the MA population is not supported.

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Appendix 1. Example of Choice Question Used in the Survey

Suppose the state is considering the purchase of either parcel A or parcel B, described below, and to purchase either one **you will have to pay additional taxes**. Which parcel, if any, would you prefer to see purchased?

Parcel A	Parcel B
• This parcel is currently an undeveloped **sandy beach** on **an open water with surf or large waves** located in **a rural** area developed with **residential housing**. • This parcel has **no unique ecological quality**, but has **unique scenic quality**. • If purchased, this parcel will be managed for **high capacity access** with parking for more than 200 cars. • There will be **regular** law enforcement and conservation patrols. • Facilities will include: **rest room**. • Purchase of this parcel will require **require you to pay $50 in additional taxes next year**.	• This parcel is currently an undeveloped **marsh** on **a salt pond** located in **a rural** area that is **not developed**. • This parcel has **unique ecological quality**, but has **no scenic quality**. • If purchased, this parcel will be managed for **low capacity access** with parking for less than 10 cars. • There will be **regular** law enforcement and conservation patrols. • Facilities will include: **walking trails**. • Purchase of this parcel will require **you to pay $25 in additional taxes next year**.

I prefer to purchase ...
(check **one** box below)

❑ ..Parcel A. ⇓ How strongly do you prefer A over B? ❑ slightly ❑ strongly	❑ ..neither Parcel A nor Parcel B. (I prefer to use my money for other purposes.)	❑ ..Parcel B. ⇓ How strongly do you prefer B over A? ❑ slightly ❑ strongly

Any comments:____

Table 1. Attributes as well as the Levels Used in the Choice Sets

Attributes	Level
Shore type	Sandy, rocky, stone, marsh
Water type	Surf, bay, river, salt pond
Location	Rural, suburban, urban
Development type	Undeveloped, residential, commercial
Ecological quality	Not unique, unique
Scenic quality	Not unique, unique
Access level	No access, low, medium, high
Law enforcement	Irregular patrol, regular patrol
Facilities	Restroom, walking trails, boat ramp
Payment vehicle	Extra tax, tax already paid
Cost	$10, 25, 50, 100, 150

Table 2. Socioeconomic Characteristics (1990) of Survey Respondents

Characteristics	Rhode Island	Massachusetts
Age (> 18 years)	35.0 years	36.8 years
Gender (% female)	42.3%	46.7%
Children	0.87	1.11
Income (median group)	$35k-50k	$35k-50k
Education (median)	associate degree	some college, no degree
Residence		
Coastal town	42.9%	54.0%
Urban town	37.0%	47.1%
Attitude*		
Pro-environment	0.169	0.019
Pro-access	0.133	-0.133

Note: * attitude components were derived from the PCA with the mean of standardized scores of zero representing the average attitude; the positive score reflect stronger than average agreement with a pro-access or pro-environment attitude, *vice versa*. The PCA used data for all respondents who completed the 17 Likert scale questions; non-zero means result from dropping CMA questions from some respondents due to item non-response on question other than the Likert scale questions.

Table 3. Definitions of Variables Used in the Analyses

Variables	Definition
NDUM	Dummy variable, neither = 1, otherwise 0
COST	Continuous variable
COST_TI	For extra tax to be paid
COST_TP	For tax already paid
Parcel attributes	
Shore type	Effect coded variables, sand as base level
ROCKY	Rocky = 1; for sand, -1; others 0
STONE	Stone = 1; for sand, -1; others 0
MARSH	March = 1; for sand, -1; others 0
Water type	Effect coded variables, surf as base level
BAY	Bay = 1; for surf, -1; others 0
RIVER	River = 1; for surf, -1; others 0
SLTPND	Salt pond = 1; for surf, -1; others 0
Location	Effect coded variables, rural as base level
SUBURB	Suburban = 1; for rural, -1; others 0
URBN	Urban = 1; for rural, -1; others 0
Development type	Effect coded variables, undeveloped as base
RSDNTL	Residential = 1; for undeveloped, -1; others 0
COMRCL	Commercial = 1; for undeveloped, -1; others 0
Ecological quality	Effect coded variables, not unique as base
ECOLGY	If unique, 1, otherwise –1
Scenic quality	Effect coded variables, not unique as base
SCENIC	If unique, 1, otherwise –1
Access Level	Effect coded variables, no access as base
LOW	Low = 1; for no access, -1; others 0
MED	Medium = 1; for no access, -1; others 0
HIGH	High = 1; for no access, -1; others 0
Law Enforcement	Effect coded variable, irregular patrol as base
LAWENFC	If regular patrol, 1, otherwise, -1
Rest Rooms	Effect coded variable, no rest room as base
RSTRM	If yes, 1, otherwise, -1
Walking Trails	Effect coded variable, no walking trails as base
TRLS	If yes, 1, otherwise, -1
Boat Ramp	Effect coded variable, no boat ramp as base
RMP	If yes, 1, otherwise, -1
Funding Mechanism	Dummy variable,
TAXPD	1 for tax already paid, 0 for others
Socioeconomic characteristics	
SEX	Dummy variable, 1 for male; 0 for others
AGE	Continuous variable
GRED	Dummy variable, 1 for graduate school or higher; else 0
LOED	Dummy variable, 1 for some college no degree or less; else 0
LOIN	Dummy variable, 1 for income < $15k; else 0
HIIN	Dummy variable, 1 for income > $50k; else 0
UTWN	Dummy variable, 1 for urban town, 0 for non
CTWN	Dummy variable, 1 for coastal town, 0 for non
Attitudinal characteristics	
TAX	Dummy variable, 1 for tax concern; 0 for others
PENV	Continuous variable, PCA score
PACCS	Continuous variable, PCA score

Table 4. Comparison of Modeling Performance of Mutinomial Logit and Nested Logit

Models		Rhode Island				Massachusetts			
		Adjusted R^2	Log-likelihood	df	Log-likelihood ratio (χ^2, 1 df)	Adjusted R^2	Log-likelihood	df	Log-likelihood ratio (χ^2, 1 df)
U_{PM}	mlogit	0.07	-1260.27	23	0.57	0.07	-403.45	23	45.75^{***}
	nlogit	0.14	-1259.99	24		0.14	-357.70	24	
U_{SM}	mlogit	0.12	-1174.09	55	0.35	0.11	-372.54	55	3.96^{**}
	nlogit	0.19	-1173.92	56		0.18	-368.58	56	
U_{AM}	mlogit	0.10	-1218.52	36	0.55	0.12	-378.67	36	1.40
	nlogit	0.17	-1218.25	37		0.19	-377.27	37	
U_{CM}	mlogit	0.15	-1137.96	68	0.09	0.17	-343.59	68	2.01
	nlogit	0.21	-1137.91	69		0.23	-341.58	69	
U_{EM}	mlogit	0.13	-1171.11	44	0.13	0.16	-359.63	44	1.93
	nlogit	0.20	-1171.05	45		0.22	-357.70	45	

Note: *** denotes significant at 0.01 level; ** denotes significant at 0.05 level.

Table 5. Estimates of Utility Parameters for both Rhode Island and Massachusetts

Variables	U_{PM}		U_{SM}		U_{AM}		U_{CM}		U_{EM}	
	RI	MA	RI	MA	RI	MA	RI	MA	RI	MA
NDUM	-0.312**	-0.455**	-1.268***	-2.448***	-0.353***	-0.453**	-1.349***	-2.487***	-0.896***	-1.953***
COST_TI	-0.009*	-0.005	-0.008***	-0.007*	-0.010***	-0.006*	-0.009***	-0.008*	-0.009***	-0.005
COST_TP	-0.003***	-0.006**	-0.003**	-0.008**	-0.003**	-0.007**	-0.004**	-0.007**	-0.003**	-0.006**
ROCK	-0.017	-0.164	0.025	-0.164	0.002	-0.216	0.029	-0.286	0.014	-0.203
STONE	-0.029	0.108	-0.038	0.025	-0.037	0.148	-0.053	0.154	-0.041	0.167
MARSH	0.111	-0.148	0.094	-0.108	0.102	-0.123	0.096	-0.097	0.103	-0.100
BAY	-0.037	0.216	-0.018	0.273	-0.004	0.189	0.004	0.191	0.002	0.232
RIVER	-0.130*	0.028	-0.151*	0.070	-0.181**	-0.011	-0.187**	-0.007	-0.183**	-0.011
SLTPND	-0.091	-0.399**	-0.104	-0.516***	-0.080	-0.375**	-0.089	-0.492**	-0.097	-0.423**
SUBURB	-0.018	-0.100	-0.023	-0.056	0.019	-0.145	0.016	-0.154	-0.009	-0.149
URBN	-0.050	-0.097	-0.234**	-0.034	-0.061	-0.068	-0.253**	-0.150	-0.122	-0.023
RSDNTL	-0.052	0.278**	-0.047	0.256*	-0.050	0.286**	-0.050	0.312**	-0.043	0.317**
COMRCL	0.024	-0.269*	0.024	-0.277	0.013	-0.258	0.014	-0.344*	0.002	-0.284*
ECOLGY	0.228***	0.297***	0.168*	0.252	0.189***	0.254**	0.085	0.288	0.192***	0.273***
SCENIC	0.165***	0.233**	0.050	0.265	0.188***	0.238**	0.045	0.214	0.176***	0.227**
LOW	0.002	-0.179	-0.044	-0.277	-0.048	-0.177	-0.079	-0.331	-0.192*	-0.166
MED	-0.026	0.343*	0.012	0.432	-0.001	0.210	0.089	0.372	-0.040	0.232
HIGH	-0.075	-0.252	0.059	0.109	-0.034	-0.200	-0.025	-0.063	0.160	-0.138
LAWENFC	0.164***	0.202**	0.025	0.110	0.167***	0.205**	0.024	0.086	0.159***	0.204**
RSTRM	0.117**	0.164	0.139***	0.134	0.136**	0.199*	0.155***	0.199	0.130**	0.218*
TRLS	0.236***	0.196*	0.248***	0.266*	0.267***	0.221*	0.282***	0.343**	0.279***	0.256**
RMP	0.037	0.282**	0.068	0.302**	0.055	0.308***	0.076	0.400***	0.071	0.330***
TAXPD_N	-0.574***	-0.674***	-0.280	0.156	-0.622***	-0.770***	-0.288	0.077	-0.225	-0.423
SEX_N			0.206	-0.082			0.253*	0.059		
AGE_N			0.009	-0.004			0.010	-0.008		
GRED_N			-0.449*	0.531			-0.527**	0.716	-0.516**	0.613
LOED_N			0.426***	0.877***			0.402***	0.814***	0.327**	0.779***

LOINC_N	0.244	1.039*			0.164	0.976*	0.151	0.945*
HIINC_N	0.132	0.788**			0.083	0.856**	0.137	0.389
UTWN_N	-0.070	0.826***			0.005	1.168***		
CTWN_N	-0.325**	0.493*			-0.295*	0.608*	-0.303**	0.117
TAX_N	1.294***	1.483***			1.283***	1.553***	1.269***	1.644***
PENV_N			-0.244***	-0.413***	-0.160**	-0.406***	-0.149**	-0.337***
PACCS_N			-0.243***	-0.230	-0.325***	-0.361**	-0.179***	-0.368***
SEX_ECO	0.150*	-0.323			0.099	-0.456*		
SEX_LOW	-0.208	0.244			-0.262	0.321		
SEX_MED	-0.214	-0.307			-0.283*	-0.521		
SEX_HI	0.153	-0.583			0.343**	-0.255		
SEX_LAW	0.317***	0.351*			0.322***	0.304		
SEX_URB	0.287***	-0.206			0.340***	0.013		
GRED_ECO	0.196	0.362			0.217	0.426		
GRED_URB	-0.166	0.216			-0.163	0.582		
LOED_ECO	0.104	0.454*			0.183*	0.376		
LOED_SCN	-0.171*	0.064			-0.162	0.019		
HINC_SCN	0.150	-0.247			0.144	-0.186		
HINC_TP	0.046	-0.792			0.054	-0.897*		
LOIN_SCN	0.343**	0.710			0.341**	0.226		
LOIN_TP	-1.714***	0.067			-1.681***	0.150	-1.612***	0.591
UTWN_SCN	0.240**	-0.125			0.296***	0.025		
UTWN_URB	0.244**	-0.062			0.219**	-0.307	0.188*	-0.211
CTWN_SCN	0.180*	-0.096			0.158	-0.006		
CTWN_LOW	0.305**	0.042			0.288*	0.013	0.322**	0.021
CTWN_MED	0.113	0.242			0.028	0.081	0.025	-0.000
CTWN_HI	-0.548***	-0.714*			-0.411**	-0.586	-0.437***	-0.380
TAX_ECO	-0.164*	-0.234			-0.112	-0.166		
TAX_SCN	-0.202**	0.310			-0.182*	0.330		
TAX_TP_N	-0.651**	-1.178**			-0.670**	-1.188**	-0.665**	-1.017**
PENV_ECO			0.198***	0.074	0.195***	0.176	0.184***	0.097

PENV_SCN					0.082*	-0.053	0.062	-0.110		
PENV_LOW					0.174**	-0.078	0.185**	-0.140	0.148*	-0.010
PENV_MED					0.026	0.154	0.038	0.300	0.031	0.170
PENV_HI					-0.378***	-0.200	-0.386***	-0.169	-0.362***	-0.138
PENV_SUB					-0.093*	0.064	-0.105*	0.099		
PACC_SCN					-0.058	0.024	-0.054	0.021		
PACC_LOW					0.042	-0.517***	0.018	-0.597***	0.069	-0.527***
PACC_MED					0.058	0.444**	0.093	0.413*	0.089	0.418*
PACC_HI					0.212***	0.458**	0.204**	0.528**	0.176**	0.451**
PACC_TP					0.237*	-0.159	0.297**	-0.068		
IV parameters										
Status quo	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
LandProtection	1.163	0.303***	1.115	-0.016***	0.866	0.497**	0.949	0.280***	0.933	0.426***
χ^2	450.86	164.88	622.99	234.63	534.33	217.26	695.00	288.63	628.73	256.39
AdjR^2	0.07	0.14	0.11	0.18	0.12	0.19	0.17	0.23	0.16	0.22

Note: For variables except IV parameters, *** , **, and * denote significantly different from 0 at the level of 0.01, 0.05, and 0.1, respectively; for IV parameters, these notations mean significantly different from 1.

Table 6. Correlation of Land Rankings between Transfer Estimates and Direct Estimates

Models	Spearman's ρ	Kendall's τ
U_{PM}	0.706^{***}	0.524^{***}
U_{SM}	0.720^{***}	0.529^{***}
U_{AM}	0.723^{***}	0.537^{***}
U_{CM}	0.678^{***}	0.494^{***}
U_{EM}	0.718^{***}	0.530^{***}

Note: *** denotes the significant level of 0.01.

Table 7. Percentage of Correct Predictions for Respondent's Choice in MA

Utility model	Percentage of correct prediction for Individual Choice among Parcel A, B and Neither			Percentage of Correct Predictions for Individual Choice between Neither and Parcel A or B		
	Transfer estimates vs Actual choice	Direct estimates vs Actual choice	Transfer estimates vs Direct estimates	Transfer estimates vs Actual choice	Direct estimates vs Actual choice	Transfer estimates vs Direct estimates
U_{PM}	48.78%	51.95%	73.17%	68.14%	68.14%	84.56%
U_{SM}	47.80%	56.34%	64.39%	66.42%	73.77%	78.92%
U_{AM}	52.44%	57.56%	68.05%	69.36%	73.53%	82.60%
U_{CM}	48.29%	62.93%	61.22%	68.63%	77.94%	78.54%
U_{EM}	50.73%	61.22%	68.54%	69.61%	77.94%	84.63%

Table 8. Implicit Price of Policy Variables of Interest

Model		Ecologial uniqueness	Scenic uniqueness	Low access	Law enforcement	Walking trails
U_{PM}	RI	26.5 [15.3, 45.8]	19.2 [9.0, 32.7]	0.26 [-18.9, 19.4]	19.0 [8.2, 34.0]	27.4 [14.6, 47.7]
	MA	56.8 [-487.5, 591.0]	44.6 [-275.8, 396.0]	-34.2 [-350.7, 365.5]	38.6 [-334.5, 371.9]	37.4 [-327.6, 394.9]
U_{SM}	RI	21.0 [-1.2, 52.2]	6.2 [-23.9, 39.4]	-5.6 [-40.1, 28.0]	3.1 [-11.3, 18.7]	31.0 [17.1, 59.2]
	MA	36.3 [-188.8, 352.7]	38.1 [-197.6, 405.8]	-39.9 [-533.1, 232.3]	15.8 [-132.4, 167.9]	38.3 [-210.3, 320.9]
U_{AM}	RI	19.4 [9.0, 36.8]	19.4 [8.7, 34.3]	-5.0 [-27.0, 12.7]	17.2 [7.8, 32.3]	27.5 [14.3, 49.6]
	MA	39.5 [-58.5, 242.3]	37.1 [-64.9, 221.6]	-27.6 [-231.1, 129.4]	31.9 [-70.7, 232.6]	34.4 [-103.8, 205.7]
U_{CM}	RI	9.3 [-12.6, 33.5]	5.0 [-24.5, 34.3]	-8.7 [-42.0, 22.3]	2.65 [-10.5, 16.6]	31.0 [16.7, 52.1]
	MA	36.9 [-172.1, 262.0]	28.2 [-132.6, 245.4]	-43.5 [-325.3, 180.4]	11.32 [-65.8, 128.0]	45.0 [-150.8, 288.6]
U_{EM}	RI	21.3 [9.7, 40.1]	19.6 [9.6, 35.3]	-21.31 [-53.3, 5.4]	17.7 [7.3, 33.9]	31.0 [17.3, 53.0]
	MA	53.1 [-419.2, 528.6]	44.1 [-327.1, 450.7]	-32.23 [-515.9, 448.9]	39.7 [-369.5, 494.6]	49.8 [-451.4, 666.7]

Table 9. Comparison of Mean WTP between Transfer Estimates (RI) and Direct Estimates (MA)

Model		Normal distribution One sample KS test	Paired Sample correlation	Mean WTP	Paired sample test (RI minus MA)
U_{PM}	RI	0.483 (0.974)	0.722 (0.000)	$22.90 [$13.82, $31.98]	$-40.46 (0.000)
	MA	0.728 (0.664)		$63.36 [$38.35, $88.37]	
U_{SM}	RI	0.561 (0.912)	0.735 (0.000)	$6.96 [$-3.81, $17.74]	$-40.43 (0.000)
	MA	0.657 (0.782)		$47.39 [$24.11, $70.67]	
U_{AM}	RI	0.488 (0.971)	0.743 (0.000)	$20.11 [$11.61, $28.62]	$-22.97 (0.002)
	MA	0.762 (0.607)		$43.08 [$23.33, 62.84]	
U_{CM}	RI	0.514 (0.954)	0.702 (0.000)	$3.94 [$-5.86, $13.73]	$-16.23 (0.049)
	MA	0.599 (0.866)		$20.17 [$-1.08, $41.42]	
U_{EM}	RI	0.538 (0.934)	0.744 (0.000)	$15.44 [$6.32, $24.57]	$-22.67 (0.035)
	MA	0.727 (0.666)		$38.11 [$11.44, $64.79]	

Note: () denotes p-value.

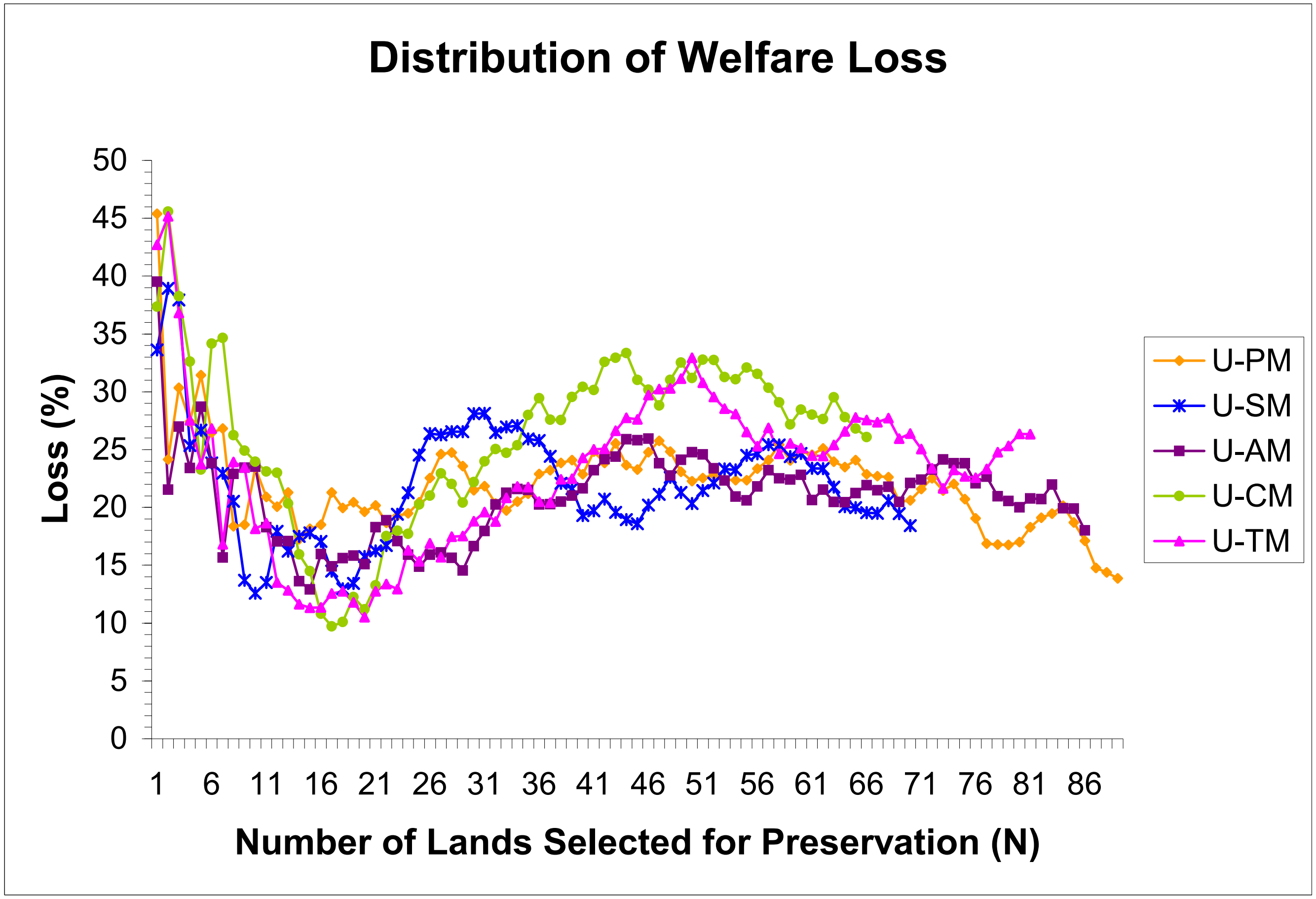
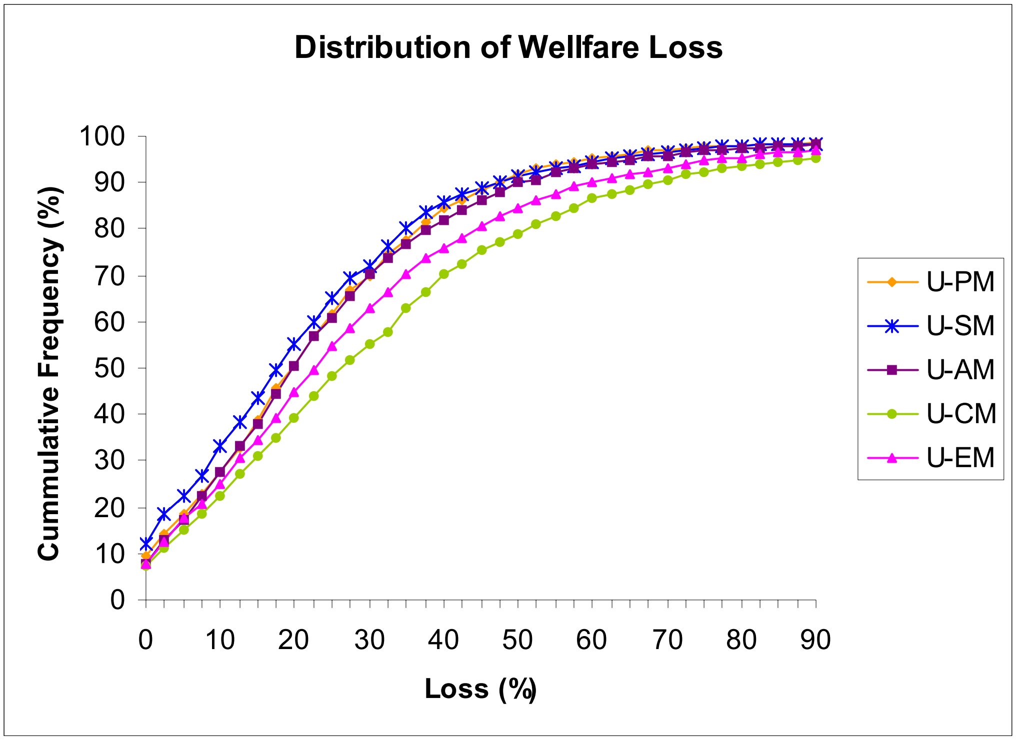


Figure 1. Distribution of Welfare Loss for Cumulative Land Preservation



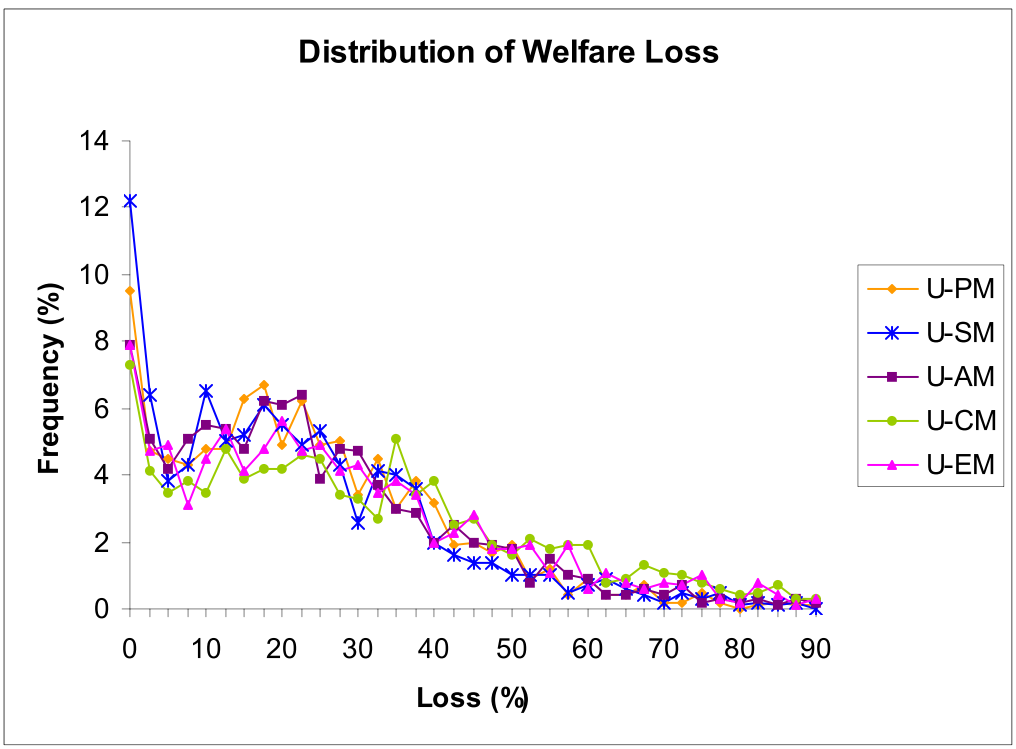
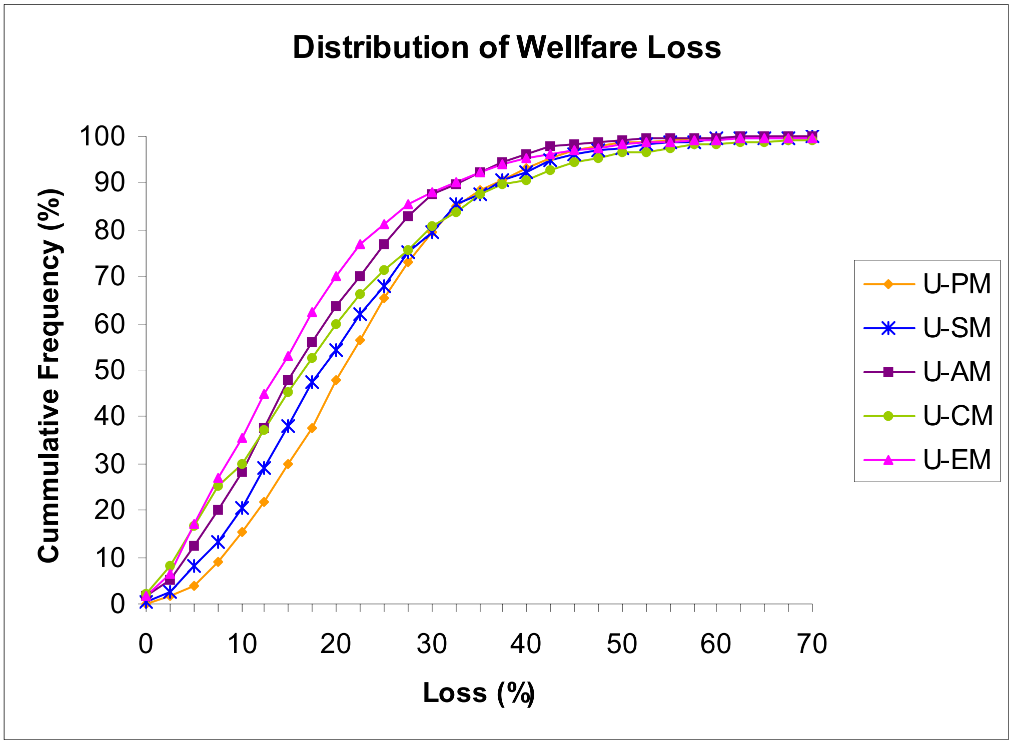


Figure 2. Distribution of Welfare Loss for: 5 out of 10 Land Parcels (random from 128)



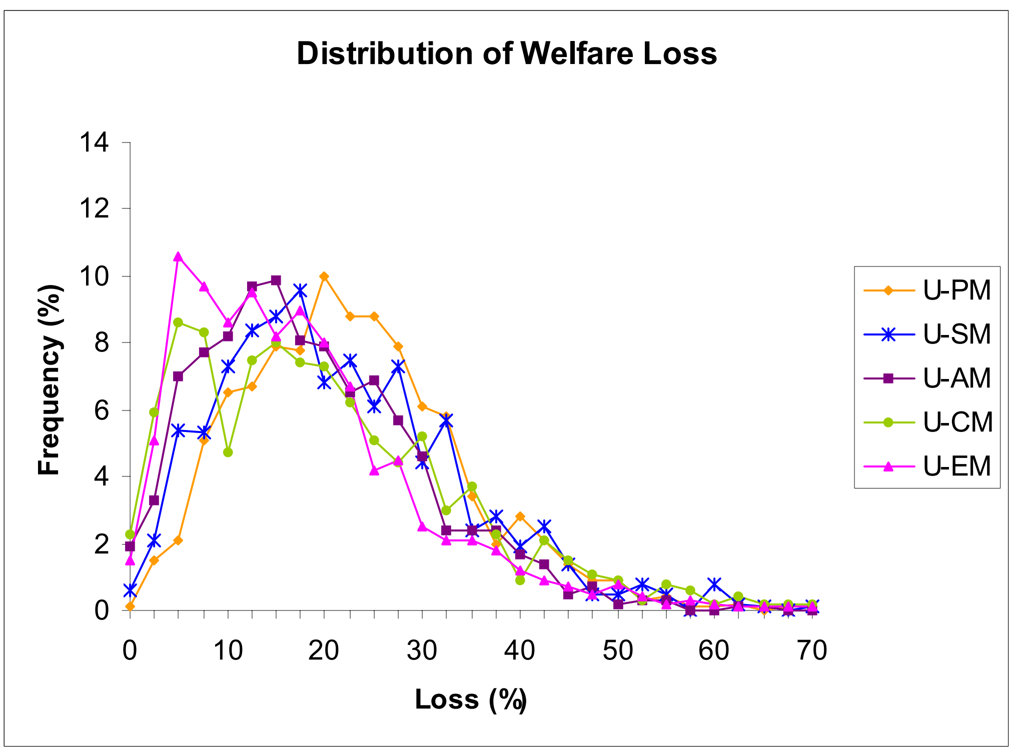


Figure 3. Distribution of Welfare Loss for: 5 out of 30 Land Parcels (random from 128)