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What Determines Prediction Errors In "Benefits Transfer" Models?

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Abstract

The aim of BT techniques is to provide decision makers with a monetary valuation of environmental goods and service in a cost-effective and timely manner, since original valuation studies are both expensive and time-consuming. Demands for environmental valuation estimates are rising in the policy community in both Europe and the US. In the UK, widespread use of benefits transfer has already occurred within policy making and regulatory bodies, for instance in the setting of water quality targets for private water companies and in the design of agri-environmental policy. An important question is how big the errors are resulting from this practice, and how sensitive transfer errors are to how the benefits transfer is conducted. In this study we employ a choice experiment study focusing on the value of landscape attributes in four upland farming regions of England to investigate the sensitivity of transfer error to procedures. This is done using an experimental design with the same set of attributes and levels applied in four different regions of England. The main findings to emerge are that transfer errors depend on the choice of study site at which original valuations are sought, on whether a single site or pooled model is used, and on whether a mean value or benefit function transfer is used. Large variations in transfer errors are found to be related to these choices.

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1. **Introduction**

Benefit Transfer (BT) is the practice of extrapolating existing information on the non-market value of goods or services. In this paper our focus is on environmental applications of BT. Typically, the practice involves predicting compensating or equivalent surplus values for an environmental quality or access change at one site (such as a particular river), based on data collected using either stated or revealed preference methods at another, similar site. Adjustments are often made for differences between the environmental characteristics of the site to which values are to be transferred (known as the "policy site") and those of the site at which the original data was collected, known as the "study site"(Loomis 1992; Downing and Ozuna 1996)[1]. Differences in socio-economic characteristics of the affected population between the study and policy sites can also be allowed for (Morrison et al 2002).

The aim of BT techniques is to provide decision makers with a monetary valuation of environmental goods and service in a cost-effective and timely manner, since original valuation studies are both expensive and time-consuming. Demands for environmental valuation estimates are rising in the policy community in both Europe and the US. In Europe, this is partly being driven by the introduction of the Water Framework Directive, which requires benefit-cost analysis of water quality improvements throughout the European Union, and by the greater emphasis on the application of cost-benefit principles to environmental policy design in the EU (Wateco, 2004). In the UK, widespread use of benefits transfer has already occurred within policy making and regulatory bodies, for instance in the setting of water quality targets for private water companies (Environment Agency 2004) and in the design of agri-environmental policy (Oglethorpe et al. 2000). However, academic scrutiny of BT procedures has, on the whole, rejected these on the basis of various tests (see below). Moreover, confidence in the wider use of BT by policy makers and regulatory bodies would be undermined if it were apparent that the accuracy of BT procedures – that is, the transfer errors they produce - are large, or are arbitrarily dependent on *how* BT is carried out.

In this paper, we use the Choice Experiment method to both examine the size of benefits transfer errors and what factors underlie the size of transfer errors for a particular environmental good, upland semi-natural landscapes. This is done using an experimental design with the same set of attributes and levels applied in four different regions of England. In particular, we examine the sensitivity of the transfer error to what the analyst chooses as the "study site", and whether she is able to pool information over several study sites before predicting values at a policy site. By specifying observable dimensions of similarity between the study and policy site as criterion to select the study site we compare the transfer errors between an informed, single study BT approach and pooled BT approach. We focus on errors associated with predictions of the mean compensating surplus for a range of environmental policy options connected with the reform of agri-environmental policy. A comparison is also provided of the relative transfer error

from using a simple value transfer with that from using a benefit function transfer. The main insights that emerge are that (i) the choices on the part of the policy maker/regulator as to which is the study site produce big effects on the size of transfer error and (ii) that making use of more information by pooling data across several study sites does not always reduce transfer errors and may be economically inefficient. However, no clear picture emerges as to whether benefit function transfer produces smaller errors than simple value transfer.

2. A Brief Overview of the Benefits Transfer Literature

Papers investigating the use and accuracy of BT in an environmental context have become increasingly frequent since an initial set of papers on the subject appeared in a special issue of *Water Resources Research* in 1992. Recent applications of BT in environmental economics include Rozan (2004) on improved air quality in France and Germany, Muthke and Holm-Mueller (2004) on national and international transfers of water quality improvement benefits, Jiang, Swallow, and McGonagle (2005) on coastal land management and Colombo, Hanley and Calatrava-Requena (2006) on the off-site impacts of soil erosion. The validity and accuracy of BT technique has been object of a thriving debate in the last decade (Dowing and Ozuna 1996; Kirchoff, Golby, and LaFrance 1997): on the whole, this literature currently fails to support the statistical accuracy of benefit transfer (Bergland, Magnussen, and Navrud 1995; Desvouges, Johnson and Spencer-Banzhaf 1998; Brouwer 2000).

Many previous studies have used the contingent valuation method to construct benefit transfer tests. However, Morrison et al. (2002) pointed out that the Choice Experiment method is arguably better suited to BT because it is possible to allow for differences in environmental improvements across sites as well as differences in socio-economics characteristics across impacted populations. Moreover, compensating surplus estimates for a wide range of potential policy scenarios can be calculated from the choice models estimated: in this sense, the method is more flexible than contingent valuation. Choice Experiments (CE) are indeed becoming a popular method of environmental valuation (Adamowicz et al. 1998; DeShazo and Fermo, 2002; Horne and Petajisto 2003; Colombo, Hanley, and Calatrava-Requena 2005; Hanley, Wright, and Alvarez-Farizo 2006). The technique combines random utility theory and the characteristics theory of value: environmental goods are valued in terms of their attributes and the levels these take. By applying probabilistic models to choices made between different bundles of attributes, marginal utilities can be estimated along with marginal willingness to pay values for changes in attributes, and compensating surplus for multiple changes in attributes calculated. Since the choice experiment methodology is well-known we do not describe it in detail here, but refer readers to sources such as Hensher, Rose, and Green (2005).

Benefit transfer tests

The accuracy of BT can be tested in a number of ways. Two main approaches have been followed in the literature. The first is the transfer of mean WTP values from the policy site to the study site. Transferring unadjusted mean values has been criticised since it does not take into account any possible differences between either the populations or the goods at the policy and study site. Because of that, an alternative adjusted mean value approach has developed, which adjusts mean WTP of the study site to account for differences in the environmental characteristics of the policy site and/or for differences in the socio-economic characteristics of the affected population between the two sites. In the case of unadjusted mean value transfer the null hypothesis of benefits transferability is:

$$WTP_s = WTP_p \qquad (1)$$

where WTP_s and WTP_p are the mean WTP at the study and policy sites measured from two different original studies. In the case of the adjusted value transfer the WTP_s is adjusted using data on socio-economic and environmental characteristics of the policy site, before the comparison takes place. Such adjustments are, to a varying degree, somewhat ad hoc.

The second approach to BT is benefit function transfer, where the entire demand function (or choice equation, in a CE setting) estimated at the study site is transferred to the policy site. Values at the policy site are predicted using independent variables collected from secondary data at the policy site and parameter values estimated from the study site. In the benefit function transfer the regression parameters of the study site and the environmental and population characteristics of the policy site are used to test:

$$\text{predicted WTP } (\beta^s, X^p) = WTP^p \qquad (2)$$

where predicted WTP (β^s, X^p) is the willingness to pay at the policy site estimated using the parameters of the benefit function of the study site (β^s) and the X values (site attributes, socio-economics characteristics etc.) of the policy site and WTP^p is defined above. An alternative test is the comparison of function parameters between the study and policy site (equation 3).

$$\beta_s = \beta_p \qquad (3)$$

When several study site data sets are available a further approach is to use a meta regression analysis. Here the analyst is concerned with understanding the influence of

methodological and study-specific factors on WTP. Data can be pooled across study sites to produce a BT model for predicting policy site values. Here, the test is:

$$\beta_{s+p} = \beta_s \text{ and } \beta_{s+p} = \beta_p \qquad (4)$$

where β_s ,β_p and β_{s+p} are the parameters of the study, policy and pooled regression models respectively. Note that testing in equation (3) requires more stringent conditions than equation (2) because in the latter it is possible that the predicted WTP and the observed WTP at the policy site are statistically the same even though the parameters of the underlying utility function are different. Equation (4) differs from (3) by including information of the policy site in the pooled model used for comparison.

Which of these approaches is preferable is still open to debate, since some authors have argued that function transfers provide more reliable transfer estimates than mean value transfers (Loomis 1992; Kirchhoff et al. 1997), whilst others, such as Downing and Ozuna (1996), found that the equality of benefit functions at the policy and study site does not entail the equality of welfare measures due to the non-linearity of the logit model used to estimate benefit functions and non-linearity of the benefit estimates themselves. Also note that with choice experiments is not possible to compare directly the two function parameters as in (3) or (4), since they are confounded with the scale parameter (λ), that derives from the statistical assumption that the error terms are Gumbel distributed.

Choice experiments and benefit transfer

Tests of benefit transfer using the CE approach are relatively scarce in the literature, beginning with Morrison et al. (2002), who found mixed results on the validity of benefit transfer for two Australian wetlands. The estimated benefit functions of these two sites differed, whilst a comparison of implicit prices (marginal willingness to pay for changes in site attributes) equivalence showed insignificant differences for six of the eight implicit prices considered. However, compensating surplus equivalence was rejected in eight of the nine policy scenarios chosen. Bueren and Bennet (2004) reported the results of a CE study aimed to test the validity of benefit transfer from a national context, to regional contexts for land and water degradation. They focused attention on implicit prices, and found that those estimated in the regional context were significantly higher than those estimated in the national context by a factor of 2-26 times. Morrison and Bennet (2004) performed a benefit transfer test for the water quality of 5 different catchments in New South Wales. Again, they focused the attention on implicit price equality and found that significant differences existed between the majority of implicit prices when the within-catchment samples were used, and that all implicit prices were the same if the out-of-catchment samples were used. Jiang, Swallow, and McGonagle (2005) assessed the validity of BT for coastal land management options, observing that a model that included the effect of respondents' environmental attitudes along with socioeconomic

characteristics outperformed other models that did not[2]. Finally, Colombo, Hanley and Calatrava-Requena (2006) found that by including respondents' heterogeneity using a random parameters approach, the transferred errors of welfare measures for policy alternatives to reduce off-site impacts from soil erosion in Southern Spain were significantly reduced.

This study adds to this literature by including a set of observable exogenous dimensions in the selection of the study site. These dimensions are the geographical proximity of the study and policy site and the similarity of site populations (in terms of average disposable income) and environmental characteristics (% of the region covered by SDAs landscape –see below). These dimensions have been chosen since the disposable income may affect the respondents' willingness to contribute to the proposed policies, whilst the percentage of SDAa area in the region describes the "scarcity" or availability of such landscape areas, i.e., may affect the willingness to preserve it. Also, we compare the transfer errors resulting from a "single" BT study selected by the similarity criteria defined above to those resulting from pooling different study sites. The costs of both approaches are analysed and compared to the transferred errors. The analysis is carried out by using both direct transfer and benefit function transfer methods.

3. Study Context

Choice experiment studies were carried out in four English regions containing Severely Disadvantaged Areas (SDA). SDAs are upland farming areas which have been designated by the UK government as qualifying for additional agricultural support measures due to the lower yields, fewer production options, and higher transport costs implied by their topography, location and soils. These SDAs include almost all of the upland areas in the North of England (including the Pennines, Lake District and North York Moors), the Peak District, some of the English-Welsh border, Exmoor, Dartmoor, and parts of Cornwall. Historically, support payments in the SDAs have been based on production levels, as proxied by livestock numbers, as well as deficiency payments on lamb and cattle production. However, recent changes in the Common Agricultural Policy, notably the "de-coupling" of support payments from production levels, has made necessary a revision in how this support is provided. One option is to replace transfers related to the output of marketed goods such as cattle with support based on the provision of public goods. These public goods are the landscape features and wildlife habitats which are the results of "traditional", low intensity upland farming methods. To implement such a support mechanism in an economically efficient manner (ie taking account of benefits and costs) would require information on the non-market values of these environmental outputs from upland farming (DEFRA, 2006). To estimate these, we use a Choice Experiment where the attributes are landscape and habitat features, and where the price tag is the taxpayer cost of providing support payments to farmers. By carrying out this CE in four different SDAs, we can

calculate the errors implied by using a benefit transfer approach instead of carrying out a full set of primary studies.

Four different regions, each containing SDAs, are included in the study, namely the North West, Yorkshire and Humberside, the West Midlands and the South West. Figure 1 shows the geographical location of these regions. The South West and the West Midlands regions are neighbouring regions and share a higher disposable income and a low percentage of the regional area covered by SDAs (6% and 5% respectively). The North West and Yorkshire and Humber regions are neighbouring regions that in comparison to the South West and West Midlands regions have lower disposable income and a higher percentage of the territory occupied by SDAs (31% and 22%, respectively)[3]. The West Midlands region borders to the North with the North West region and to the South to the South West regions. Long distances exist between the North West, and Yorkshire and Humber regions to the South West region.

Considering these patterns, if site similarity is finally found to be an important indicator of potential transfer error, welfare measures estimated from the North West and Yorkshire and Humber regions, and those from South West and West Midland regions, should be more similar than the ones between North West and South West (for example). If, in contrast, geographical proximity is found to be important, the differences commented above should still exist, but the welfare estimates of the West Midlands should lie in the middle with respect to the northern and southern regions.

To allow for further heterogeneity in preferences within each regional population we use a Random Parameters specification, as explained below. Socioeconomic and attitude variables are also included in the model specification, since they have been found to improve the accuracy of BT. We focus in the transferability of compensating surplus estimates, as these are likely to be the basis of cost-benefit comparisons for alternative policy designs.

4. Study design

Based on an audit of land cover in the 4 SDAs to be studied, a "long list" of twelve landscape attributes was initially considered. These attributes were: heather moorland and bog; improved grassland; rough grassland; hay meadows; bracken; gorse; arable & set aside land; broadleaf and mixed woodland; coniferous woodland; field boundaries; cultural heritage (such as traditional farm buildings and traditional livestock breeds); and water quality. By carrying out two focus groups, this long list of attributes was reduced to a more manageable set of five attributes, indicated as being important by focus group participants. Attribute level selection was carried out by experts, based on a literature review of recent rates of changes in these attributes and a wide spectrum of future scenarios for the uplands (Haynes-Young et al., 2000; Cumulus 2005). The attributes and attributes levels finally used in the survey are shown in Table 1. Attribute and attribute levels were combined in a fractional factorial main effects

experimental design (Louviere, Hensher, and Swait 2000), obtaining eighteen profiles that were combined to form the choice sets. The choice cards were constructed following the procedure proposed by Street, Burgess and Louviere. (2005). Respondents were each presented with six choice cards, each containing three alternatives: policy option A, policy option B and a status quo scenario. Respondents were told that the landscape changes shown in the choice cards would occur over the period 2007-2013, whilst tax increases to pay for these would be incurred annually over the same period. An example of these choice cards is shown in Table 2.

A pilot survey with a sample of 50 respondents was carried out to test the design of the questionnaire. The final surveys were carried out during the summer and autumn of 2005. Three hundred respondents in each of the case study SDA regions were interviewed. Each sample was chosen according to quotas for age, gender, socio-economic grouping and also whether respondents resided in an urban or rural area. The survey mode was face-to-face interviews conducted in people's homes. Debriefing questions were included in the survey to allow us to identify protests. We defined as "protest bids" those respondents who had chosen the status quo on each of the 6 choice cards with which they were presented, and who gave a reason for this always-zero choice which was other than that they did not value the landscape changes, or that they could not afford to pay. Protest answers (which accounted for between 14% and 26% of all responses, dependent on region) were then excluded from the econometric analysis, but choices of the status quo for non-protest reasons were retained.

5. Results

Respondents' preferences over landscape features were analysed using a Random Parameters logit model. This model specification is becoming increasingly popular in applied research (Train, 1998). In this approach the utility function for respondent *n* choosing over alternatives *j* (*j*=1,2,...*J*), $U_{jn,}$ is described as follow:

$$U_{jn} = C_j + \sum_k \beta_{jk} X_{jk} + \sum_m \gamma_m S_{mn} + \sum_k \eta_{kn} X_{jk} + \varepsilon_{jn} \qquad (5)$$

where C_j is an alternative specific constant, X_{jk} is the k-th attribute value of the alternative j; β_{jk} is the coefficient associated with the k-th attribute, S_{mn} is the m-th socio-economic characteristic of individual n[4], γ_m is the coefficient associated with the m-th individual socio-economic characteristic, η_{kn} is a vector of k deviation parameters which represents the individual's tastes relative to the average (β) and ε_{jn} is an unobserved random term which is independent of the other terms in the equation, and which is identically and independently Gumbel distributed.

In order to estimate the model it is necessary to make an assumption over how the β coefficients are distributed over the population. There are several possibilities depending on

one's a priori expectation of respondents' preferences. Here, since respondents may either like or dislike the landscape attributes employed in the design, we assume that preferences for all landscape attributes follow a normal distribution, whilst preferences towards the price attribute are assumed to be homogeneous to facilitate the interpretation of the resulting welfare measures. Separate parameters are estimated for each individual for all landscape attributes, along with a single parameter for all respondents for cost. The result is that each random attribute has a mean value (interpreted as the average preference of respondents for the attribute) and a standard deviation value (interpreted as the magnitude of differences in respondents' preferences for the attribute relative to this mean).

Model coefficients are shown in Table 3, whilst Table 4 clarifies the coding used. Given the high number of coefficients we do not provide a full description of each model, but just an overview of findings. Concerning the interpretation of the mean coefficient values, a significant positive coefficient indicates that the likelihood of a respondent choosing an option is greater the higher the level of the variable, since the utility of the option in increased. A significant negative coefficient (for example on the tax attribute) indicates that the higher the level of the variable, the lower is the utility associated with the option, and thus the lower the probability of choosing an option with higher levels of this attribute. The significance and sign of the constant indicates whether, all things being equal, respondents are willing (positive coefficient) or not (negative coefficient) to support a policy to generate public goods in the uplands for reasons not explained by the attributes used in the design[5]. The sign and significance of the socioeconomic variables reveal if respondents are more likely to choose either option A or B than the status quo.

All models are statistically significant at $p<0.01$. In all cases, the mean coefficient values for the landscape attributes and for the price term have the *a priori* expected sign. Some general findings emerge from the analysis. While the same questionnaire and specification of attributes (in terms of % changes in quantitatively-coded attributes, and in terms of discrete changes for qualitative attributes) are used in all regions, there is much variation in the factors that influence the choices respondents across the 4 SDA regions. Heather moorland and bog and "much better conservation" of cultural heritage are shown to be significant factors in respondents' choices in all regions. Changes in broadleaved and mixed woodland significantly affected choice in two of the four SDA regions. On the other hand, changes in rough grassland and "no change" in cultural heritage (relative to rapid decline under the status quo) are only significant factors in choices in one region, whilst changes in field boundaries have no significant effects on choice. The effect of the tax increase on choice is always significant, showing that higher increases in household tax payments produce a decrease in respondents' utility. In the Yorkshire and Humber and West Midlands regions the Alternative Specific Constant is positive and significant, suggesting that respondents are in favour of supporting

public good production in the uplands, but for reasons other than variations in the landscape attributes.

In terms of socio-economic variables, several of them help explain respondents' choices. Respondents that stated that environmental policy is "very important" in relation to other things that government is concerned with, such as law and order, or education, are more likely to support hill-farmer's being paid to produce environmental goods. In the same way, those with a higher level of education[6] are more likely to choose an alternative to the status quo. Place of residence was also found to affect respondents' choice, although this effect works in different directions in different regions. In the North West and West Midlands urban dwellers are more likely to support the hill-farming scheme, while in the Yorkshire and Humber region rural dwellers are more likely to be supporters.

The standard deviation estimates reveal that a common characteristic amongst all regions is preference heterogeneity, being significant at the 95% level in 19 out of 20 cases. This heterogeneity is observed both between regions and within regions. For instance, in the North West region an average of 28% of respondents have a preference for diminishing the areas of heather moorland and bog, or for a reduction of traditional field boundaries.

Assuming a linear approximation for utility, the negative of the ratio between any k^{th} attribute coefficient (β_k) and the monetary attribute coefficient (β_{tax}), $-\beta_k / \beta_{tax}$, gives the implicit price, or marginal WTP, for the kth attribute. In the North West region, for instance, respondents are willing to pay on average £0.75 per household per year for a 1% increase of the area of heather moorland and bog and £4.75 for a better conservation of the cultural heritage instead of a rapid decline. Similar valuations are observed in the West Midlands region. Important differences across regions are observed: for instance the implicit price of the discrete change in cultural heritage from "rapid decline" to "much better conservation" is more than double in the Yorkshire and Humber and South West regions compared with the North West or West Midlands. A formal comparison across the implicit prices is carried out using the convolution approach proposed by Poe, Severance-Lossin, and Welsh (1994) and results are described in Table 5. Considering first the heather moorland and bog attribute, mean implicit prices do not differ statistically between the North West, West Midlands and South West regions, but do differ between these three regions and the Yorkshire and Humber region. The rough grasslands implicit price is similar between the South West and West Midlands regions but different if we consider the North West region. Broadleaved and mixed woodland implicit prices are quite similar in two regions but not in the North West and York and Humber. The overall comparison between regions shows that 20 of the 36 implicit prices do not differ statistically at the α=0.1 significance level whilst in 16 of the 36 cases they do differ significantly.

Although implicit prices are useful to policy makers when defining priorities for policy design, they do not represent valid welfare measures to be used in cost-benefit analysis. To

obtain respondents' willingness to pay it is necessary to include the alternative specific constant in the estimation since the attributes do not capture all the reasons that drove respondents to choose their preferred options. Moreover, compensating surplus calculations allow combinations of attribute changes to be considered. Estimates of compensating surplus (CS) are calculated using the standard Hanemann formula:

$$CS = -1/\beta_{price}(V_0 - V_1) \qquad (6)$$

where β_{price} is the marginal utility of income (assumed to be equal to the negative of the price coefficient), V_0 represents the utility of the current situation and V_1 the utility of any new alternative or scenario that can be described by the attribute levels used in the experimental design. Welfare values and, as consequence, the results of CS comparison between any two regions are therefore contingent on the scenarios chosen by the analyst. Given this, we use a systematic sampling from the full factorial space of combinations to select policy scenarios in order to test the transferability of WTP estimates. This generated eighteen policy scenarios, which are described in Table 6, whilst Table 7 shows the compensating surplus estimates together with the Poe, Severance-Lossin, and Welsh (1994) test of CS mean equality[7] for these scenarios.

A general comment on results shown in Table 7 is that compensating surplus estimates for the North West region are systematically lower than the welfare estimates in the other three regions. The opposite is true for the CS estimates for the South West region, which are consistently the highest. This is due to a several factors: first the value of the tax coefficient (representing the marginal utility of income) is much lower in the North West region. For instance, respondents in the South West regions would, on average, be WTP 2.62 times as much as respondents in the North West for the same change in landscape attributes Second, the North West region is the only one that has a positive, significant value for the rough grassland attribute, and many of the 18 scenarios where the WTP is negative in the North West region have associated with them a 10% reduction of the rough grassland attributes. Third, in the North West region the value of the alternative specific constant is low (and insignificant). This is not true for the Yorkshire and Humber and West Midlands regions where the constants have high and significant positive values. Results of the Poe, Severance-Lossin, and Welsh (1994) test indicate that mean compensating surplus estimates for the North West region are indeed different at the $\alpha = 0.001$ significance level to all the other regions for all the scenarios considered. Similar differences are also observed between the CS of the Yorkshire and Humber and South West regions. If we compare the CS figures for the West Midlands with those for the South West we observe that only four of the eighteen estimates do not differ at the $\alpha = 0.1$ level.

The regions that showed the most similar values are the Yorkshire and Humber and the West Midlands, where pairwise comparisons show that 50% of the CS estimates are statistically the same at $\alpha = 0.1$ significance level.

Transfer errors are the "key measures" in a BT context, since they inform policy decision makers about the error they would commit by adopting a BT technique instead of carrying out a primary study. The acceptance of errors of different magnitudes is clearly context dependent, since the same value of error can be considered fully acceptable in some contexts and unacceptable in other situations (Brouwer, 2000). Table 8 shows the magnitude of these transfer errors for all regions, where data from a single primary study is used to produce the transferred estimates for the other regions[8]. Both direct (unadjusted) value transfer and function transfer were tested. Results from the two approaches are quite similar, with slightly smaller errors resulting from the benefit function transfer approach. For conciseness, we focus solely on the transfer errors of the direct transfer approach for each scenario, since we believe this is the approach most likely to be adopted in practice due to its simplicity[9]. We also describe the average error across the eighteen policy scenarios considered for both the direct transfer and benefit function transfer approaches. These are described in the last two lines of the table.

As can be observed, the magnitude of the transfer error depends on the scenario chosen and on the region chosen as the study site – that is, as the hypothetical sole source of data from an original valuation exercise. For instance, imagine the policy maker had chosen the South West as the study site, and transferred values to the other three regions based on the model estimated using data from the South West. For policy scenario 1, this would give a transfer error of 258% for the North West,63% for Yorkshire/Humberside and 36% for the West Midlands. If instead the policy maker had chosen the West Midlands as the study site from where original data was collected, the transfer errors for the same scenario for other three regions (North West, Yorkshire/Humberside and South West) would be 163%, 19% and 27% respectively. The North West region showed very different CS estimates with respect to the other regions, so unsurprisingly the transfer errors are high if the North West is used as the policy site. The very high average errors (1141-2234% using unadjusted direct transfers) are due to the contribution of some scenarios (e.g. scenarios 2, 7, 10, 13) where the observed CS are very low so that an absolute difference of £10 between the predicted and measured CS gives a transfer error of 1123% (if we use the CS of scenario 2, for instance). In the case of the other regions the average error for the eighteen scenarios extends over the range of 15-95% for benefit function transfers, values that can be consider in accordance to those observed in previous benefit transfer studies. For instance, Morrison et al. (2002) observed errors that lie between 4% and 191%; Rozan (2004) detected an error of around 25 % whilst Colombo, Hanley and Calatrava-Requena (2006) measured an average transfer error of 66 %. The benefit function transfer approach provided lower transfer errors than the direct transfer approach in a majority of situations considered.

The main implication of the results in Table 8 is that the benefits transfer error depends critically on which site is chosen as the study site where the original valuation exercise is carried out. However, we typically do not know a priori which area to choose as the study site in order to reduce the transfer error to a minimum. Such choices are unlikely to be entirely arbitrary, since, indicators exist that inform the analyst about existing differences (physical, socio-demographics, historical, etc.,) that may be thought to have an effect on the transferability of estimates. For example, if we know that the North West region the landscape features (area of rough grassland, for instance) and individual characteristics are very different from the ones observed in the West Midlands region and, at the same time, are rather similar to the ones observed in the Yorkshire and Humber, we would expected the analyst to: 1) if primary studies are available for both West Midlands and Yorkshire and Humber regions, to use the more similar region to carry out the BT or 2) use a pooled model estimated by stacking the information available in all the study sites she has. The first condition is often difficult to meet because usually the policy site has some characteristics that are more similar to study site A and others that are more similar to study site B. What is more, it is hard to know which of several alternative similarity measures to use, ex ante, in selecting sites for the source of benefits to transfer. Does it matter which similarity indicators we use? With regard to the second condition, if original studies are available or can be made available for several sites, how should this pooled model be constructed, and does this matter to the size of the transfer error?

We address these questions by comparing the transfer errors resulting from the selection of a single study site, according to the site characteristics indicators defined at the end of section 2, to those obtained from four different pooled models, each one estimated by stacking the data of all regions leaving out the data of the region for which we aim to transfer the estimated benefit. This comparison allows to shed light on the idea of using a limited set of sites as the source of transfer information – chosen according to similarity indicators – compared with the use of "as much information as possible" in BT applications. The first approach relies on the choice of the "best" indicators" of similarity between the study and policy site. The second approach is a more general, and invites the question as to whether the extra costs of gathering more information are justified by lower transfer errors.

Table 9 shows results of the pooled models; the first model, for instance, has been estimated stacking the data from the Yorkshire and Humber, West Midlands and South West regions to predict welfare measures for the North West region. On the whole, these pooled models show more landscape attributes to be significant than the single site models in Table 3. Compensating surplus estimates and transfer errors resulting from using these pooled models are shown in Table 10. Again, high variability is observed in the transfer error values depending on the scenario selected and the pooled model chosen, with the errors from predicting values for the North West region using pooled model 1 being very high.

However, implying that any of the transfer errors shown in Table 10 is equally likely is the same as saying that decisions over which site data to pool are arbitrary. As argued above, practitioners have, rather, a number of similarity indicators which they can use, relating both to the sites themselves (the goods being valued) and the population affected. The potential similarity indicators used here are the geographical proximity of sites, the % of each region covered by SDAs, and regional income. The North West region is, according these indicators, more similar to the Yorkshire and Humber region than to the other two regions. The North West and Yorkshire/Humberside are geographical neighbours and share a high coverage of SDAs and a low disposable income, i.e., are similar in all the three indicators considered. Given that, if analyst chooses as study site Yorkshire and Humber to predict the WTP for landscape conservation in the North West, the average error would be 1141%. If analyst chooses the pooled approach (model P1) instead the average error across the 18 scenarios would be 1528% (we limit here the discussion on the direct function approach, since results are very similar for the benefit function approach). This is a warning that accuracy in a BT exercise does not always increase with more information, even if it were available and free of charge. Here, the effects of adding two extra sites (more different in disposable income and landscape abundance) worsens the transfer errors.

However, if the North West estimates are use to predict the WTP values of the Yorkshire and Humber region the average transferred error would be greater (104%) than those obtained using a pooled approach (19%) and also greater than the ones resulting from using either the West Midlands (41%) or South West (101 %) estimates alone. The same is observed in the other "similar" regions. The West Midlands and the South West regions share similarities in terms of the three indicators that might be used to select the study site. Transferring the welfare estimates of the West Midlands region to the South West region (transfer error = 30%) would outperform the use of a pooled model (transfer error= 60%). If the South West region would be chosen as study site, the pooled model transfer would be slightly better than the single transfer (42% against 47%). In this case, the single site transfer from the Yorkshire and Humber region to the West Midlands would provide the lowest transfer errors.

The overall picture that emerges is thus that choosing sites on the basis of similarity indicators does not always reduce transfer errors. Of course we may have chosen a bad set of indicators, but a universally valid indicators set that can assist the analyst in the selection of the study site will not exist, simply because sites differ in many dimensions. Despite these mixed results, the "single study" approach that takes into account for site similarity increases the likelihood of producing the lowest error in BT applications. If we compare the probability of producing a larger or smaller transfer error using a single (arbitrarily chosen) model approach with respect to the pooled model approach we would have:,

§ in the NW region 50% of probability of doing better and 50% of doing worse. This happens for both direct and function transfer[10].

§ in the YH region 100% chance of doing better using the pooled approach under the direct transfer and 67% of doing better under the function transfer approach.

§ in the WM region 67% chance of doing better using the pooled approach under the direct transfer and 100% of doing better under the function transfer approach.

§ in the SW region 33% chance of doing better using the pooled approach under the direct transfer and 33% of doing better under the function transfer approach.

In summary, the pooled approach provides smaller errors 14 times (2 in the NW, 5 in the YH and WM, 2 in the SW) out of 22. The "single" (arbitrarily chosen) study approach provides smaller errors 8 times out of 22. This second aspect of the overall picture thus shows that adding more information does not always reduce transfer errors, if we ignore ex ante indicators of site similarity.

If we now take into consideration the site similarity in the selection of the study site as the basis for the benefits transfer, again compared with the results from using a pooled model, we would have:

§ in the NW region a 100% chance of doing *better* using the "single similar study" than the pooled approach for both direct and function transfer.

§ in the YH region 100% chance of doing *worse* using the "single similar study" than the pooled approach for both direct and function transfer.

§ in the WM region 100% chance of doing better using the "single similar study" than the pooled approach for both direct and function transfer.

§ in the SW region 100% of chance worse using the "single similar study" than the pooled approach for both direct and function transfer.

When site similarity is taken into account the probability of committing a smaller error under the pooled model approach is thus exactly the same than under the "single" study approach.

The use of a pooled model to predict the CS of any region entails the use of more information than the use a "single study site" model. This has associated higher costs of gathering data that should be justified by smaller transfer errors. By using the site similarity indicators we have seen that in half of the cases it would be better (cheaper and with lower transfer errors) to use a single study site: more information is not necessarily better. In the cases where the pooled model *is* better than the single model approach, it is of interest to test if the improvement in the transfer error is achieved in an economically efficient manner. To begin to test this, we can compare the average errors for the eighteen scenarios of the pooled models with the average errors resulting from the "single" models, when the pooled models outperforms the single models, by regressing the total cost of gathering data with the resulting

transfer errors. Using the Yorkshire and Humber region as the policy site, and assuming the same survey costs in different regions, a linear relationship between transfer error and survey costs, and use of a direct value transfer approach, the marginal rate of error reduction is of the order of 0.42% for every 1% increase in the total survey costs, i.e. an increase of 10% of the survey costs would cause a reduction of 4.2% of the transfer error. Under the benefit function transfer, the marginal rate of error reduction is of 2.6% for a 10% increase in the survey costs. If we use the West Midlands region as policy site, an increase of survey costs of 10% would reduce the error by 2.5% under the direct transfer approach and by 2.8% under the benefit function transfer approach. Clearly, the answer as to whether more information generates positive net benefits will depend on individual circumstance (the marginal costs of surveys, and the social costs of errors in benefit estimation). But these rough calculations show that more is not always better – a conclusion that should not surprise economists!

6. Conclusions.

In this paper we were interested in seeing how the degree of error involved in using a benefits transfer approach to estimate environmental values depends on how the benefits transfer is conducted. This was accomplished using a choice experiment of the benefits resulting from uplands landscape conservation in the Severely Disadvantaged Areas of four English regions. The landscape features considered were heather moorland and bog, rough grassland, broad and mixed woodlands, field boundaries and cultural heritage. A Random Parameters model specification has been used since we observed large variations in the values individuals place on landscape features across and within different regions that were not possible to explain fully on the basis of socio-economic and attitudinal differences between populations.

The main conclusion that emerged is that benefits transfer error depends on the selection of the study site or sites from which values are transferred. The inclusion of three similarity indicators (disposable income, landscape coverage and geographical distance) in the selection of the study site allowed the reduction of the transfer errors although no clear pattern emerged. This implies that it is hard to design a sampling regime (in terms of site selection) that is efficient in terms of minimising expected transfer errors. Although the requirement of similarity between the study and policy site has been established from the early BT literature, there are no clear criteria that define the concept of "similarity". We believe that more research should be addressed to this aspect of BT. We also present evidence here that simple, unadjusted benefit transfers are not consistently out-performed by more complex benefit function transfer approaches. This is also problematic for the BT practitioner wishing to minimise errors. Finally, we show that adding more information to the benefits transfer calculation does not always reduce transfer errors. Errors may actually rise; whilst in the case of falling errors, the marginal increase in accuracy may be outweighed by the marginal costs of data collection. Whether

additional data collection makes sense in a particular policy setting, will depend on the marginal costs and benefits of information in that precise setting. Our results show, however, that one cannot take a positive net benefit fore-granted.

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Figure 1: Map of England showing the Severely Disadvantaged Areas (shadowed areas) and Government Office Region borders.

Table 1. Attributes and attribute levels

Upland attribute	**Levels**
Heather moorland and bog	-12%; -2%; +5%.
Rough grassland	-10%; +2%; +5%.
Mixed and broadleaved woodland	+3%;+10%;+20%.
Field boundaries	For every 1 km, 50m is restored; For every 1 km, 100m is restored; For every 1 km, 200m is restored.
Cultural heritage	Rapid decline No change Much better conservation
Increase in tax payment by your household per year	£2; £5; £10; £17; £40; £70.

Table 2. Example of choice card used in the survey.

	Policy Option	Current Policy	Policy Option A	Policy Option B
	Change in area of Heather Moorland and Bog	A loss of 2% (-2%)	A gain of 5% (+5%)	A loss of 2% (-2%)
	Change in area of Rough Grassland	A loss of 10% (-10%)	A gain of 10% (+10%)	A loss of 10% (-10%)
	Change in area of Mixed and Broadleaf Woodlands	A gain of 3% (+3%)	A gain of 20% (+20%)	A gain of 10% (+10%)
	Condition of field boundaries	For every 1km, 100 m is restored	For every 1km, 200 m is restored	For every 1km, 50 m is restored
	Change in farm building and traditional farm practices	Rapid decline	Much better conservation	No change
	Increase in tax payments by your household each year	£0	£40	£17
	Which do you like best?			

Table 3. Random parameters logit model coefficients for each region.

Region	**NW**		**YH**		**WM**		**SW**	
	Coef.	S.e.	Coef.	S.e.	Coef.	S.e.	Coef.	S.e.
Mean Values								
Const	0.337	0.933	**4.266**	1.084	**3.458**	0.801	1.463	0.957
HMB	**0.058**	0.013	**0.017**	0.010	**0.034**	0.008	**0.030**	0.009
RG	**0.056**	0.012	0.009	0.008	0.009	0.007	-0.002	0.007
BMW	**0.045**	0.010	0.006	0.010	**0.017**	0.009	0.009	0.006
FB	0.001	0.001	0.001	0.001	0.001	0.001	-0.001	0.001
CH1	0.063	0.119	0.100	0.105	0.012	0.071	**0.187**	0.083
CH2	**0.363**	0.136	**0.561**	0.116	**0.186**	0.088	**0.291**	0.108
TAX	**-0.076**	0.006	**-0.051**	0.004	**-0.041**	0.003	**-0.029**	0.003
AGE	-0.547	0.213	0.156	0.235	0.237	0.163	0.155	0.188
GENDER	0.038	0.276	0.402	0.267	**-0.413**	0.209	**0.903**	0.240
ENVIMP	**-0.898**	0.197	**-0.836**	0.211	**-0.468**	0.188	-0.255	0.204
VISFREQ	**0.161**	0.062	**-0.288**	0.062	**-0.201**	0.047	**-0.125**	0.047
LIVING	**-0.021**	0.009	**-0.015**[a]	0.011	-0.010	0.007	0.003	0.008
REMAIN	**-0.216**[a]	0.126	**-0.276**[a]	0.163	-0.148	0.102	-0.127	0.142
MEMBER	0.524	0.360	**0.746**[a]	0.403	**0.574**	0.221	-0.006	0.270
EDU	**0.435**	0.100	0.234	0.131	**0.153**	0.073	**0.281**	0.105
EMPLOY	**1.573**	0.332	0.062	0.277	-0.053	0.226	-0.059	0.280
RURAL	**-1.120**	0.491	**0.880**	0.412	**-1.379**	0.386	-0.394	0.261
S. d. values								
HMB	**0.078**	0.018	**0.067**	0.017	**0.059**	0.012	**0.062**	0.014
RG	**0.085**	0.011	**0.054**	0.010	**0.050**	0.008	**0.049**	0.009
BMW	0.010	0.031	**0.074**	0.014	**0.076**	0.011	**0.031**	0.012
FB	**0.009**	0.002	**0.005**	0.002	**0.004**	0.002	**0.008**	0.001
CH1	**0.449**	0.175	**0.773**	0.130	**0.336**	0.115	**0.471**	0.131
CH2	**0.706**	0.156	**0.886**	0.124	**0.706**	0.099	**0.900**	0.117
No. Obs.	1197		1138		1373		1135	
Log likelihood at convergence	- 829.57		-963.52		-1268.62		-1032.41	
LR	948.95		573.39		479.54		429.02	
Pseudo R^2	.36		.23		.16		.17	

Notes: NW = North West; YH = Yorkshire and Humberside; WM = West Midlands; SW = South West.
Coefficients found to be statistically significant at the 95% level are indicated in bold.
[a]: significant at the 90% level.

Table 4. Explanation of variable abbreviations and coding.

Const	constant term (= 0 for the current policy, = 1 for alternatives A or B)
HMB	percentage change in area of heather moorland and bog
RG	percentage change in area of rough grassland
BMW	percentage change in area of broadleaf and mixed woodland
FB	change in the length of field boundaries (in metres restored)
CH1	change in cultural heritage from "rapid decline" to "no change" (1 = yes, 0 = no)
CH2	change in cultural heritage from "rapid decline" to "much better conservation" (1 = yes, 0 = no)
TAX	Additional tax payment per year
AGE	respondent's age in years
GENDER	respondent's gender (1 = male, 0 = female)
ENVIMP	importance of environmental policy to respondent (1 = very important, 4 = not important)
VISFREQ	respondent's frequency of visits to severely disadvantaged areas (1 = every day, 10 = never)
LIVING	number of years respondents have been living in the region
REMAIN	respondent's expected residence in the region (1 = less than 6 month, 5 = indefinite)
MEMBER	whether respondent belongs to an environmental, recreational, etc. organization (1 = yes, 0 = no)
EDU	respondent's education level 1= primary, 6= higher degree)
EMPLOY	whether respondent is an active worker (1 = yes, 0 = no)
RURAL	whether respondent is a rural-dweller (1 = yes, 0 = no)

Table 5. Comparison of Implicit prices between all regions: prob values for differences equal to zero.

Heather moorland and bogs	YH	WM	SW
NW	0.039	0.388	0.219
YH		0.038	0.016
WM			0.280

Rough Grassland	YH	WM	SW
NW	0.010	0.013	0.002
YH		0.443	0.213
WM			0.173

Braodleaved and Mixed Wooodland	YH	WM	SW
NW	0.029	0.251	0.137
YH		0.133	0.262
WM			0.363

Field Boundaries	YH	WM	SW
NW	0.365	0.342	0.096
YH		0.447	0.058
WM			0.058

Cultural Heritage 1	YH	WM	SW
NW	0.336	0.415	0.040
YH		0.270	0.087
WM			0.029

Cultural Heritage 2	YH	WM	SW
NW	0.008	0.478	0.083
YH		0.018	0.424
WM			0.111

Notes: Values in the table represents the probability of accepting the null hypothesis that the differences between implicit prices is equal to 0. For heather moorland, rough grassland and broadleaved and mixed woodland, implicit prices are willingness to pay for a 1% increase in the area of each habitat. For field boundaries the implicit price is willingness to pay for 1 metres of hedgerow/stone wall restored per 1 kilometre. For the cultural heritage terms the implicit price is the willingness to pay to change the current outlook of rapid decline to “no change” (CH1) or “much better conservation” (CH2).

YH = Yorkshire and Humberside; WM = West Midlands, SW = South West, NW = North West.

Table 6. Scenarios description for compensating surplus calculations

Attributes	HMB	RG	MBW	FB	CH
Scenario 1	5	10	20	200	Better conservation
Scenario 2	-2	5	3	100	No change
Scenario 3	-12	-10	10	50	Rapid decline
Scenario 4	5	5	10	100	Rapid decline
Scenario 5	-2	-10	20	50	Better conservation
Scenario 6	-12	10	3	200	No change
Scenario 7	5	-10	3	100	Better conservation
Scenario 8	-2	10	10	50	No change
Scenario 9	-12	5	20	200	Rapid decline
Scenario 10	5	-10	10	200	No change
Scenario 11	-2	10	20	100	Rapid decline
Scenario 12	-12	5	3	50	Better conservation
Scenario 13	5	10	3	50	Rapid decline
Scenario 14	-2	5	10	200	Better conservation
Scenario 15	-12	-10	20	100	No change
Scenario 16	5	5	20	50	No change
Scenario 17	-2	-10	3	200	Rapid decline
Scenario 18	-12	10	10	100	Better conservation

HMB = heather moorland and bog, **RG** = rough grassland, **MBW** = mixed and broadleaved woodland, **FB** = field boundaries, **CH** = cultural heritage

Table 7. Compensating surpluses estimates and comparisons between regions.

	NW	YH	WM	SW	NW – YH	NW – WM	NW – SW	YH – WM	YH – SW	WM – SW
	CS €	CS €	CS €	CS €	p[a]	p	P	p	p	p
Scenario1	23.67	52.12	62.19	84.74	0.000	0.000	0.000	0.102	0.005	0.027
Scenario2	-0.89	33.57	40.89	65.82	0.000	0.000	0.000	0.076	0.000	0.001
Scenario3	-22.18	12.25	25.66	37.08	0.000	0.000	0.000	0.011	0.000	0.062
Scenario4	2.06	21.75	44.54	52.12	0.000	0.000	0.000	0.000	0.000	0.123
Scenario5	2.34	42.53	48.05	84.03	0.000	0.000	0.000	0.221	0.000	0.000
Scenario6	-3.79	33.66	36.16	51.49	0.000	0.000	0.000	0.342	0.028	0.054
Scenario7	-1.80	44.07	48.12	84.34	0.000	0.000	0.000	0.265	0.000	0.000
Scenario8	6.35	34.08	43.61	69.41	0.000	0.000	0.000	0.046	0.000	0.000
Scenario9	2.47	34.69	42.20	57.10	0.000	0.000	0.000	0.142	0.006	0.043
Scenario10	-1.50	36.32	49.07	72.84	0.000	0.000	0.000	0.016	0.000	0.002
Scenario11	6.26	21.54	43.92	47.55	0.000	0.000	0.000	0.000	0.000	0.309
Scenario12	-4.16	40.08	35.76	67.26	0.000	0.000	0.000	0.273	0.003	0.000
Scenario13	1.14	20.66	41.39	51.37	0.000	0.000	0.000	0.000	0.000	0.101
Scenario14	8.93	47.78	51.02	74.64	0.000	0.000	0.000	0.322	0.003	0.007
Scenario15	-9.46	29.51	36.34	61.63	0.000	0.000	0.000	0.168	0.000	0.002
Scenario16	13.80	36.58	52.61	80.19	0.000	0.000	0.000	0.014	0.000	0.001
Scenario17	-2.66	22.02	39.40	38.76	0.000	0.000	0.000	0.001	0.019	0.498
Scenario18	4.06	43.01	41.08	67.33	0.000	0.000	0.000	0.385	0.005	0.005

[a]: p is the probability to accept the null hypothesis that the CS of model 1 is equal to the CS of model 2.

Table 8. Transfer errors between all the regions.

Policy site	NW			YH			WM			SW		
Study site	YH	WM	SW	NW	WM	SW	NW	YH	SW	NW	YH	WM
Scenario1	120	163	258	55	19	63	62	16	36	72	38	27
Scenario2	3872	4694	7496	103	22	96	102	18	61	101	49	38
Scenario3	155	216	267	281	109	203	186	52	45	160	67	31
Scenario4	956	2062	2430	91	105	140	95	51	17	96	58	15
Scenario5	1718	1953	3491	94	13	98	95	11	75	97	49	43
Scenario6	988	1054	1459	111	7	53	110	7	42	107	35	30
Scenario7	2548	2773	4786	104	9	91	104	8	75	102	48	43
Scenario8	437	587	993	81	28	104	85	22	59	91	51	37
Scenario9	1304	1609	2212	93	22	65	94	18	35	96	39	26
Scenario10	2521	3371	4956	104	35	101	103	26	48	102	50	33
Scenario11	244	602	660	71	104	121	86	51	8	87	55	8
Scenario12	1063	960	1717	110	11	68	112	12	88	106	40	47
Scenario13	1712	3531	4406	94	100	149	97	50	24	98	60	19
Scenario14	435	471	736	81	7	56	82	6	46	88	36	32
Scenario15	412	484	751	132	23	109	126	19	70	115	52	41
Scenario16	165	281	481	62	44	119	74	30	52	83	54	34
Scenario17	928	1581	1557	112	79	76	107	44	2	107	43	2
Scenario18	959	912	1558	91	4	57	90	5	64	94	36	39
Average UDT[1]	1141	1517	2234	104	41	98	101	25	47	100	48	30
Average BFT[2]	1366	1540	2423	93	24	95	55	15	64	84	27	37

Notes. Numbers are percentages.
[1]Unadjusted direct transfer.
[2] Benefit function transfer.

Table 9. Pooled random parameters logit model coefficients.

Regions	**YH-WM-SW**		**NW-WM-SW**		**NW-YH-SW**		**NW-YH-WM**	
Pooled model no.	**Pooled 1**		**Pooled 2**		**Pooled 3**		**Pooled 4**	
	Coef.	S.e.	Coef.	S.e.	Coef.	S.e.	Coef.	S.e.
Mean Values								
Const	**2.734**	0.506	**1.070**	0.466	**1.330**	0.519	**1.454**	0.475
HMB	**0.025**	0.005	**0.031**	0.005	**0.027**	0.006	**0.031**	0.005
RG	0.005	0.004	**0.013**	0.004	**0.013**	0.005	**0.017**	0.005
BMW	**0.013**	0.005	**0.020**	0.005	**0.018**	0.005	**0.020**	0.006
FB	0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.001
CH1	**0.083**[a]	0.047	**0.107**	0.049	**0.122**	0.056	0.081	0.052
CH2	**0.273**	0.059	**0.187**	0.061	**0.302**	0.069	**0.284**	0.062
TAX	**-0.038**	0.002	**-0.040**	0.002	**-0.044**	0.002	**-0.049**	0.002
AGE	0.163	0.102	-0.128	0.098	**-0.205**[a]	0.113	-0.124	0.107
GENDER	**0.221**[a]	0.127	**0.330**	0.127	**0.592**	0.139	0.104	0.132
ENVIMP	**-0.465**	0.107	**-0.843**	0.100	**-0.999**	0.108	**-0.934**	0.103
VISFREQ	**-0.183**	0.026	**0.086**	0.024	**0.057**	0.028	**0.063**	0.025
LIVING	**-0.008**	0.004	**-0.012**	0.004	**-0.010**	0.005	**-0.013**	0.005
REMAIN	**-0.201**	0.072	**-0.108**[a]	0.064	-0.116	0.074	**-0.149**	0.067
MEMBER	**0.534**	0.150	**0.854**	0.145	**0.730**	0.179	**0.750**	0.164
EDU	**0.235**	0.050	**0.281**	0.048	**0.355**	0.058	**0.388**	0.051
EMPLOY	0.143	0.140	**0.432**	0.144	**0.388**	0.154	**0.302**	0.144
RURAL	-0.162	0.181	-0.008	0.174	**0.398**	0.187	0.122	0.215
S. d. values								
HMB	**0.060**	0.008	**0.062**	0.008	**0.070**	0.009	**0.063**	0.008
RG	**0.051**	0.005	**0.059**	0.005	**0.065**	0.005	**0.061**	0.005
BMW	**0.060**	0.007	**0.055**	0.007	**0.053**	0.008	**0.069**	0.007
FB	**0.005**	0.001	**0.006**	0.001	**0.007**	0.001	**0.005**	0.001
CH1	**0.412**	0.075	**0.409**	0.082	**0.562**	0.072	**0.477**	0.071
CH2	**0.902**	0.064	**0.870**	0.066	**0.973**	0.073	**0.846**	0.066
No. Obs.	3646		3695		3460		3698	
Log likelihood at convergence	-3334.45		-3347.87		-3047.35		-3252.01	
LR	1342.17		1423.01		1507.70		1621.31	
Pseudo R^2	.17		.18		.20		.20	

Coefficients found to be statistically significant at the 95% level are indicated in bold.
[a]: significant at the 90% level.

Table 10. Compensating Surplus estimates of the pooled models (columns 2-5) and transfer errors between the pooled models and the region excluded from the estimation of the pooled models (columns 6-9).

Model	P[a]1	P2	P3	P4	P1-NW	P2-YH	P3-WM	P4-SW
	CS €	CS €	CS €	CS €	% error	% error	% error	% error
Scenario1	61.84	49.37	43.78	44.42	161	5	30	48
Scenario2	43.15	29.66	24.86	24.20	4948	12	39	63
Scenario3	25.09	10.77	5.16	5.47	213	12	80	85
Scenario4	38.65	28.65	19.77	22.25	1776	32	56	57
Scenario5	53.54	38.15	34.55	30.82	2188	10	28	63
Scenario6	37.89	22.99	19.49	21.03	1100	32	46	59
Scenario7	52.94	34.81	31.48	29.05	3041	21	35	66
Scenario8	45.74	35.08	29.61	28.16	620	3	32	59
Scenario9	42.84	29.87	25.02	26.06	1634	14	41	54
Scenario10	48.86	33.15	26.87	27.34	3357	9	45	62
Scenario11	37.95	29.86	21.09	23.67	506	39	52	50
Scenario12	43.27	26.79	25.85	23.09	1140	33	28	66
Scenario13	36.63	27.05	18.73	20.58	3113	31	55	60
Scenario14	53.27	37.27	33.84	34.19	497	22	34	54
Scenario15	40.18	25.48	21.24	19.33	525	14	42	69
Scenario16	53.02	43.89	36.56	34.79	284	20	31	57
Scenario17	33.07	20.81	13.35	18.15	1343	5	66	53
Scenario18	46.58	31.68	29.89	28.36	1047	26	27	58
Average UDT					1528	19	42	60
Average BFT					1541	40	9	51

[a] P1 is the pooled model number 1 as described in table 9, similarly P2, P3 and P4 correspond to pooled models in table 9.

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[1] The use of the word "site" here is possibly misleading, since the two goods may not be spatially specific, but the terms "policy site" and "study site" have become commonplace in the literature.

[2] In the case of the contingent valuation method Brouwer (2000) observed that the inclusion of attitudinal variables provides a valid basis for value transfer, since it is an important key to the understanding of preferences in terms of willingness to pay.

[3] Disposable income data are obtained from the Office of National Statistics online Regional Trends publication, available on http://www.statistics.gov.uk/statbase/Product.asp?vlnk=14356. Data are from the Expenditure and Food Survey during years 2001- 2004. The percentage of area covered by SDAs is obtained from the Countryside Survey (Haines-Young et al., 2000).

[4] Socio-economic characteristics, being invariant across choices for each individual, are interacted with the constant to allow estimation.

[5] The constant captures systematic but unobserved information (that is, unrelated to the choice set attributes) about why respondents chose a particular option.

[6] The income variable has been excluded from the analysis given the high number of respondents that refused to declare their income level.

[7] 95% confidence intervals are omitted due to lack of space, but were computed.

[8] The error is calculated by the following formula:

$(|\text{predicted } WTP_p - \text{observed } WTP_p|) \ / \text{ observed } WTP_p$

[9] Also, there may be a lack of data necessary to implement a benefit function transfer. In this application we use both attitudinal and socioeconomic variables in the function. These data may not be available without carrying out a primary study.

[10] Here we considered a transfer error of 1517% and 1528% the same since the difference is lower than 0.1%. The same is valid for the errors 1540% and 1541% in the benefit function transfer.