Testing choice experiment for benefit transfer

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Abstract.
Benefit transfer is a cost-effective method for estimating the value of environmental goods that relies on information obtained in previous studies. The multi-attribute approach of choice experiment should provide advantages in terms of benefit transfer allowing differences in environmental improvements between sites as well as differences in socio-economic and attitude characteristics between respondent populations. Furthermore, choice experiment allows the estimation of implicit prices and the welfare change for many scenarios. If the transferability of these values is confirmed, that would be good news for benefit transfer practitioners. This paper investigates the capability of choice experiment method to be used in environmental benefit transfer.

Keywords: Choice experiment, benefit transfer, soil erosion.

Jel code: Q30

1. Introduction

Environmental monetary valuation is always more important in policy makers decisions and this takes time and can be very costly. When financial resources are insufficient to carry out an environmental monetary evaluation, benefit transfer could be a way for obtaining an approximation of the sought value at low cost. Such value has to be considered a “second best” value respect to the one that could have been obtained from a primary study, and it has to be carefully tested before being used in policy decision. In benefit transfer, existing estimates of a non-marketed good, from one or more sites (study sites), are used to predict the value for the same or for a similar good in a different site (policy site).

The main criteria for selecting the studies to be used in a benefit transfer exercise were published in the special issue of the Water Resource Research journal (volume 28, number 3, 1992), in which several authors (Boyle and Bergstrom, 1992; Desvounges et al., 1992) set the conditions to be met to perform effective and efficient benefit transfer. Among these conditions are particularly relevant the exact identification of the extent and magnitude of the policy site, the impact of the policy under question and the population affected by it. The studies used to transfer the values must be based on adequate data and sound economic methods, have to contain information on the relationship between monetary estimates and socio-economic characteristics of the population and should exist an adequate number of them to allow statistical inferences. Furthermore, the good or goods of interest in the study and policy sites should be similar, so as the populations demographic and cultural profiles.

Benefit transfer have been used for the evaluation of natural resources at different geographical scale and for a wide spectrum of goods. At planetary level, Costanza et al. (1997) extrapolated monetary point estimates from studies carried out in the developed and developing countries to the global ecosystem services and natural capital. At European level, Ready et al. (2004) compared the benefit estimates of water and air pollution reduction in England, Norway, Netherlands, Spain and Portugal. Rozan (2004) compared the willingness to pay (WTP) for improved air quality between France and Germany. Several other benefit transfer studies have been carried out nationally or locally between two specific sites for broad spectrum of environmental goods ranging from water quality management (Pearson and Kealy, 1994; Bergland et al., 1995; Muthke and Holm-Muller, 2004) and associated health risk (Kash and Shogren, 1994) to recreation (Loomis et al., 1995; Downing and Ozuna, 1996; Kirchhoff et al., 1997; Bateman et al., 2002; Shrestha and Loomis, 2003), waste (Brisson and Pearce, 1995) and forest management (MacMillan, 2002). At the present, there is not a general consensus over the reliability of the benefit transfer method and more research is needed to shed light on it.

Most of the benefit transfer studies listed above was based on applications that used the contingent valuation method to obtain the value of the good in the study site. Morrison et al. (1998) pointed out that the choice experiment method is better suited for benefit transfer since, with respect to contingent valuation, it has the advantage that it is possible to allow for differences in improvements in environmental quality as well as differences in socio-demographics when transferring value estimates.

In choice experiment the good of interest is described by means of its attributes, following Lancaster characteristic theory (Lancaster, 1966), so that it is possible to value any policy alternative that is within the space described by the attributes[1].

Despite in the last decade Choice Experiment have been used more and more frequently for the economic evaluation of non-marketed goods, up to our best knowledge, there are only two studies that used choice experiment estimates to transfer values from a study site to a policy site. Morrison and Bennet (2000) contrasted the equality of marginal value of several attributes of two Australian wetlands. They found mixed results on the validity of benefit transfer, since the benefit functions of the two sites differed and only in few cases the compensating surplus were statistically equivalent. Mogas and Riera (2003) tested the validity of benefit transfer using the marginal willingness to pay for some forest externalities. They compared the choice experiment compensating surplus estimates with the marginal willingness to pay elicited through the contingent valuation method. The results showed that the attributed marginal value derived from the choice experiment were suitable for benefit transfer.

In this paper we provide a further test of the validity of choice experiment estimates to be used in benefit transfer. To do that, we carried out two concurrent surveys in two different watersheds located in the Southeast of Spain. We estimate two multinomial logit models that accounted for the benefits of soil erosion off-farm effects reduction. The models account for the main attributes, the socio-economics characteristics and attitudinal variables[2] to allow the construction of a benefit transfer function. The policy scenarios used in the Guadajoz watershed (policy site) are fully described by the choice experiment attribute levels used in the Genil basin (study site). The resulting benefit functions, implicit prices and compensating surplus estimates of the two basins will be compared to check the validity of choice experiment to be used in benefit transfer.

2. Methodology

Two main approaches can be distinguished in benefit transfer: 1) value transfer and 2) function transfer. The first divides into two branches called *unadjusted value transfer* and *adjusted value transfer*. The unadjusted value transfer is the easiest way to transfer the benefit from one site to another, and it simply assumes that the welfare change experienced by the average person in the study site is the same to the one that would have experienced the average person in the policy site. This assumption is difficult to defend even when the study and policy sites are very similar, simply because people at the policy site may be different from individuals at the study site. Formally, the test hypothesis to be met is that the mean willingness to pay value for similar changes in environmental quality at the study and policy sites is the same:

$$WTP^s = WTP^p \qquad (1)$$

where WTP^s is the mean willingness to pay at study site and WTP^p is the mean willingness to pay at the policy site.

The adjusted value transfer tries to correct the benefit estimation by adding information about the demographic or socio-economic characteristics of respondents of the policy site. In this case, the test hypothesis to be met, to check the validity of benefit transfer, is that the predicted willingness to pay at the policy site, using the parameters form the study sites, equals the calculated willingness to pay at policy site, that is:

$$pWTP^p (\beta^s, X^p) = WTP^p \qquad (2)$$

[1] For a full description of the choice experiment method see Louviere et al. (2000) or Bennet and Blamey (2001).
[2] As pointed out by Brouwer (2000) the inclusion of attitudinal variables provides a valid basis for value transfer, since it is an important key to the understanding of people preferences in terms of willingness to pay.

where $pWTP^p$ (β^s,X^p) is the predicted willingness to pay at the policy site estimated using the β^s parameters of the benefit function of the study site and the X^p values (site attributes, socio-economics characteristics etc.) of the policy site. An inconvenience of this approach is that the analyst needs to know the values of all the factors used in the function at policy site and this may be difficult some times.

The other approach is the benefit function transfer. It requires the estimation of a model that statistically relate benefit measures with study factors such as demographic and attitudinal characteristics of the population and the resource being evaluated at the policy site. In contrast to the value transfer method this approach transfers the entire demand function that is estimated by a regression analysis and comprehends the impact of the independent variables on the willingness to pay. The function transfer assumes that the benefit function at policy site has the same parameters that the benefit function at study site, that is:

$$\beta^s = \beta^p \qquad (3)$$

where β^s is the vector coefficients at study site and β^p is the vector coefficients at the policy site.

Some authors pointed out that functions transfer provide more reliable transfer estimates than values transfer (Loomis, 1992; Kirchhoff et al. 1997) since more information is being transferred. Anyway, 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. Because of that it is of interest to compare benefit function parameters and benefit function welfare estimates.

In choice experiment is not possible to compare directly the two function parameters, since they are confounded with the scale parameter (λ), that derives from the statistical assumption that the error terms are Gumbel distributed. So, the values of the estimated parameters β^s and β^p are equal to the values of the true parameters β_t^s and β_t^p multiplied by the scale parameters ($\beta^s = \lambda^s\ \beta_t^s$ and $\beta^p = \lambda^p\ \beta_t^p$). The scale parameter is equal to $\pi^2 / 6\sigma^2$ where π is 3.1416 and σ^2 is the variance of the error terms. The scale parameter cannot be estimated for any one data set and only the ratio of scale parameters from different data sets can be estimated. A comparison of taste vectors therefore required a comparison of the underlying β vectors, once differences in scale factors across data sets have been taken into account. Swait and Louviere (1993) found an easy procedure to estimate the ratio of scale parameters from two data sets that consists in stacking the two data sets, in which one of them has been rescaled (multiplied by the hypothesised value of the scale parameter), and conducting a one-dimensional grid search using different values of the scale parameter. The correct value of the scale parameter ratio is found when the log-likelihood of the stacked model is maximised. The test statistic used is:

$$LR = -2[LogL_{\lambda 1|2} - (LogL_{X1} + LogL_{X2}) \qquad (4)$$

where $LogL_{\lambda 1|2}$ is the log-likelihood obtained from the stacked [X_1] and [$\lambda_{1|2}\ X_2$] datasets, and $LogL_{X1}$ and $LogL_{X2}$ are the log-likelihoods corresponding to separate estimation of X_1 and X_2. This test statistic is asymptotically chi-square distributed with [k + 1] degrees of freedom, where k is the number of parameters estimated in the two models. This procedure is not needed when comparing the implicit prices or the welfare measures of the two data sets, because the scale parameter of each data set cancels out in the estimations. This is because the implicit prices are estimated by dividing the coefficient of any no monetary attribute by the coefficient of the monetary attribute, that is:

$$\text{Implicit price}_{\text{attribute a}} = - (\lambda\ \beta_{\text{attribute a}} / \lambda.\beta_{\text{monetary}}) \quad = \quad - (\beta_{\text{attribute a}} / \beta_{\text{monetary}}) \qquad (5)$$

The same applies in case of compensating surplus estimation, where the whole utility function is divided by the monetary attribute coefficient (marginal effect of income). Stated formally, the comparison of the implicit prices and compensating surplus estimates leads to the hypothesis:

$$H_0 : IP_{i\ Genil} = IP_{i\ Guadajoz}$$
$$H_1 : IP_{i\ Genil} \neq IP_{i\ Guadajoz} \qquad (6)$$

$$H_0 : CS_{j\ Genil} = CS_{j\ Guadajoz}$$
$$H_1 : CS_{j\ Genil} \neq CS_{j\ Guadajoz} \qquad (7)$$

where IP_i is the implicit price of the attribute *i*, and CS_j is the compensating surplus for the scenario *j*.

Testing these hypotheses is not straightforward since the standard errors for implicit prices and compensating surplus are not directly calculated in the multinomial logit model. To circumvent this problem, the bootstrapping approach (Krinsky and Robb, 1986) will be used in this research using 1000 random draws from the multivariate normal distribution with mean and variance equal to the β vectors and the covariance matrixes of the estimated multinomial logit models. The no parametric test of Poe et al. (1997) will be use in the comparison of the resulting compensating surplus welfare measures. The transfer error will be calculated with the formula:

$$Transfer\ Error = \frac{|\ \Pr edicted\ value_{policy\ site} - Estimated\ Value_{policy\ site}\ |}{Estimated\ Value_{policy\ site}} \qquad (8)$$

3. The study

The scenario shown to respondents was the reduction of the soil erosion off-farm effects. Due to specific pedological and climatic conditions, and long term human exploitation the soil erosion process is probably the main environmental threat in these sites. Soil erosion causes many off-farm negative effects that affect directly to society; among them the most important are the advancing desertification, the siltation of water bodies and the reduction of biodiversity. To reduce these effects it is necessary to provide subsidies to farmer for encouraging them to adopt soil conservation measures in their land management. To define the nature and quantity of the subsidy, policy makers need a composite information in which the economic impact of soil erosion is substantial. Benefit transfer could be an effective and low cost way to provide public administration with a monetary value of the soil erosion effects.

The benefit transfer exercise was based on two parallel surveys conducted broadly at the same time in two different watersheds (Genil and Guadajoz) located in the south of Spain. Favourably to benefit transfer conditions, the two watersheds present similar environmental and physical features if we exclude the area, since the Genil watershed (5000 Km^2) is vaster than the Guadajoz one (2425 Km^2). Because of that, differences in welfare measures are expected to be found more in population sample characteristics that in differences in the environmental goods and benefits involved in the study. To fully account for the attitudinal and socio-economic characteristics the choice experiment model was estimated adding respondents' attitudinal and socio-economic characteristics to the main effect multinomial logit model.

The basic scenario presented to respondents described the environmental conditions (referred to the main off-farm effects of soil erosion) expected in the watershed in 50 years if nothing would have been done to reduce the current high erosion rate. The change scenario outlined the environmental improvement expected with the implementation of a soil erosion reduction project that mainly consisted of sowing a grass cover in olive orchards and reforesting degraded hill and mountain slopes. The soil erosion process and its effects, the basic and the change scenarios, so as the project description were summarised to respondents by means of an information package.

The questionnaires used were identical in the two basins with the exception of site specific information. In the first part of the questionnaire, respondents were asked for their beliefs about the present environmental conditions, the need of preserving natural stock to next generation and the interaction that they have with the natural medium. The next stage was the elicitation question in which respondent were required to chose the most preferred alternative in a set of four choice cards each containing three alternatives.

The attributes and attribute levels selection was carried out by consulting experts in the soil erosion field and by informal interviews to citizens. The specification of the non-monetary attribute levels was made using the Geographic Information System of Andalusia Community (SINAMBA) and the aid of experts in the theme that each attribute represented. Special care was used in the monetary attribute levels selection, due to its central role in welfare change estimation. So, a contingent valuation, whose details can be seen in Colombo et al. (2003b), was carried out to establish the mean value and the range of this attribute levels. The attributes and attributes levels finally selected are summarised in table 1.

Table 1. Attributes and attributes levels used in the choice experiment study.

Attributes	**Levels Genil**	**Levels Guadajoz**
Landscape change: desertification of the semiarid areas	**Degradation** Small improvement Improvement	**Degradation** Small improvement Improvement
Superficial and underground water quality	**Low** Medium High	**Low** Medium High
Flora and fauna quality	**Poor** Medium Good	**Poor** Medium Good
Rise of agricultural productivity: job created (number)	**0** 100 200	**0** 65 130
Area of the project execution (KM^2)	**0** 330 660 990	**0** 154 308 462
Extra tax (euros)	**0** 6.01 12.02 18.03 24.04 30.05 36.06	**0** 6.01 12.02 18.03 24.04 30.05 36.06

In case of environmental attributes we used qualitative levels to describe the scenarios, due to the difficulty to predict the environmental conditions expected in the watersheds in 50 years due to the project execution. Anyway, respondents were clearly explained about what each qualitative level meant; for instance they were told that a *poor quality* of the flora and fauna attribute corresponded to a loss of 350 birds for squared kilometre respect to the current conditions. The attributes: *rise of agricultural productivity: job created* and *area of project execution* were added by the analyst to study the importance of agricultural employment in the region and to include a spatial attribute that would have considered the different scope of the project in the two watersheds.

In table 1, in bold are represented the attribute levels of the *status quo* situation that described the expected environmental conditions, in 50 years in the watersheds, in case of no project execution. The other attribute levels were permitted to vary in each choice card according to the experimental design (details in Colombo and Calatrava, 2003a). An example of a choice card presented to respondents is shown in table 2.

Table 2. Example of choice set card presented to respondents

	Situation A	**Situation B**	***Status quo***
Landscape change: desertification of the semiarid areas	Worsening	Improvement	**Neither situation A nor situation B compensate to me the tax payment . I choose the *Status quo* option**
Superficial and underground water quality	Low	High	
Flora and fauna quality	Medium	High	
Agricultural productivity : job created	200	100	
Area of the project execution (KM^2)	Two third	All	
Extra tax (euros)	18.03 €	24.04€	
I choose situation A ☐		**I choose situation B** ☐	☐

To easy respondents' task in doing the attributes trade-off, the *status quo* option was dropped from the choice sets. Anyway, during the interview the interviewer showed to respondents an extra card in which the *status quo* alternative was clearly described and the interviewer constantly repeated to interviewees that they had to compare the situations A and B against the *status quo* and choose the most preferred.

The two surveys were carried out between March and June 2002. The sample size was around 350 citizens in both watersheds. The survey format was face to face interviews made in "quiet" places as shops, train stations, airports etc., to guarantee that the respondents had enough time and tranquillity to understand and answer the questionnaire. The last part of the survey collected the socio-economic characteristics of respondents, their suggestions and critics and finally the interviewer comments about the attitudes and understanding of interviewees.

4. Results

On the total of the survey that were done in the Genil watershed 19 did not complete the questionnaire and were excluded from the analysis, 74 expressed a protest answer and did not respond to the choice experiment cards; 51 manifested a 0 willingness to pay, choosing always the *status quo* option without doing any attributes trade-off; 201 completed the survey providing 1008 (252 * 4) valid observations for model estimation. In the Guadajoz basin the response rate was similar with 88 protest answers, 52 "real" zero, and 218 surveys in which interviewees chose either *status quo* or alternative A, B, providing 1060[3] valid observations.

The mean value of socio-economic and attitudinal characteristics gathered in the survey and used in the models[4] are summarised in table 3. The two samples do not differ significantly in the per capita income (*t* value = .84, p = .40) and in the gender (χ^2 = 1.47, p = .23) whereas are different in the age (χ^2 = 11.72, p = .008) and in the degree of solidarity (*t* value = -12.14, p= 0.000) stated by respondents.

Table 3. Respondents' socio-economics and attitudinal characteristics

Variable	**Genil watershed**	**Guadajoz watershed**
Solidarity[a]	5.18	7.32
Gender (male)	47 %	49 %

[3] Of the 218 respondents who chose either *status quo* or alternative A, B, five were dropped from the analysis since they did not revealed their incomes.
[4] These were the socio-economics and attitudinal characteristics that provided the best fitting of the models to the data.

Age1 (less than 35)	38 %	45%
Age2 (between 35 and 50)	26 %	20 %
Age3 (between 51 and 65)	20 %	16 %
Age4 (more than 65)	16 %	19 %
Per capita income €	456.76	484.34

a: importance that respondents assigned to the questions related to the solidarity in a ten points likert scale.

Interviewees' preferences were modelled by means of multinomial logit models. Before accepting the validity of the models, we checked if they fulfilled the statistical condition of Independence of Irrelevant Alternative (IIA), obtaining that both models did. As usual in choice experiment, the socio-economic and attitudinal characteristics were included in the model as interaction with the constant[5]. Results of the conditional logit model are shown in table 4.

Table 4.Conditional logit models results

Variable	**Genil**		**Guadajoz**	
	Coefficients	**P-value**	**Coefficients**	**P-value**
Constant	-4.726	0.000	-5.243	.0000
Landscape desertification: small improvement	0.983	0.000	1.537	.0000
Landscape desertification: improvement	1.476	0.000	1.639	.0000
Superficial and underground water quality: medium	1.030	0.000	1.430	.0000
Superficial and underground water quality: high	1.475	0.000	2.072	.0000
Flora and fauna quality: medium	0.745	0.000	0.786	.0000
Flora and fauna quality: good	0.982	0.000	1.083	.0000
Jobs created	0.007	0.000	0.012	.0000
Degraded area treated	0.001	0.001	0.003	.0000
Tax	-0.053	0.000	-0.066	.0000
Constant * Solidarity[a]	0.031	0.000	0.017	.1002
Constant * Sex[b]	0.099	0.002	0.103	.0002
Constant * Age2[c]	0.024	0.531	0.053	.1468
Constant * Age3[c]	0.002	0.964	0.048	.2321
Constant * Age4[c]	-0.264	0.000	0.069	.0677
Constant * Income[d]	0.0004	0.000	0.00002	.5795
Number of observations	1008		1060	
Log likelihood at constant	- 1049.50		- 1105.94	
Log likelihood at convergence	- 845.80		- 866.94	
LR	407.4		478.0	
Pseudo R^2	.194		.216	

Clarification

[a] Importance that respondents assigned to solidarity (likert scale 1-10).
[b] Respondents' gender (female: 0; male: 1)
[c]Respondents' age (Age1: less than 35; Age2, 35-50; Age3, 51-65; Age4, more than 65)
[d] Respondents' income

[5] Socio-economic characteristics cannot be introduced alone into the model. This is because they are invariant among respondents and Hessian singularities would arise in the model estimation. To circumvent this problem in this study the individual socio-economic characteristics are introduced as interactions with the constant. The resulting interactions coefficients have to be interpreted as the effect that of socio-economic features of individuals have on the probability of choosing the alternative A or B respect to the *Status quo* option.

Overall the models are highly significant and show a good fitting of the data when comparing the log likelihood value at zero and at convergence[6]. All the regression coefficients of the attributes are highly significant ($\alpha \geq 0.01$) and have a priori expected signs. The coefficients of the interactions between the socio-economics characteristics and the constant have the same sign in the two models, but the per capita income coefficient is no longer significant ($\alpha \geq 0.10$) in the Guadajoz model.

The interpretation of the coefficients suggests that in both watersheds interviewees feel higher utility when faced to better environmental and social conditions. The interactions with the constant show that people that assigned higher importance to solidarity have more probability of choosing the alternative A or B. The male gender resulted to be the one with the higher probability to choose alternative A or B respect the *status quo* option and residents older than 65 years were more likely to choose the no change option respect to the younger ones. The income coefficient shows that, at least in the Genil basin, the higher the income the higher the probability to contribute in the proposed project.

The application of the Swait and Louviere (1993) procedure revealed that the scale parameter at the study site is greater than the one at the policy site, being $\lambda^s / \lambda^p = 1.125$ the value in which is maximised the log-likelihood function of the stacked data sets. Since the scale parameter has an inverse relation with the variance of the error term, it means that the Genil basin has a lower variance of the random component[7]. The likelihood test described in (4) provides a chi-square value of 117. 86

$$LR = -2[-1771.67 - (-845.80 + (-866.94))] = 117.86$$

that is well-greater than the tabulated critical chi-square value at the 5% level with 17 degrees if freedom ($\chi^2_{17,\,0.05} = 27.59$). Therefore the null hypothesis of parameters equality is roundly rejected and it can be concluded that two models are different, even after taking into account for scale differences.

Table 5 shows the implicit prices for the considered attributes. In brackets are shown the 95% confidence intervals estimated using the Krinsky and Robb (1986) procedure. In the last column are presented the approximate significance levels resulting from the Poe et al (1997) test of mean equality.

Table 5. Implicit prices and confidence intervals

Attributes	**Genil Implicit price (€)**	**Guadajoz Implicit price (€)**	**Sign. $H_0 : IP_{i\ Genil} = IP_{i\ Guadajoz}$**
Landscape desertification: small improvement	18.58 (12.28 ; 27.33)	23.36 (17.77 ; 30.52)	0.163
Landscape desertification: improvement	27.91 (20.98 ; 37.89)	24.91 (19.49; 31.58)	0.290
Superficial and underground water quality: medium	19.48 (20.98 ; 37.89)	21.73 (16.44 ; 28.22)	0.328
Superficial and underground water quality: high	27.89 (20.65 ; 37.54)	31.49 (25.48 ; 38.90)	0.266
Flora and fauna quality: medium	14.08 (8.44 ; 21.23)	11.94 (7.67 ; 16.73)	0.280
Flora and fauna quality: good	18.57 (13.13 ; 25.44)	16.45 (12.10 ; 21.55)	0.291
Jobs created	0.127 (0.094 ; 0.176)	0.181 (0.134 ; 0.234)	0.049
Degraded area treated	0.014 (0.006 ; 0.023)	0.050 (0.035 ; 0.066)	0.000

[6] Simulations done by Domenich and McFadden (1975) compare values of ρ^2 between 0.2-0.4 to values between 0.7-0.9 of the R^2 in the case of the ordinary linear regression.

[7] As pointed out by Swait and Louviere (1993) this assertion it is only true if we cannot reject the hypothesis of parameters equality, since it was premised on the equality of two parameters vectors.

The implicit prices for the environmental attributes do not differ between the two watersheds, whilst the implicit prices referred the employment and the degraded area treated do. That is, it exist a similar willingness to pay for increasing in the environmental quality and a greater willingness to pay in the Genil basins for any added job and square kilometre of project execution. This might be due to the fact that the project implementation in the Guadajoz basin creates less employment and it covers a smaller area respect to the Genil basin, so that each employment and square kilometre of degraded area added are more valued by respondents.

Comparing the compensating surplus estimates previously required the definition of the scenarios used in the estimation. As an example, the following four situations have been used to illustrate the overall willingness to pay for improvements in soil erosion over the *status quo*. Results are shown in Table 6:

Scenario 1: Landscape desertification is characterised by a small improvement; surface and ground water quality is improved to the medium level; flora and fauna quality is improved to a medium level; 50 extra jobs are created; and the watersheds degraded area treated is 150 square kilometres.

Scenario 2: Landscape desertification is characterised by a small improvement; surface and ground water quality is improved to a high level; flora and fauna quality is improved to a medium level; 100 extra jobs are created; and the watersheds degraded area treated is 250 square kilometres.

Scenario 3: Landscape desertification is characterised by an improvement; surface and ground water quality is improved to a medium level; flora and fauna quality is improved to a high level; 100 extra jobs are created; and the watersheds degraded area treated is 350 square kilometres.

Scenario 4: Landscape desertification is characterised by an improvement; surface and ground water quality is improved to a high level; flora and fauna quality is improved to a high level; 150 extra jobs are created; and the watersheds degraded area treated is 450 square kilometres.

Table 6. Compensating surpluses and confidence intervals

Scenarios	**Genil Comp Surplus (€)**	**Guadajoz Comp Surplus (€)**	**Sign. $H_0 : CS_{i\ Genil} = CS_{i\ Guadajoz}$**
Scenario 1	1.5 (-8.10 ; 8.63)	10.96 (5.09 ; 15.75)	0.000
Scenario 2	17.65 (10.44 ; 23.76)	34.73 (29.95 ; 40.05)	0.000
Scenario 3	24.44 (17.45 ; 30.43)	36.01 (31.13 ; 41.28)	0.000
Scenario 4	40.59 (34.15 ; 48.58)	59.77 (52.26 ; 69.16)	0.000

The null hypothesis of compensating surplus equality is roundly rejected in all scenarios considered, being the Guadajoz estimates greater than the Genil ones. The compensating surplus can be considered the leading measure in benefit transfer, since it is the value that is used in cost-benefit analysis. The results of this study shed doubts on the transferability of compensating surplus estimates using choice experiment method.

However, when compensating surplus estimates differ, a very important issue is to know when are these differences likely to fall within an acceptable range. That is, it is of interest to know the magnitude of the error that is tolerated by policy makers. If we consider that the methods used in the economic evaluation of natural resources often provide an approximate value of the good under question, an error up to 30 % may be considered acceptable for a cost-benefit analysis, particularly when the benefits clearly outweigh the costs. After all, it is left to the discretion of policy makers to decide if to rely on benefit transfer values or to commit new studies.

If we estimate the compensating surplus in the Guadajoz basin, for the four scenarios, using the model parameters of the Genil basin and the site attributes and socio-demographic characteristics of the Guadajoz watershed (equation 2), it would be possible to calculate the transferred error using equation 8. The transferred errors, for the four scenarios considered, are shown in table 7.
Table 7. Transferred errors for the four considered scenarios

Scenarios	**Transferred errors %**
Scenario 1	28
Scenario 2	31
Scenario 3	14
Scenario 4	21

The transferred errors extend from the 14% to the 31% depending on the scenario considered. Despite the divergence of consumer surplus estimates, the transferred error has a magnitude that has been considered acceptable in most benefit transfer settings. For instance, Ready at al. (2004) observed an average error of about 38%; Smith and Pattanayak (2002), in their revision of benefit transfer studies of outdoor recreation, found an average error of 80%; Rozan (2004) detected an average error of 25 %. On a positive side of choice experiment, it is reassuring that, spite of the identified preference structures and welfare measure estimates were different in the study and policy sites, the transferred errors have magnitudes that can be considered "normal" in benefit transfer. On the light of these results, there are enough evidences to claim for further researches to answer the question about the possibility to use choice experiment in benefit transfer.

5. Conclusions

Benefit transfer is a very interesting low cost alternative for natural resource assessment. In the last decade the number of benefit transfer applications has increased and it has resulted that some uncertainty surrounds the reliability of benefit transfer technique. It is so very important to further investigate the circumstances under which it is possible to perform a benefit transfer.

Practically the totality of the benefit transfer studies carry out up to now used the contingent valuation or travel cost method to elicitate the benefit value. Choice experiment, accounting for differences in environmental values and socio-demographic characteristics of the population at study and policy sites, should suit well to benefit transfer. Despite these potentialities the studies that used the choice experiment method in benefit transfer are very scarce.

In this study we compared the benefit function parameters, the implicit prices and the compensating surplus estimates resulting from two choice experiment applications to the economic evaluation of the soil erosion reduction in two similar watersheds located in the Southeast of Spain. The results are not particularly positive regarding the validity of benefit transfer. The function parameters and the compensating surpluses differ between the study and policy sites; the comparison of the implicit prices provided mixed results, since the ones related to environmental attributes do not differ, whilst the ones associated to the employment and to the degraded areas treated differed. These results are similar to the ones obtained by Morrison and Bennet (2000) and shed doubts over the validity of choice experiment to be used in benefit transfer.

Anyway, the transferred errors, for four different scenarios, lie in a tight interval whose lower and upper bounds are 14% and 31 %. A similar magnitude of error is often considered acceptable in others benefit transfer studies, depending on the elicitation method used, the quality and quantity of information available and the final goal of the analysis. In this exercise, considering that the elicitation method used can only provide approximate benefit estimations and there was only a study available to be used in the benefit function comparison, we believe there are some elements to encourage other tests of transferability. When other studies be available, it will be possible to carry out a benefit transfer using meta-analysis so that to further test the capability of choice experiment to provide useful estimates to be used in benefit transfer.

6. References

Bateman, I.J., Jones, A.P., Lovett, A.A., Lake, I.R. and Day, B.H.(2002). Applying Geographical Information Systems (GIS) to Environmental and Resource Economics. *Environmental & Resource Economics* 22: 219-269.

Bennet, J. and Blamey, R. (2001). The Choice Modelling Approach to Environmental Valuation, New horizons en Environmental Economics. Edward Elgar, Cheltenham, UK, Northhampton, MA, USA.

Bergland, O., K. Magnussen and Navrud, S. (1995). Benefit Transfer: Testing for Accuracy and Reliability. Discussion Paper, #D-03/1995, Department of Economics and Social Sciences, Agricultural University of Norway.

Boyle, K.J. and Bergstrom, J.C. (1992). Benefit transfer studies: myths, pragmatism and idealism. *Water Resource Research* 28 (3): 675-683.

Brisson, I., Pearce, D.W. (1995). Benefits transfer for disamenity from waste disposal. Global Environmental Change Working Paper WM 95-06. Centre for Social and Economic Research on the Global Environment (CSERGE), University College London and University of East Anglia, Norwich.

Brouwer, R. (2000). Environmental value transfer: state of the art and future prospects. *Ecological Economics* 32: 137-152.

Colombo, S. and Calatrava J. (2003a). Evaluation of the off-farm effects of soil erosion: an application of Choice Experiment to the eroded areas of Southern Spain. XXV IAAE Congress of Agricultural Economics, Durban, South Africa, 17-26 August.

Colombo, S., Calatrava J. and Hanley N. (2003b). The economic benefits of soil erosion control: an application of the contingent valuation method in the Alto Genil basin of southern Spain. *Journal of Soil and Water Conservation* (58): 367-371.

Costanza, R., Arge, R., Groot, R., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., Van Den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature* 387:253-260.

Desvounges, W.H., Naughton, M.C. and Parson, G.R. (1992). Benefit transfer: conceptual problems in estimating water quality benefits using exinting studies. *Water Resource Research* 28 (3): 675-683.

Domencich, T. and McFadden, D. (1975): Urban travel demand: a behavioural approach. Amsterdam: North-Holland.

Downing, M. and T. Ozuna Jr (1996). Testing the Reliability of the Benefit Function Transfer Approach’, *Journal of Environmental Economics and Management* 30: 316–322.

Kask, S.B. and Shogren, J.F.(1994). Benefit transfer protocol for long-term health risk valuation: A case of surface water contamination. *Water Resource Research* 30(10): 2813-2823.

Kirchhoff, S., B. G. Colby and J. T. LaFrance (1997). Evaluating the Performance of Benefit Transfer: An Empirical Inquiry. *Journal of Environmental Economics and Management* 33: 75–93.

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

Lancaster, K. (1966). A New Approach to Consumer Theory. *Journal of Political Economy* 74: 132-157.

Loomis, J. B. (1992). The evolution of a more rigorous approach to benefit transfer: Benefit function transfer *Water Resources Research* 28(3): 701–705.

Loomis, J. B., B. Roach, F. Ward, and R. Ready (1995). Testing Transferability of Recreation Demand Models Across Regions: A Study of Corps of Engineer Reservoirs. *Water Resources Research* 31(3): 721–730.

Louviere, J.J., Hensher, D.A. and Swait, J. (2000). Stated Choice Methods, Analysis and Application. Cambridge University Press.

MacMillan, D. (2002). The value of managing forests to protect archaeology. Report to Forest Commission. Centre for Research in Environmental Appraisal and Management. University of Newcastle.

Mogas, J. and Riera P. (2003): Validación del Experimento de Elección en la Transferencia de Beneficios. *Hacienda Pública Española/Revista de Economía Pública* 165: 79-95

Morrison, M.D. and Bennett, J.W. (2000). Choice Modelling, non-use values and benefit transfer, *Economics Analysis and Policy,* 30(1): 13-32.

Morrison, M.D., Bennett, J.W., Blamey R.K. and Louviere J. J.(1998). Choice modelling and test of Benefit Transfer, Choice modelling Research Report No. 8, University College, The University of New South Wales, Canberra.

Muthke, T. Holm-Muller, K. (2004). National and International Benefit Transfer Testing with a Rigorous Test Procedure. *Environmental & Resource Economics* 29: 323-336.

Poe, G., Welsh, M. and Champ, P. (1997). Measuring the difference in mean willingness to pay when dichotomous choice contingent valuation responses are not independent. *Journal of Environmental Economics and Management* 73: 255-267.

Pearson, G. R. and M. J. Kealy (1994). Benefits Transfer in a Random Utility Model of Recreation. *Water Resources Research* 30(8): 2477–2484.

Ready, R., Navrud, S., Day, B., Dubourg R., Machado, F., Mourato, S., Spanninks, F. and Vazquez-Rodriguez, M.J. (2004). Benefit transfer in Europe: How reliable Are Transfers between Countries? *Environmental & Resource Economics* 29: 67-82.

Rozan, A. (2004). Benefit Transfer: A Comparison of WTP for Air Quality between France and Germany. *Environmental & Resource Economics* 29: 295-306.

Shrestha, R.K. and Loomis, J.B. (2003). Meta-Analytic Benefit Transfer of Outdoor Recreation Economic Values: Testing Out-of-Sample Convergent Validity. *Environmental & Resource Economics* 25: 79-100.

Smith, V.K. and Pattanayak, S.K. (2002). Is Meta-Analysis a Noah's art for Non.Market Valuation? *Environmental & Resource Economics* 22: 271-296.

Swait, J. and Louviere, J.J. (1993). The Role of the Scale Parameter in the Estimation and Comparison of Multinomial Logit Models. *Journal of Marketing Research* 30: 305-314.