Economía Agraria y Recursos Naturales. ISSN: 1578-0732. e-ISSN: 2174-7350. Vol. 14,1. (2014). pp. 103-128

Transferring landscape values using discrete choice experiments: Is meta-analysis an option?

Amaia de Ayala[a,b], Petr Mariel[b] and Jürgen Meyerhoff[c]

ABSTRACT: Discrete Choice Experiment (DCE) is an increasingly used valuation method to guide policy-makers in their landscape management decision-making. However, due to time and budget constraints, conducting an original DCE for every single policy decision may not be possible in practice. In this context, meta-analyses are becoming a popular tool for supporting benefit transfer in environmental valuation. This paper raises the question whether meta-analysis is an option for transferring landscape values using DCEs within Europe. We argue that the use of specific and different attributes, definitions and units of measurement makes it hard to compare willingness-to-pay values across current DCE studies.

KEYWORDS: Discrete choice experiment, landscape valuation, meta-analysis, review, willingness-to-pay.

JEL classification: Q51.

DOI: 10.7201/earn.2014.01.06.

La transferencia de los valores del paisaje mediante los experimentos de elección discreta: ¿Es el meta-análisis una opción?

RESUMEN: Llevar a cabo un Experimento de Elección Discreta (EED) por cada decisión política relativa a la gestión de paisajes no es factible en la práctica dadas las limitaciones del tiempo y el presupuesto. El meta-análisis constituye una herramienta cada vez más utilizada para transferir los valores económicos del medioambiente. Este trabajo plantea la cuestión de si el meta-análisis es una opción para transferir los valores de los paisajes mediante los EED en Europa. Encontramos que el uso específico y diferente de los atributos, sus definiciones y unidades de medida dificultan la comparación de las disposiciones pagar entre los EED considerados.

PALABRAS CLAVE: Experimento de elección discreta, valoración de paisajes, meta-análisis, revisión, disposición a pagar.

Clasificación JEL: Q51.

DOI: 10.7201/earn.2014.01.06.

[a] Basque Centre for Climate Change (BC3).

[b] Dpto. Economía Aplicada III (Econometría y Estadística). Universidad del País Vasco (UPV/EHU).

[c] Institute for Landscape and Environmental Planning. Technische Universität Berlin.

Acknowledgements: Amaia de Ayala is grateful to the financial support from the Basque Government through a Ph.D. grant (BFI09.23). Petr Mariel acknowledges financial support from UPV/EHU Econometrics Research Group, Basque Government grant IT-642-13 and Universidad del País Vasco (UPV/EHU) under research grants UFI11/03 and US12/09.

Corresponding author: *Amaia de Ayala.* E-mail: amaiadeayala@gmail.com; amaia.deayala@bc3research.org.

Received on January 2014. Accepted on May 2014.

1. Introduction

Landscapes are continuously changing and evolving through natural and human-induced processes and activities. Landscape changes are often characterised by the loss of diversity and identity, which brings an urgent need to preserve and develop landscapes sustainably. In this context, measuring and quantifying the economic value of changes in landscapes according to social preferences would guide policy-makers in landscape management decision-making. This practice is known as landscape valuation, aiming at aiding welfare optimization by incorporating public preferences that are not appropriately reflected by market mechanisms.

Since landscapes are complex environmental goods involving several attributes, the Discrete Choice Experiment (DCE) method is growing rapidly to enrich landscape management decision-making (Adamowicz *et al.*, 1998; Bennett and Blamey, 2001; Bateman *et al.*, 2002). However, carrying out an original valuation study, such as a DCE, for every single landscape management policy decision may not be feasible in practice. It would not match the time and budget constraints of most policy-evaluation exercises. There is often interest from policy-makers in transferring the results from previous and similar studies rather than conducting new ones, this being faster and cheaper. This practice is known as benefit transfer (BT), although a more general term would be value transfer (Rolfe, 2006; Navrud and Ready, 2007).

BT is the application, with the necessary adjustments, of valuation information from an original study (i.e. the study site), or multiple studies, to a different context, where such information is required to evaluate a new policy (i.e. the policy site). Over the last few years there has been substantial research regarding the accuracy and validity of BT, in particular investigating in which situations environmental value transfer is valid and reliable (Muthke and Holm-Mueller, 2004; Brouwer and Bateman, 2005; Rosenberger and Stanley, 2006; Rolfe, 2006; Colombo *et al.*, 2007; Santos, 2007; Scarpa *et al.*, 2007; Colombo and Hanley, 2008; Johnston and Rosenberger, 2010; Bateman *et al.*, 2011; Martín-Ortega *et al.*, 2012). Two main BT approaches have been followed in the environmental valuation literature (Navrud and Ready, 2007; Pattanayak *et al.*, 2007; Colombo and Hanley, 2008): (i) unit value transfer (simple unit transfer and unit transfer with adjustments) and (ii) function transfer (benefit function from one study and meta-analysis).

The focus of this paper is on the meta-analysis, which refers to the study of studies (Barrio and Loureiro, 2010). More formally, it is the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings (Glass, 1976). Meta-analysis has been mainly developed in medicine, psychology, marketing or education and it is gaining popularity in the field of environmental economics. According to Shrestha *et al.* (2007), BT using meta-analysis has several advantages. First, information from multiple studies can be added, thus providing more rigorous measures of a central tendency than can usually be derived from any single study. Second, methodological differences in the original studies can be controlled for when estimating a value from the meta-regression equation. And third, by setting the explanatory variables specific to the policy site, the analyst can potentially account for the heterogeneity in the policy site features. Given this, and compared with the other BT methods, the benefit estimate based on meta-analysis might be a better approximation of the value of the resource at the policy site (Rosenberger and Loomis, 2000; Shrestha *et al.*, 2007).

Most of the meta-analyses concerning environmental valuation have been based on Contingent Valuation (CV) studies so far, despite the increasing application of DCEs in this field. This raises the question whether meta-analysis is an option for transferring landscape values using estimates from DCEs. Thus, the objective of this paper is to analyse and discuss the opportunities to use the results from DCE studies in meta-analysis regarding landscape values in Europe. The paper is structured as follows. Section 2 presents meta-analysis methodology and reviews meta-analysis studies in environmental valuation. Section 3 discusses the suitability of European DCEs for landscape valuation for meta-analysis and Section 4 provides discussion and the main conclusions of the paper.

2. Meta-analysis methodology

An explicit specification of the meta-regression model can be described generally as follows:

$$y_{in} = \alpha + \beta_1 x_{1,in} + \beta_2 x_{2,in} + \cdots + \beta_K x_{K,in} + \varepsilon_i + u_n, \quad [1]$$

where i subscript denotes which candidate study the value estimate comes from (i =1, 2, ..., I), n denotes the value estimate reported in the study (n = 1, 2, ..., N_i) and $x_{1,in}$, $x_{2,in}$, ..., $x_{K,in}$ refer to the explanatory variable $x_{k,in}$ (k = 1, 2, ..., K). In the case where each study i provides a single estimate n, then N_i = 1 and ε_i collapses into u_n. However, in the case where a study gives more than one value estimate, then it is necessary to account for the common error across estimates (u_n) and the group-specific or panel error within a study (ε_i). The total number of estimates is $N = \sum_{i=1}^{I} N_i$. Thus, the dependent variable y_{in}, is the estimate of the n-th value for the environmental change found in study i (often a willingness-to-pay, WTP, per unit change for the resource change specified), α represents an intercept term and β_1, β_2, ..., β_K are the coefficients to be estimated associated with the explanatory variable $x_{k,in}$ (e.g. amenity characteristics, socio-economic characteristics, methodological characteristics). There are several approaches to estimating this model depending on assumptions regarding the error variance-covariance matrix (Lindhjem, 2007; Nelson and Kennedy, 2009). The most common specifications of the functional form of the regression equation are linear, double-log, semi- and trans-log (Johnston *et al.*, 2005).

After a wide bibliographic review, meta-analysis for BT should only rely on a subset of studies which fulfil the necessary conditions (see Boyle *et al.,* 2009). Colombo and Hanley (2008) found that BT errors depend on the selection of the study sites and that additional data collection does not always reduce transfer errors. There are some specific challenges in performing a successful meta-analysis, including the difficulties of ensuring commensurability across data sets, the variation in methods and approaches because the experiments are not controlled, limited data sets and inadequate methods of analysis (Florax *et al.*, 2002; Smith and Pattanayak, 2002; Nelson and Kennedy, 2009; Johnston and Rosenberger, 2010). An essential requirement is to define clearly and accurately the environmental issue of interest. To be comparable across studies analysed, it is very important to ensure that the dependent variable measures from the primary studies are all measuring the same thing or concept and in a common unit.

2.1. Meta-analysis in environmental valuation

Recent meta-analyses have been conducted in the field of environmental valuation. Table 1 classifies meta-analysis studies conducted recently according to the area of application, valuation methods, the number of value observations, as well as the definition of the dependent variable of the meta-regression model. When facing the challenge of defining a common dependent variable for the policy site, they should reconcile commodity definitions across the studies selected. For this, they often add explanatory variables to the right hand side of the equation [1]. For example, in Ghermandi *et al.* (2008), the wetland value estimates per hectare and year are for different wetland types, sizes or goods and services provided. Similarly, in Lindhjem (2007), WTP estimates per household and year for protection of forests are for different dimensions of geography, country, time of year or scope (forest area).

Another challenge related to the definition of the dependent variable is its measurability. Even some studies of seemingly similar non-market goods or services may estimate values for differing underlying quantities or qualities. For example, Johnston *et al.* (2005) reconciled measurements of water quality change by mapping all water quality measures to the Resources for the Future (RFF) water quality ladder. In those studies in which such information was not provided, they used descriptive information to approximate the baseline level of water quality and the magnitude of the change. Likewise, Van Houtven *et al.* (2007) converted the specified water quality changes into a common metric by constructing a 10-point water quality index (WQI_{10}). Alternatively, Liu and Stern (2008) addressed the marginal changes in the valuation of ecosystem services by adding dummies as explanatory variables regarding the type and degree of the change. It is noteworthy that in all cases the process of converting comparable commodity definitions and measurements across studies required subjective judgments and involved uncertainty. Furthermore, in many cases assumptions required to reconcile commodity definitions and measurements are not clearly specified in the studies reviewed.

TABLE 1

Recent meta-analysis studies in environmental valuation

Area of application	Reference	Valuation method(s)	Number of observations	Dependent variable
Wetland	Brouwer *et al.* (1999)	CV	130 (92)	Log of WTP per household and year in SDR (1995) for the preservation of specific wetland aspects
	Woodward and Wui (2001)	CV, HP, RC, TC, NFI	65	Log of wetland value per acre and year in US$ (1990)
	Brander *et al.* (2006)	CV, HP, TC, RC, NFI, PF, MP, OC	215 (202)	Log of wetland value per hectare and year in US$ (1995)
	Ghermandi *et al.* (2008)	CV, HP, TC, RC, NFI, PF, MP, OC, DCE	385	Log of wetland value per hectare and year in US$ (2003)
Recreation	Bateman and Jones (2003)	CV, TC	77	Recreation value per person and visit in £ (1990) for open-access woodland in Great Britain
	Brander *et al.* (2007)	GR, PF, NFI, TC, HP, CV	100 (73)	Log of the coral reef recreation value per visit in US$ (2000)
	Shrestha *et al.* (2007)	CV, TC	682	WTP per person and activity day in US$ (1996) of outdoor recreation for a new policy
	Zandersen and Tol (2009)	TC	251 (189 and 166)	A) Log of consumer surplus per trip in € (2000) of forest recreation B) Consumer surplus per trip in € (2000) normalized for size of forest (per hectare) of forest recreation
Water	Johnston *et al.* (2003)	CV	29	Log of WTP per household and year in US$ (2002) for surface water improvements
	Johnston *et al.* (2005)	CV	81	Log of WTP per household and year in US$ (2000) for water improvements in aquatic habitat
	Van Houtven *et al.* (2007)	CV, CA	131	Log of WTP per household and year in US$ (2000) for water quality change
River	Rolfe and Brouwer (2012)	DCE	145	Log of WTP per household and kilometre in US$ (2012) of river health
Forest	Lindhjem (2007)	CV, DCE (only two)	72	Log of WTP per household and year in NOK (2005) for protection and multiple use forestry
	Barrio and Loureiro (2010)	CV	101	A) Log of mean WTP in US$ (2008) for forest management programmes
			50	B) Log of median WTP in US$ (2008) for forest management programmes.
Species	Richardson and Loomis (2009)	CV, DCE (only one)	67	Log of WTP per household and year in US$ (2006) for the preservation of threatened, endangered and rare species
Ecosystem services	Liu and Stern (2008)	CV	120	Log of WTP per household and year in US$ (2006) for coastal ecosystem services
Agricultural landscape	Santos (2007)	CV	61 and 32	Log of WTP per household and year in £ (1996) for the conservation of agricultural landscapes

Notes:
In some studies the number of observations is reduced from the total number of value observations because of missing values for explanatory variables.
In these cases, the final number of observations used in the meta-regression model is specified in brackets.
When different numbers of observations are specified (e.g. 61 and 32) this is because different meta-models (with different numbers of observations) were estimated.
Zandersen and Tol (2009) and Barrio and Loureiro (2010) specified the dependent variable in two different ways (A and B).
When Log is in brackets this means that the dependent variable was also initially specified as non-log (i.e. linear specification).
Abbreviations:
CA: Conjoint Analysis; CV: Contingent Valuation; DCE: Discrete Choice Experiment; GR: Gross Revenue; HP: Hedonic Pricing; Log: Logarithm; MP: Market Prices;
NFI: Net Factor Income; OC: Opportunity Cost; PF: Production Function; RC: Replacement Cost; RP: Revealed Preference; SDR: Special Drawing Rights; SP: Stated Preference;
TC: Travel Cost.
Source: Own elaboration.

Analysts should also specify whether Marshallian consumer surplus or Hicksian compensating surplus is used to define the dependent variable, which depends on the valuation method(s) considered. As can be seen from Table 1, six meta-analyses (out of 17) incorporated results from different Stated Preference (SP) and Revealed Preference (RP) valuation methods, among others (e.g. Ghermandi *et al.*, 2008; Brander *et al.*, 2007; Brander *et al.*, 2006). However, this type of analysis is limited and leads to criticism that values may not be commensurable (Smith and Pattanayak, 2002; Bergstrom and Taylor, 2006; Johnston and Rosenberger, 2010). Selecting estimates derived from similar valuation methods might be advantageous to ensure a common concept for the dependent variable (Van Houtven *et al.*, 2007). The remaining eleven meta-analysis studies are based on the same valuation approaches or just on one valuation method. According to Table 1, seven meta-analyses draw value estimates from only one type of valuation method, where the majority (six studies) are based on studies using the CV method (e.g. Santos, 2007; Barrio and Loureiro, 2010; Johnston *et al.*, 2005).

However, meta-analyses using estimates from DCEs for BT seem to be still uncommon. To the best of our knowledge, the only study doing BT through meta-analysis using only estimates from DCEs was recently carried by Rolfe and Brouwer (2012). In order to generate a consistent base for data pooling and analysis, only WTP estimates for one common attribute (river health) across the 19 collected DCEs in Australia were chosen, obtaining in total 145 WTP estimates relating to river health. The implicit prices of different measures and scales of river health were transformed into a common standard of WTP per kilometre of river in good health in order to ensure comparable value estimates across studies.

3. Suitability of discrete choice experiments for meta-analysis regarding landscape values

The data used to discuss the opportunity to perform a meta-analysis concerning landscape values comes from a literature review of DCEs published between 1997 and beginning of 2013 for valuing landscape changes. We considered studies that applied DCE in order to value landscapes or landscape elements, such as agricultural landscape, mountain, forest and wetland, or to value a mixture of landscapes (a particular area or region) within Europe. The review considered 87 studies including published articles as well as “grey literature”.

Definition of the dependent variable proved problematic. Our primary DCE studies involved slightly different aspects of landscapes (i.e. different attributes), ranging, for example, from landscape aesthetic, air pollution, or cultural heritage to endangered wildlife, hedgerows and recreational facilities. So, we encounter the first issue when carrying out a meta-analysis using these DCEs: the wide heterogeneity in the attributes used to define the landscape. The most common attributes found across DCEs reviewed are related to biodiversity, landscape in general, forest, recreation, water, grassland, hedgerows, cultural heritage, field boundaries and moorland. Attributes related to biodiversity and to landscape are the most commonly used (used by 39 and 19 studies, respectively).

Richardson and Loomis (2009) conducted a meta-analysis concerning the value of threatened, endangered and rare species (see Table 1). By adding an explanatory variable at the right-hand side of the meta-regression [1], they were able to control for the percentage change in the species population, among other factors. However, transferring values from one landscape to another requires more than just transferring estimates for biodiversity, for example. That is, the value of the landscape is more than transferring the value of the attributes of single landscape elements. But the question is how to conduct a meta-analysis for transferring landscape values using DCEs which involve very specific and different attributes and levels. In the case of Santos (2007), a meta-analysis concerning agricultural landscapes was carried out using only CV methods and characterising the studies with respect to (i) the landscape change (or programme), (ii) the surveyed population and (iii) the method applied, finally having 61 value observations for the meta-regression model estimation (see Table 1).

But in our case, the DCEs considered involve not only different landscape types but also many specific and different attributes with different descriptions. Thus, using compensating surplus estimates instead of marginal WTP value estimates as the dependent variable was not found to be appropriate because of both the difficulty in finding future management scenarios that were consistent across DCE studies and the variation in attributes between primary studies. In this context, similarly to Rolfe and Brouwer (2012), we decided to analyse the suitability of meta-analysis based on DCEs for landscape valuation focusing on the general landscape attribute as used in 19 studies.

Table 2 reports detailed information about landscape attribute definitions and levels (units of measurement) used in the 19 DCE studies reviewed. But even when restricting ourselves to the landscape attribute, we note that it is arduous to ensure commensurability across data sets and that too many (subjective) assumptions would be necessary. First of all, not all of these attributes are measuring the same concept; that is, they are defined in different ways, such as the impact of a project in L1 and L7; landscape view in L2-L6 and L12; landscape desertification level in L10; size of grassland and possibility of surrounding land in L13; the percentage of surface area on which today´s landscape could be seen in the future in L14, or scenic quality in L17 (see Table 2).

In order to make some definitions compatible, one possible approach could be to group together some definitions or terms that may be considered as consistent with indicators, for example, of landscape view or configuration (landscape view in L2-L6 and L12; landscape aesthetic in L8; proportion of native forest and open moor in L9; landscape diversity in L15; intervention in the scenic quality in L17; possible landscapes in L18 and size of forest in the landscape in L19). Then, some dummy variables would be necessary in the meta-regression model to capture the characteristics of the attribute, such as the landscape element to be present (e.g. forest, lake, grassland).

TABLE 2

DCEs with landscape attribute

Code	Reference	Named as	Definition	Levels
L1	Álvarez-Farizo and Hanley (2002)	Landscape protection	Impact of a wind farm project	Protection; Loss
L2, L3	Baumgart (2005)	Landscape view	Forest land (trees)	A lot; Medium; As today
L4	Baumgart (2005)	Landscape view	Lake for storing water	Large; Small; As today
L5, L6	Baumgart (2005)	Landscape view	Hotels and apartments	A lot; Medium; As today
L7	Bergmann *et al.* (2006)	Landscape impact	Visual impact of the renew-able energy project	None; Low; Moderate; High
L8	Borresch *et al.* (2009)	Landscape aesthetic	Landscape scenarios	Status Quo; Multifunctionality scenario; Grassland-dominated scenario; Intensity sce-nario; High price scenario
L9	Bullock *et al.* (1998)	Landscape	Proportion of native forest and open moor	Deer in high open mountain scenery; Deer in both open mountain areas and Caledonian Pine forest; Deer only in low-density Caledo-nian Pine forest
L10	Colombo *et al.* (2005)	Landscape desertification	Desertification level	Degradation due to desertification; Small improvement: reducing desertification risks in high erosion areas; Moderate improvement: reducing risks in all areas
L11	Domínguez-Torreiro and Soliño (2011)	Rural landscape	Conservation level of forest and/or grassland landscape	Deterioration of forest and grassland; Re-covery and conservation of forest; Recovery and conservation of grassland; Recovery and conservation of forest and grassland
L12	Elsasser *et al.* (2010)	Landscape view	Typical landscapes of the region in the summer and winter aspect	Situations with different forest types (pine forest, broadleaved forest or mixed forest) with low or high structural diversity; Situa-tion without any forest (grassland only)
L13	Hasund *et al.* (2011)	Surrounding landscape and size of grassland	Size of grassland and possi-bility of surrounding land	Grassland small and isolated; Grassland large and surrounded by other similar land
L14	Hoyos *et al.* (2009)	Landscape	Percentage of surface area on which today's landscape could be seen in the future	40%; 60%; 80%; 100%
L15	Meyerhoff *et al.* (2009)	Landscape diversity	Diversity level	Low; Medium; High
L16	Moran *et al.* (2004)	Landscape and access	Changes regarding land-scape and access	Current practices; Enhance landscape appear-ance; Enhance public access
L17	Rulleau *et al.* (2008)	Landscape	Intervention in the scenic quality	Clear-cutting without replanting; Bush re-planting; Sample replanting
L18	Schmitz (2006)	Landscape	Possible landscapes	Only forest; Grassland dominated; Mulch dominated; Arable land dominated; Arable and grassland balanced
L19	Schmitz *et al.* (2003)	Landscape	Percentage of forest in the landscape	Only forest; 75%; 55%; 35%; 5%

Note: Baumgart (2005) described five different DCEs (with varying attributes) in the same publication, so each DCE has been treated in the analysis as an individual reference (L2, L3, L4, L5 and L6).

Source: Own elaboration.

Another possibility could be to group the landscape attributes consistent with landscape protection/conservation (protection of the landscape in L1; landscape desertification level in L10; conservation of forest and/or grassland landscape in L11 and today´s landscape which could be seen in the future in L14). This concept reconciliation, however, would only be possible with some of the studies.

The next step required, if we are to continue discussing the suitability of carrying out a meta-analysis with DCEs valuing landscapes, is to identify for each DCE study the attributes' levels used to obtain the WTP estimates. At this point, the task of defining a common dependent variable becomes even more laborious, given the use of different attributes' levels measuring very specific changes in the landscape. Thus, the main issue to address is that the changes in landscapes are measured differently in different DCE studies.

The attributes concerning landscape view or configuration present very specific levels. For instance, as can be seen in Table 2, studies L2-L3 and L5-L6 measure the presence of trees and hotels, respectively as a lot, medium and as today; study L8 describes different landscape scenarios (multifunctionality, grassland, intensity scenario, high price scenario); study L12 shows different pictures with either a pine forest, a broadleaved forest, a mixed forest with low or high structural diversity or grassland only; study L17 presents different replanting levels (clear-cutting, bush, sample) and study L19 presents the percentage of landscape covered by forests. Furthermore, some of these studies show images or pictures in the choice cards to describe visually the possible changes in landscapes (studies L2-L6, L12, L18, L19). Finally, in one of these studies related to landscape view, linear coding is used to address changes in landscape diversity in the econometric model (study L15), compared with other studies that use dummy variables in their econometric model specification (e.g. L8, L12, L17, L18, L19).

Taking into account all the above stated issues, the estimate values are usually incommensurable and hence incomparable across studies. Based on certain assumptions, it might be possible to apply some restrictions. For example, regarding studies on landscape view, we could take into account only those WTP estimate values that have been measured qualitatively according to some landscape scenario, such as forest, lake or grassland. However, this would be feasible only with a few studies (L2-L6, L8, L12, L18). All in all, after several exclusions to reconcile first of all the commodity definitions and then the WTP units of measurement, a limited number of WTP value observations remain for the estimation stage of our data. Moreover, given that many independent variables would have to be included in the meta-regression model distinguishing the characteristics of the change under valuation (i.e. one for each type of landscape to be present) and regarding methodological and socio-economic factors, degrees of freedom would be lost.

In addition, as stated by Bergstrom and Taylor (2006), on the one hand, accounting for commodity inconsistency by adjusting the dependent variable of the meta-regression model before the estimation may be inadequate if it essentially alters the nature of what people valued. On the other hand, addressing commodity inconsistency by introducing explanatory variables may also be problematic because it inserts restrictions into the model that may or may not be plausible. As pointed out by

Colombo and Hanley (2008), the analyst should check beforehand whether the study site is suitable or not for the corresponding analysis.

4. Discussion and conclusions

There is growing interest in the potential for producing meta-analyses in the environmental valuation field which do not rely upon expensive and time-consuming survey work and also help to statistically explain the variation in the values obtained in different studies. The increasing number of landscape DCE publications in recent years shows that the use of DCEs is seen as a promising method for landscape valuation. However, we could not identify any meta-analysis using compensating surplus measure estimates derived from the DCE. Due to the inconsistency in potential management scenarios, as well as the variation in attributes across DCE studies, the meta-analysis studies focused on just one common attribute to collect value estimates from DCEs, therefore losing information (e.g. Rolfe and Brouwer, 2012).

In this paper we discuss whether meta-analysis is an option for transferring landscape values from DCEs. We found that the opportunities to use the results from DCE studies in meta-analysis concerning landscape values in Europe are quite limited given the issues related to commodity inconsistency and incommensurability across the data sets reviewed. We also discarded the use of compensating surplus estimates, given both the difficulty in establishing future management scenarios in agreement with the DCEs reviewed and the use of specific and different attributes across primary studies. Even focusing on the landscape specific attribute, we found that the use of different definitions and levels to describe the landscape under valuation makes it hard to compare WTP values across studies.

Many meta-analysts do not pay enough attention to ensuring comparable commodity definitions and metrics, and consequently often pool inconsistent measures (Smith and Pattanayak, 2002; Nelson and Kennedy, 2009). Furthermore, in many of the meta-analyses reviewed it is not clearly specified how commodity definitions and measurements reconciliations are achieved. In our case, the definition and measurement of the dependent variable of the meta-regression model is problematic and several subjective assumptions and explanatory variables for possible reconciliation would be required, leading to the loss of specific information. It is important to reflect on the extent to which the assumptions made for meta-analysis are in line with what the primary studies had in mind.

As one exception, a reasonable reconciliation between attribute definitions and units of measurement was possible in Rolfe and Brouwer (2012) because they collected DCE studies valuing rivers in Australia that were conducted by a small community of researchers using similarly defined attributes and levels. It might be the case that once one study started to cover river health in its DCE (and usually measured per kilometre), others tried to follow the same pattern. However, this is not the case with European DCE studies valuing landscapes, where each study seems to select specific attributes and levels depending on the particular landscape to be valued and main objective of valuation.

There is still no consensus on the concept through which the quantity (or quality) of certain landscape changes may be defined and measured. In the words of Johnston and Rosenberger (2010), "*without consensus, decisions made during benefit transfer research or policy applications to reconcile attribute definitions will probably continue to be perceived as ad hoc"*. Some advances have been made to find a common way to address water quality in Europe by the introduction of the Water Framework Directive (WFD) in the European Union (Martín-Ortega, 2012; Martín-Ortega *et al.*, 2012). So, with enough DCEs addressing water quality following the WFD, meta-analysis might be possible for water quality improvements.

However, there is still no agreement on a set of criteria for the selection of certain landscape attributes to be used in DCEs, their definition and units of measurement. An additional point is whether landscape values are comparable across different studies at all. The term landscape is subjective and becomes a mental and social construct with different values and meanings linked to it. Although from the meta-analysis point of view a consensus could be useful to ensure a common dependent variable, such standardization may not be desirable for specific landscape changes under valuation, since landscape is closely related to concepts such as identity, character and place-making, which also carry many symbolic meanings (Antrop *et al.*, 2013). As pointed out by Brouwer and Spaninks (1999), the historical context in which estimate values have emerged may be one of the causes behind the difficulty of establishing an unequivocally valid BT in the literature, even in the ideal case where the environmental goods and the sites where they are found and the development scenarios are identical.

In conclusion, currently estimates from DCEs seem to be unsuitable for transferring landscape values through meta-analysis in spite of their increasing popularity. A limitation of this study might be its generic aim of transferring landscape values without focusing on a particular type, and consequently, the large heterogeneity in the studies considered, all of which are site specific. The main consequences for transferring values when meta-analysis might not be an option are that fewer results could be incorporated in the analysis, the possibility of controlling for effects such as sample size and heterogeneity would be restricted and methodological effects on values (e.g. number of choice cards, alternatives or attributes, payment vehicle) in DCE studies may not be distinguishable. Unlike the BT function approach, where extensive research has been carried out on improving and testing the accuracy of its transfer (Morrison and Bergland, 2006), further work is needed to evaluate the applicability of the meta-analysis BT approach based on DCEs.

References

Adamowicz, W., Boxall, P., Williams, M. and Louviere, J. (1998). "Stated preference approaches for measuring passive use values: Choice experiment and contingent valuation". *American Journal of Agricultural Economics*, 80(1): 64-75. http://doi.org/dg5gn6.

Álvarez-Farizo, B. and Hanley, N. (2002). "Using conjoint analysis to quantify public preferences over the environmental impacts of wind farms: An example from Spain". *Energy Policy*, 30(2): 107-116. http://doi.org/dkpc48.

Antrop, M., Sevenant, M., Tagliafierro, C., Van Eetvelde, V. and Witlox, F. (2013). "Setting a framework for valuing the multifunctional landscape and its multiple perceptions". In Van der Heide, C.M. and Heijman, W. (Eds.): *The Economic Value of Landscapes*. Routledge, London and New York: 23-52.

Barrio, M. and Loureiro, M.L. (2010). "A meta-analysis of contingent valuation forest studies". *Ecological Economics,* 69(5): 1023-1030. http://doi.org/dqhnf9.

Bateman, I.J. and Jones, A.P. (2003). "Contrasting conventional with multi-level modelling approaches to meta-analysis: Expectation consistency in UK woodland recreation values". *Land Economics,* 79(2): 235-258. DOI:10.3368/le.79.2.235.

Bateman, I.J., Brouwer, R., Ferrini, S., Schaafsma, M., Barton, D.N., Dubgaard, A. *et al.* (2011). "Making benefit transfers work: Deriving and testing principles for value transfers for similar and dissimilar sites using a case study of the non-market benefits of water quality improvements across Europe". *Environmental and Resource Economics*, 50(3): 365-387. http://doi.org/bm7vjz.

Bateman, I.J., Carson, R.T., Day, B.H., Hanemann, W.M., Hanley, N., Hett, T. *et al.* (2002). *Economic Valuation with Stated Preferences Techniques: A Manual*. Edward Elgar, Cheltenham.

Baumgart, K., (2005). *Bewertung landschaftsrelevanter projekte im Schweizer Alpenraum – Die methode der discrete-choice-experimente*. Ph.D. Thesis, Geographisches Institut, Universität Bern.

Bennett, J. and Blamey, R. (2001). *The Choice Modelling Approach to Environmental Valuation*. Edward Elgar, Cheltenham.

Bergmann, A., Hanley, N. and Wright, R. (2006). "Valuing the attributes of renewable energy investments". *Energy Policy*, 34(9): 1004-1014. http://doi.org/b225h7.

Bergstrom, J.C. and Taylor, L.O. (2006). "Using meta-analysis for benefits transfer: Theory and practice". *Ecological Economics*, 60(2): 351-360. http://doi.org/fn228m.

Borresch, R., Maas, S., Schmitz, K. and Shcmitz, P.M. (2009). "Modelling the value of a multifunctional landscape – A discrete choice experiment". Paper presented at the *International Association of Agricultural Economists (IAAE) Conference*, Beijing, China.

Boyle, K.J., Kuminoff, N.V., Parmeter, C.F. and Pope, J.C. (2009). "Necessary conditions for valid benefit transfers". *American Journal of Agricultural Economics*, 9(5): 1328-1334. http://doi.org/bszh9g.

Brander, L.M., Florax, R.J.G.M. and Vermaat, J.E. (2006). "The empirics of wetland valuation: A comprehensive summary and a meta-analysis of the literature". *Environmental and Resource Economics*, 33(2): 223-250. http://doi.org/bw2zdx.

Brander, L.M., Van Beukering, P. and Cesar, H. (2007). "The recreational value of coral reefs: A meta-analysis". *Ecological Economics*, 63(1): 209-218. http://doi.org/dmjxm4.

Brouwer, R. and Bateman, I.J. (2005). "Benefits transfer of willingness to pay estimates and functions for health-risk reductions: A cross-country study". *Journal of Health Economics*, 24(3): 591-611. http://doi.org/d27dq4.

Brouwer, R. and Spaninks, F.A. (1999). The validity of environmental benefits transfer: Further empirical testing. *Environmental and Resource Economics*, 14(1): 95-117. http://doi.org/bzpx48.

Brouwer, R., Langford, I.H., Bateman, I.J. and Turner, R.K. (1999). "A meta-analysis of wetland contingent valuation studies". *Regional Environmental Change*, 1(1): 47-57. http://doi.org/cd8c7v.

Bullock, C., Elston, D.A. and Chalmers, N.A. (1998). "An application of economic choice experiments to a traditional land use – Deer hunting and landscape change in the Scottish Highlands". *Journal of Environmental Management*, 52(4): 335-351. http://doi.org/fp3ghs.

Colombo, S. and Hanley, N.D. (2008). "How can we reduce the errors from benefits transfer? An investigation using the choice experiment method". *Land Economics*, 84(1): 128-147. DOI: 10.3368/le.84.1.128.

Colombo, S., Calatrava-Requena, J. and Hanley, N. (2007). "Testing choice experiment for benefit transfer with preference heterogeneity". *American Journal of Agricultural Economics*, 89(1): 135-151. http://doi.org/d6cc6v.

Colombo, S., Hanley, N. and Calatrava-Requena, J. (2005). "Designing policy for reducing the off-farm effects of soil erosion using choice experiments". *Journal of Agricultural Economics*, 56(1): 81-95. http://doi.org/fm2pzx.

Domínguez-Torreiro, M. and Soliño, M. (2011). "Provided and perceived status quo in choice experiments: Implications for valuing the output*s* of multifunctional rural areas". *Ecological Economics*, 70(12): 2523-2531. http://doi.org/ck3qf2.

Elsasser, P., Englert, H. and Hamilton, J. (2010). "Landscape benefits of a forest conversion programme in North East Germany: Results of a choice experiment". *Annals of Forest Research*, 53(1): 37-50.

Florax, R.J.G.M., Nijkamp, P. and Willis, K.G. (2002). "Meta-analysis and value transfer: Comparative assessment of scientific knowledge". In Florax, R.J.G.M., Nijkamp, P. and Willis, K.G. (Eds.): *Comparative Environmental Economic Assessment.* Edward Elgar, Cheltenham: 3-18. DOI: 10.4337/1840642602.00009.

Ghermandi, A., Van der Bergh, J.C.J.M., Brander, L.M., de Groot, H.L.F. and Nunes, P.A.L.D. (2008). *The economic value of wetland conservation and creation: A meta-analysis*. Working paper 238, Fondazione Eni Enrico Mattei. Available from: http://services.bepress.com/feem/paper238. [January, 2014].

Glass, G.V. (1976). "Primary, secondary, and meta-analysis of research". *Educational researcher*, 5(10): 3-8. http://doi.org/dnb83x.

Hasund. K.P., Kataria, M. and Lagerkvist, C.L. (2011). "Valuing public goods of the agricultural landscape: A choice experiment using reference points to capture observable heterogeneity". *Journal of Environmental Planning and Management*, 54(1): 31-53. http://doi.org/dxmf7p.

Hoyos, D., Mariel, P. and Fernández-Macho, J. (2009). "The influence of cultural identity on the WTP to protect natural resources: Some empirical evidence". *Ecological Economics*, 68(8-9): 2372-2381. http://doi.org/dc74h2.

Johnston, R.J. and Rosenberger, R.S. (2010). "Methods, trends and controversies in contemporary benefit transfer". *Journal of Economic Surveys*, 24(3): 479-510. http://doi.org/fgh97v.

Johnston, R.J., Besedin, E.Y. and Wardwell, R.F. (2003). "Modeling relationships between use and non-use values for surface water quality: A meta-analysis". *Water Resources Research*, 39(12): 1363. http://doi.org/b6km2s.

Johnston, R.J., Besedin, E.Y., Iovanna, R., Miller, C., Wardwell, R. and Ranson, M. (2005). "Systematic variation in willingness to pay for aquatic resource improvements and implications for benefit transfer: A meta-analysis". *Canadian Journal of Agricultural Economics*, 53(2-3): 221-248. http://doi.org/fkfvhf.

Lindhjem, H. (2007). "20 Years of stated preference valuation of non-timber benefits from Fennoscandian forests: A meta-analysis". *Journal of Forest Economics*, 12(4): 251–277. http://doi.org/bw355w.

Liu, S. and Stern, D.I. (2008). *A meta-analysis of contingent valuation studies in coastal and near-shore marine ecosystems*. Working paper 11720, Munich Personal RePEc Archive (MPRA), Munich University. Available from: http://mpra.ub.uni-muenchen.de/id/eprint/11608. [January, 2014].

Martín-Ortega, J. (2012). "Economic prescriptions and policy applications in the implementation of the European Water Framework Directive". *Environmental Science & Policy*, 24: 83-91. http://doi.org/sn4.

Martín-Ortega, J., Brouwer, R., Ojea, E. and Berbel, J. (2012). "Benefit transfer and spatial heterogeneity of preferences for water quality improvements". *Journal of Environmental Management*, 106: 22-29. http://doi.org/sn5.

Meyerhoff, J., Liebe, U. and Hartje, V. (2009). "Benefits of biodiversity enhancement of nature-oriented silviculture: Evidence from two choice experiments in Germany". *Journal of Forest Economics*, 15(1-2): 37-58. http://doi.org/dmrhc8.

Moran, D., McVittie, A., Allcroft, D. and Elston, D. (2004). *Beauty, Beast and Biodiversity: What Does the Public Want from Agriculture?* Final report to the Scottish Executive Environment and Rural Affairs Department (SEERAD), Scotland.

Morrison, M. and Bergland, O. (2006). "Prospects for the use of choice modelling for benefit transfer". *Ecological Economics*, 60(2): 420-428. http://doi.org/fkcgsn.

Muthke, T. and Holm-Mueller, K. (2004). "National and international benefit transfer testing with a rigorous test procedure". *Environmental and Resource Economics*, 29(3): 323-336. http://doi.org/b268tm.

Navrud, S. and Ready, R. (2007). "Review of methods for value transfer". In Navrud, S. and Ready, R. (Eds.): *Environmental Value Transfer: Issues and Methods*. Springer, Netherlands: 1-10. http://doi.org/bf6wg7.

Nelson, J.P. and Kennedy, P.E. (2009). "The use (and abuse) of meta-analysis in environmental and resource economics: An assessment". *Environmental and Resource Economics*, 42(3): 345-377. http://doi.org/ck9ph7.

Pattanayak, S.K, Smith, V.K. and Van Houtven, G. (2007). "Improving the practice of benefits transfer: A preference calibration approach". In Navrud, S. and Ready, R. (Eds.): *Environmental Value Transfer: Issues and Methods*. Springer, Netherlands: 241-260. http://doi.org/bqxr36.

Richardson, L. and Loomis, J. (2009). "The total economic value of threatened, endangered and rare species: An updated meta-analysis". *Ecological Economics*, 68(5): 1535-1548. http://doi.org/dv2bfx.

Rolfe, J. (2006). "A simple guide to choice modelling and benefit transfer". In Rolfe, J. and Bennett, J. (Eds.): *Choice Modelling and the Transfer of Environmental Values*. Edward Elgar, Cheltenham: 10-27.

Rolfe, J. and Brouwer, R. (2012). "Design effects in a meta-analysis of river health choice experiments in Australia". *Journal of Choice Modelling*, 5(2): 81-97. http://doi.org/sn6.

Rosenberger, R.S. and Loomis, J.B. (2000). "Using meta-analysis for benefit transfer: In-sample convergent validity tests for an outdoor recreation database". *Water Resources Research*, 36(4): 1097-1107. http://doi.org/d4rhbs.

Rosenberger, R.S. and Stanley, T.D. (2006). "Measurement, generalization and publication: Sources of error in benefit transfers and their management". *Ecological Economics*, 60(2): 372-378. http://doi.org/c3pmqb.

Rulleau, B., Dehez, J. and Point, P. (2008). "Valuing preferences for outdoor recreation in French forests: A choice experiment approach". Paper presented at the *Thematic Meeting of the French Economic Association: "Frontiers in Environmental Economics and Natural Resources Management"*, Toulouse.

Santos, J.M.L. (2007). "Transferring landscape values: How and how accurately?" In Navrud, S. and Ready, R. (Eds.): *Environmental Value Transfer: Issues and Methods*. Springer, Netherlands: 45-75. http://doi.org/cds7jh.

Scarpa, R., Hutchinson, W.G., Chilton, S.M., and Buongiorno, J. (2007). "Benefit value transfers conditional on site attributes: Some evidence of reliability from forest recreation in Ireland". In Navrud, S. and Ready, R. (Eds.): *Environmental Value Transfer: Issues and Methods*. Springer, Netherlands: 179-206. http://doi.org/cbqzf2.

Schmitz, K. (2006). *Die bewertung von multifunktionalität der landschaft mir diskreten choice experimenten*. Ph.D. Thesis, Zentrum für internationale Entwicklungs- und Umweltforschung (ZEU), Justus-Liebig-Universität Giessen.

Schmitz, K., Schmitz, P.M. and Wronka, T.C. (2003). "Bewertung von landschaftsfunktionen mit choice experiments (Assessment of landscape function with choice experiments)". *Agrarwirtschaft (German Journal of Agricultural Economics)*, 52(8): 379-389.

Shrestha, R.K., Rosenberger, R.S., and Loomis, J.B. (2007). "Benefit transfer using meta-analysis in recreation economic valuation". In Navrud, S. and Ready, R. (Eds.): *Environmental Value Transfer: Issues and Methods*. Springer, Netherlands: 161-177. http://doi.org/b6fcgg.

Smith, V.K. and Pattanayak, S.K. (2002). "Is meta-analysis a Noah's ark for non-market valuation?" *Environmental and Resource Economics*, 22(1-2): 271-296. http://doi.org/bjrf9z.

Van Houtven, G., Powers J. and Pattanayak, S.K. (2007). "Valuing water quality improvements in the United States using meta-analysis: Is the glass half-full or half-empty for national policy analysis?" *Resource and Energy Economics,* 29(3): 206-228. http://doi.org/d9crvv.

Woodward, R.T. and Wui, Y.S. (2001). "The economic value of wetland services: A meta-analysis". *Ecological Economics*, 37(2): 257-270. http://doi.org/b8z3j6.

Zandersen, M. and Tol, R.S.J. (2009). "A meta-analysis of forest recreation values in Europe". *Journal of Forest Economics*, 15(1-2): 109-130. http://doi.org/c9cz64.