The Value of EU Agricultural Landscape

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Abstract

The present paper provides a meta-analysis of agricultural landscape valuation studies and through the estimated benefit transfer function it projects the value of EU landscape. The analyses are based on information from more than thirty European and Non-European studies which use stated preference approach to uncover the society's willingness to pay (WTP) for landscape. Our calculations show that, the per hectare WTP in EU varies between 89 and 169 €/ha with an average value of 142 €/ha in 2009. Further the calculations indicate that the total value of EU landscape in 2009 is estimated to be in the range of €16.1 – 30.8 billion per year, with an average of €25.8 billion, representing around 7.5 percent of the total value of EU agricultural production and roughly half of the CAP expenditures.

Introduction

Besides producing traditional commodities (e.g. food and fiber), agricultural sector also supplies several other goods to society such as landscape, environment, biodiversity, food security. Most of these outputs convey the characteristics of public goods[2] (OECD, 2001; Meister, 2001). They are *non-excludable* and *non-rival* in consumption. In principle consumers cannot be excluded from enjoying the benefits from them, and the addition of further consumers does not necessarily reduce their availability to consumers already enjoying them. In general, the public-good status of the non-market agricultural outputs leads to market failure. Market is often inefficient in delivering an optimal production level, allocation and distribution of agricultural public goods to society (OECD, 2001; Meister, 2001).

Market failure has motivated a lot of governments to design the support programmes aiming at improving the provision of agricultural public goods. Several countries, particularly developed ones, implement policies which support farmers in maintaining rural environment, landscape and other societal benefits. In the EU context, since the 1990s there has been a significant shift in the emphasis of the Common Agricultural Policy (CAP). Instead of supporting commodity prices, the policy reforms have been directed to integrate environmental aspects into the agricultural support programmes. Different measures have

[1] The authors are solely responsible for the content of the paper. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

[2] Pure public goods are goods that meet the following two criteria: (i) *Non-excludability*: a good is non-exclusive if it is physically or institutionally impossible, or very costly, to exclude individuals from consuming the good. This implies that no one can be excluded from consuming the good. (ii) *Non-rivalry*: A good is non-rival when a unit of the good can be consumed by one individual without diminishing the consumption opportunities available to others from the same unit. This implies that it is optimal not to exclude anyone from consumption of this good because there is no additional cost to accept another consumer while the individual/social benefit deriving from the increased consumption stays constant or increases (e.g. Mas-Colell, Whinston and Green 1995).

been introduced (e.g. cross-compliance, agri-environmental schemes; less favoured area payments, Natura 2000) in order to give incentives to farmers to reduce farming practices, which may have a negative impact on conserving nature and landscape. The recent European Commission communication on the future CAP, "The CAP towards 2020", aims at further strengthening and enhancing these environmental objectives of the CAP (European Commission 2010).

Landscape is one of the key public good produced by agriculture. Farmers by being involved in the production of traditional commodities confer benefits on society by maintaining and creating rural landscapes through a combination of activities covering land use decisions, crop composition, and farming practices.

Agricultural landscape is a complex good. European Landscape Convention defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe 2000). Agricultural landscape is the visible outcome from the interaction between agriculture, natural resources and the environment, and encompass amenity, cultural and other societal values. According to OECD (2000), landscape can be considered as consisting of three key elements (i) *landscape structures* or appearance: including environmental features (e.g. flora, fauna, habitats and ecosystems), land use types (e.g. crop types and systems cultivation), and man-made objects or cultural features (e.g. hedges, farm buildings); (ii) *landscape functions*: such as place to live, work, visit, and provide various environmental services; and (iii) *landscape values*: concerning the costs to farmers of maintaining landscapes and the value society places on agricultural landscape, such as recreational and cultural values. The value of the landscape is determined by different components, such as: *biological diversity* (e.g. genetic species and ecosystem diversity, agrobiodiversity,); *cultural and historical components* (e.g. management of the natural landscape, buildings, traditions, handicrafts, stories and music), *amenity value of the landscape* (aesthetic value,); *recreation and access* (e.g. outdoor recreation, skiing, biking, camping) and *scientific and education interests* (e.g. archaeology, history, geography to plant and animal ecology, economy and architecture) (Romstad et al, 2000; Vanslembrouck and van Huylenbroeck 2005).

In the last few decades there has been a great deal of research attempting to value (to place a price on) agricultural landscape (e.g. Drake, 1992; Garrod and Willis, 1995; Hanley and Ruffell, 1993; Pruckner, 1995; Campbell, Hutchinson and Scarpa 2005; Johns et al. 2008). Because landscape is a non-traded good its value cannot be observed and thus it is not available from traditional statistical sources. The literature therefore most often applies *stated preference* (SP) approach by using survey based method to uncover consumers' *willingness to pay* (WTP) for landscape. The vast majority of these studies find that society positively values agricultural landscape. However, an important shortcoming of these studies is that nearly all studies on landscape valuations are concerned with valuing specific landscape at particular location. There are few studies aiming to aggregate the results for EU Member States or for the EU as a whole.

The objective of this study is to estimate the value of EU agricultural landscape. The valuation of EU agricultural landscape is relevant at least for two reasons: (i) it provides information on the societal value generated by the agricultural landscape and (ii) from policy making perspective, it can identify the proportionality of resources allocated on conserving rural nature and landscape relative to benefits generated by it.

We apply meta-approach by estimating a benefit transfer function based on exiting studies on landscape valuation. More precisely, we review the literature estimating WTP for agricultural landscape. The final database in this paper contains 33 studies providing 96 WTP estimates. The database covers studies from 11 European and 3 non-European countries for the period 1982 to 2008. This paper is one of the first attempts to apply meta-analysis to non-market valuation of agricultural landscape particularly in the European context. Several meta-analyses of non-market valuation studies have been conducted in the literature such as for recreational value of natural resources (e.g. Kaoru 1990; Shrestha and Loomis 2001; Rosenberger, Loomis and Shrestha 1999), forest ecosystems services (e.g. Barrio and Loureiro 2010); urban open space (Brander and Koetse 2007); cultural goods (Noonan 2003); wetland ecosystem services (Brander, Florax and Vermaat 2006); air quality (Smith and Huang 1995); and for testing methodological approach and valuation theories (Murphy, et al. 2003; Schlapfer 2006; Meyerhoff, and Liebe 2010).

The estimated benefit transfer function is used to calculate the value of EU landscape. We calculate landscape by land type (grassland/permanent crops and arable land), by MS and for whole EU for the period 1991-2009. Our calculations indicate that the value of EU landscape in 2009 is around €25.8 billion representing around 7.5 percent of total agricultural output. This figure is comparable with the EU support level, representing roughly half of the €49.2 billion CAP payments allocated to farming sector in 2009.

Valuation of agricultural landscape

Economic valuation involves placing monetary value (price) on the agricultural landscape. According to the neo-classical economics framework, the price of a good reflects the willingness to pay of consumer for the last increment of that good. In this context, the value (price) of landscape is determined by the marginal (monetary) contribution of an additional unit that it generates to consumers. Theoretically appropriate measures to calculate economic value of landscape are *compensating variation* and *equivalent variation* (Bergstrom 1990; Vanslembrouck and van Huylenbroeck 2005).

Following Bergstrom (1990) and Vanslembrouck and van Huylenbroeck (2005), assume consumer derives utility $U(M,G)$ from composite goods *M* and landscape *G*. Further assume that price of composite good is one and is held constant but the quantity of landscape is changed exogenously by one unit implying $U^0(M,G)$ and $U^1(M,G+1)$ which represent utility levels before and after the increase in the quantity of landscape, respectively. The value of landscape *G* can be measured using indirect money measure for consumers' utility change, i.e. the *compensating variation* (ΔM^C) and *equivalent variation* (ΔM^E) of income defined as, respectively:

(1) $U^0(M-\Delta M^C;G+1)=U^0(M;G)$

(2) $U^1(M-\Delta M^E;G+1)=U^1(M;G)$

Rearranging the expressions (1) and (2), the monetary equivalent of the landscape value can be expressed as:

(3) $\Delta M^C = M(U^0,G+1)-M(U^0,G)$

(4) $\Delta M^{E} = M(U^{1}, G+1) - M(U^{1}, G)$

The price of landscape measured in terms of *compensating variation, ΔM^C*, (*equivalent variation, ΔM^E*) is equal to the amount of additional money the consumer would need to give up (to be compensated) in order to reach its utility before (after) the increase in the quantity of landscape.

This is illustrated in Figure 1. The vertical axis shows the quantity of composite good *M* and the horizontal axis shows the quantity of landscape *G*. The initial bundle of the two goods (M^*, G^*) is given along the indifference curve I_0 at point *A*. An exogenous increase in the supply of landscape (by one unit) implies higher utility to consumer causing an upward shift in the indifference curve to I_1. This shift implies a move from the initial bundle of composite good and landscape at point *A* to a new bundle at point *B*. The *compensating variation* of the landscape is equal to the amount of additional money, ΔM^C, the consumer would need to give up in order to come back to the initial indifference curve (to move from *B* to *C*), i.e. to move from I_1 to I_0. In other words, ΔM^C represents the consumer's willingness to pay (WTP) for the increase in landscape from G^* to G^*+1 (i.e. to secure new level of public good G^*+1 keeping consumer at original utility U^0).

The *equivalent variation* of landscape is equal to the amount of additional money, ΔM^E, the consumer would need to be compensated in order to reach to the indifference curve I_1 (to move from *A* point *D*), i.e. to move from I_0 to I_1. In order words, ΔM^E represents the consumer's willingness to accept (WTA) compensation to forego the increase in landscape from G^* to G^*+1 (i.e. to reach new level of utility U^1 while reaming at original level of public good G^*).[3]

This approach is the most widely used in empirical studies to value agricultural public goods including landscape.

Estimation methodologies

The absence of a market for landscape implies that there is no immediately observable price. The objective for economic valuation in this context is to provide the relevant *willingness to pay* (WTP)[4] for landscape. Two general techniques are applied: *revealed preference* and *stated preference* (SP). The *revealed preference* approach relies on measuring actual behaviour of individuals with respect to the valued good by observing expenditure incurred on landscape related activities. This approach can be used to uncover only the use value[5] of

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[3] Note that *compensating variation* and *equivalent variation* will be equal if landscape and the composite good are perfect substitutes. If they are imperfect substitutes their values will differ and the divergence will expand with the degree of substitution decrease or with income elasticity. Shogren (1994) showed that if the imperfect substitutability or positive income elasticity of public goods hold, the WTA will exceed the WTP.

[4] Throughout this paper, all the arguments made for WTP are also valid for willingness to accept compensation (WTA).

[5] According to the Secretariat of the Convention on Biological Diversity the total economic value of agricultural landscape can consist of *use value* (direct, indirect and option value[5]) and *non-use value* (SCBD 2001, 2007). *Direct use value* is the value derived from direct use or interaction with landscape (e.g. recreation, scenery). This is linked to activities such as leisure, tourist visits, residence or other activities associated with a landscape which results in direct benefits occurring to individuals undertaking these activities. *Indirect use value* relates to the indirect benefit streaming from the landscape. For example, an attractive agricultural landscape may attract tourist to the region thus generating indirect benefits to owners of the tourist resort located in the vicinity of the

the good because the revealed expenditure behaviour in general represents the individuals' costs of using (consuming) a particular good. Most prominent examples of this approach include hedonic price approach and travel cost methods (e.g. Zander et al., 2005; Smith and Kaoru 1990).

More appropriate approach to value landscape is the SP technique. The underling principle of the SP is based on creating a hypothetical market situation for landscape. More precisely, individuals are asked to elicit their WTP for landscape (usually using survey technique) in that hypothetical market situation. The advantage of SP is that it can uncover both *use* and *non-use values* of landscape. Non-use values tend to be important in certain contexts, including for agricultural landscape. SP techniques are therefore capable of being more comprehensive than revealed preference techniques (Swanwick, Hanley and Termansen 2007).

The SP techniques applied in the empirical literature are of two types: Contingent Valuation Method (CVM) and Choice Experiments (CE). The CVM seems to be most widely used for estimating demand for agricultural public goods (e.g. Drake, 1992; Garrod and Willis, 1995; Hanley and Ruffell, 1993; Pruckner, 1995; Willis and Garrod, 1992 and 1994; Zander et al., 2005; Bergstrom et al., 1985; Dillman and Bergstrom, 1991; Kline andWichelns, 1996; Hoehn and Loomis, 1993; Mitchell and Carson, 1989). However, more recent valuation studies tend to use the CE (e.g. Hanley et al. 1998; Campbell, Hutchinson and Scarpa 2005; Johns et al. 2008; O'Leary et al. 2004; Moran et al. 2007; Arriaza et al. 2008). The key difference between the two SP approaches is that, the CVM values a particular public good and tends to provide information on preferences for the whole good rather than for a specific aspect/feature of it. On the contrary the CE breaks down the public good in attributes and evaluates preferences over attributes[6] (Garrod and Willis 1999; Swanwick, Hanley and Termansen 2007).

In this paper we consider only studies which use the SP technique for landscape valuation due to above mentioned reasons. Other reason for using only the SP based studies is that they provide theoretically appropriate Hicksian measure of valuing landscape as compared to, for example, hedonic and travel cost approaches which provide less exact Marshallian measure of landscape valuation (Smith and Pattanayak 2002).[7]

Findings form empirical literature

The landscape valuation studies are summarised in Table 1. In general studies find that individuals' WTP is positive implying that the landscape generates benefit to society. However, the WTP varies strongly depending on landscape type, methodology, type of survey, type of respondents surveyed, etc.

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landscape. *Option value* is a type of use value in that it relates to future use of the landscape (option value is also sometimes classified as a non-use value). Option value arises because individuals may value the option to be able to use the landscape sometime in the future. *Non-use value* is derived from the ongoing existence of landscape (existence value), or from conservation for future generations (bequest value). Non-use value does not result in a direct or indirect benefit to consumers of landscapes but may be based on, for example, religious, spiritual, ethical motives or other intrinsic reasons.

[6] Note that the sum of attributes' values could exceed or could be smaller than the value of the whole good.

[7] The difference between the Hicksian and Marshallian welfare measures is that the former is constructed by keeping constant a given utility level whereas the latter keeps constant a given income level. Both valuation measures are equal if the income effect is inexistent or very small.

Drake (1992) used the CV method to assess values ascribed to Swedish agricultural landscape by asking respondents their WTP, via income tax, for preventing half of all agricultural land from being abandoned and cultivated with spruce forest. Based on a sample size of 1089 respondents from all Sweden, a mean WTP of SEK 468 (68 ECU) per person per year was estimated. They found that average WTP varied by region but the variation was not significant. Regions dominated by agriculture showed higher levels of WTP for landscape. Stronger variation was found for landscape types. Respondents had higher WTP for grazing land, by 91%, and for wooded pasture, by 141%, relative to land cultivated with grains.

Alvarez-Farizo et al. (1999) find that the WTP for environmental improvement of landscape declined with decreasing familiarity with the site in two regions in Scotland: bids were highest for residents or visitors, and lowest for those who had no prior information about the study site. Significant non-use values were found, in that those neither living in nor visiting the sites had positive WTP amounts which were significantly different from zero at the 95% confidence level. Further, residents had a higher WTP than non-residents, although the difference was not statistically significant.

Garrod and Willis (1995) also estimate the use and non-use WTP to maintain the current ESA landscape in England. The estimated WTP to general public who has not visited an ESA region and who likely derive non-use value from landscape[8] was 21 £ per household and year. On the other hand, respondents who visited the ESA regions and who may have both use and non-use value from landscape (i.e. respondents) show higher WTP, between 30 and 45 £.

Marangon and Visintin (2007) value landscape in a wine-producing areas located in the Italian/Slovenian border region. They found that there was a considerable difference in the way Italians and Slovenes valued the rural landscape. While Italians considered the development and extension of vineyards to be very important in counteracting the abandonment of rural areas, Slovenian respondents preferred more diverse landscape (composed of crops and plantations dominated by small farm which create a landscape with high biodiversity) to vineyard dominated one. This difference in preferences for landscape could be due to the political and historical past of the countries. The past regimes of the former Yugoslavia imposed policies oriented towards intensification and industrialisation of agriculture leading to destruction of historical and cultural landscapes which may have reduced the supply of these landscape features to society.

Arriaza *et al*. (2008) value several attributes of multifunctional mountain olive growing in Andalusia in Spain (i.e. landscape and biodiversity, prevention of soil erosion, food safety and farm abandonment). They find that women value more than men the multifunctionality of these agricultural systems. Likewise, young people, large families, people living in large cities and/or brought up in rural areas are more in favour of the provision of these public goods. Conversely, income level was not statistically significant in determining landscape value.

Willis and Garrod (1992) value agricultural landscape in Dales National Park in UK. In their survey they ask respondents (visitors and residents) to rank most preferred landscapes from eight alternatives. Their results reveal that the overwhelming preference of both visitors and residents was for today's landscape (for 50% of respondents). The conserved landscape, which is very similar to today's landscape, was also a popular first choice (for 30% of respondents). The other landscape types (i.e. semi-intensive and intensive agriculture landscapes,

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[8] Actually these respondents may have option use value (e.g. from potential future visit) from landscape.

abandoned agricultural landscape, sporting landscape, wild landscape and planned agricultural landscape) were rarely ranked as the most preferred ones.

Loureiro and López (2000) investigated the preferences of tourists for the local cultural landscape in the Ribeira Sacra region of Galicia (Spain). 173 tourists were interviewed and asked to choose between two alternative types of cultural landscape, with a number of attributes such as: preservation of traditional customs, food products, and rural settlements; protection of the local environment; protection of the traditional agro-forestry landscape; and preservation of the historical-cultural heritage. The WTP for each attribute (€ per day) was estimated as follows: History: 22.39, Tradition: 7.45, Environment: 32.47 and Agri-forestry landscape: 24.44. The study concludes that visitors value the attributes they experience (for example the wildlife, the landscape and historical sites) more than local traditional products (for example local wines and foods).

Non-European studies reveal similar patterns of landscape valuation by society as the European studies (e.g. Bergstrom, Dillman and Stoll 1985; Bowker and Didychuk 1994; Walsh 1997; Kashian and Skidmore 2002; Ozdemir 2003). Changa and Ying (2005) value rice fields for their water preservation and landscape protection functions in Taiwan. Their results show that an average household in Taiwan is willing to pay $1777.92 NT (about US $50.80) to maintain paddy rice fields which is equivalent to 3.57 times of the market value of rice production in Taiwan.

Moon and Griffith (2010) measure the willingness to pay to compensate farmers for the supply of various public goods associated with US agriculture. The estimated mean WTP was $515 per person annually.[9] The aggregation of individual WTPs across the U.S. taxpayers above 20 years old amounts to $105 billion of agricultural public goods value in 2007 which is about one-third of the value of total farm production ($300 billion). Further, Moon and Griffith (2010) find that respondents not favourable to government involvement in agricultural markets are predisposed to be less willing to pay for the agricultural public goods. In contrast, respondents who are in support of the idea of farmland conservation programs are more willing to pay taxes to ensure that agricultural sector continues supplying the public goods.

Methodology

We apply Benefit Transfer (BT) approach to estimate the value of EU landscape. The BT methodology is based on the idea of using existing valuation studies, that are referred to specific study areas, and it transfers valuation information from these studies to build the benefit estimate for other study areas, i.e. to study areas within other MS and/or the whole EU in our case. Its main advantage is that it can be used to valuate landscape for cases when there is no opportunity to conduct a primary study due to time or resource constraints. According to Lima e Santos (2001, p. 32) there are several ways to carry out benefit transfers such as: (1)

[9] Note that this estimated WTP is for multiple agricultural public goods (for multifunctional agriculture) where landscape is one component of it. Further note that the estimated WTP represents willingness to pay for continuing to support agricultural public goods that offset the negative environmental effects of farming. (maybe it is worthwhile to insert the concepts discussed in this note in the text. Maybe the right place is p. 3, where WTP is for the first time introduced. Also the text could benefit with a slightly more developed explanation of the: concept of "offset the negative environmental effects of farming"

transfer of an unadjusted WTP value, i.e. use of a WTP estimate exactly as it is in the original study; (2) transfer of an adjusted value, e.g. using a GNP ratio between the original study's and the new study; or (3) transfer of a WTP function, estimated from original studies and applied for new region using the same functional form but using the specific values of independent variables from the new region.

Application of the Benefit Transfer

In this paper we apply the third approach by using meta-approach to estimate the benefit transfer function. Through the meta-approach we combine the results of several studies which estimate WTP for agricultural landscape. The main aim is to estimate the benefit transfer function for WTP from these existing valuation studies. We regress the mean WTP collected from the available studies over a number of independent variable. The estimated transfer function allows us to obtain the valuation of landscape specific to EU regions and landscape type. The estimated transfer function is then used to calculate the value of landscape for the whole EU.

The meta-analysis as a benefit transfer tool provides several advantages over simple point estimate, or average value transfer. First, it utilizes information from a greater number of studies providing more rigorous measures of landscape value. Second, methodological and other differences between studies can be controlled for when econometrically estimating the transfer function by including variables describing study characteristics in the regression. Third, by varying the independent variables at the levels specific to the evaluated region/landscape, the values obtained are region/landscape specific.

While meta-analysis is a conceptually sound approach to BT, the quality of original studies and the quality of reported results in original studies is critical factor determining the quality of the meta-analysis. For example, Schlapfer, Roschewitz and Hanley (2007) compare the difference in WTP for landscape protection in Switzerland calculated from contingent valuation survey and the WTP obtained from actual referendum voting behaviour. Their results indicate that hypothetical WTP magnitudes obtained from the contingent valuation survey may overestimate the actual WTP expressed through the actual referendum voting choices. This could be due to the hypothetical bias embodied in the CVM approach where respondents' WTP expression of preferences over hypothetical situation with no budgetary implications potentially leads to biased answers and strategic responses (e.g. to socially acceptable response such as positive response to valuation question - yea-saying behaviour - although they may not willing to pay the amount that is asked). This may indicate that our results will overestimate the value of landscape if the original studies indeed suffer from a similar bias. The ability of meta-model to capture value differentiation between different regions, income groups, and/or other relevant variables depends not only on the quality of the original studies, but also on the availability of studies. One main limitation of the meta-analysis is the lack of an adequate number of studies for certain regions and landscape types. Availability of more studies may result in a more robust results leading to a more accurate estimation of the benefit transfer function. In our sample of European landscape valuation studies, the UK and Irish regions tend to be overrepresented whereas Western, Central and Eastern European continental regions tend to be underrepresented[10].

[10] For example, for Eastern European countries only studies from the Czech Republic and Slovenia are available.

Several meta-analyses of non-market valuation studies have been conducted in the literature (e.g. Kaoru 1990; Smith and Huang 1995; Loomis and Shrestha 1999; Shrestha and Loomis 2001; Brander, Florax and Vermaat 2006; Rosenberger, Brander and Koetse 2007; Barrio and Loureiro 2010). In a pioneer paper, Smith and Kaoru (1990) reviewed the literature of travel cost recreation studies carried out between 1970 and 1986 in the USA. Lima e Santos (2001) tested performance of various transfer benefits approaches (e.g. unadjusted value, adjusted value, multiple-study averages, meta-model) for agricultural landscape and showed that meta-analysis performed rather well in predicting original estimates. Similarly, Shrestha and Loomis (2001) test the meta-analysis for international benefit transfer of the valuation of the outdoor recreational resources. They estimated benefit transfer function from the US data and apply the estimated function to test prediction accuracy of recreation activity values in other countries. The average percentage error of the meta-predictions was 28%.

The key data used in this paper come from 33 existing studies on landscape valuation (Table 1). We consider only studies which use stated preference approach in estimating the WTP for landscape. After cleaning for outliers the final data set contains 96 (74 European and 22 non-European) WTP observations[11] Multiple observations are extracted from several studies because they report alternative results due to the use of split survey samples targeting different respondents, landscape types and/or testing different survey designs. The database covers studies from 1982 to 2008. The WTP values from all studies were adjusted for inflation from their original study year (not publication year) values to 2009 price level and where necessary they were converted to euro.

Model Specification

The dependent variable in our meta-regression equation is a vector of WTP values. Following other studies performing meta-regression (e.g. Brander, Florax and Vermaat 2006; Barrio and Loureiro 2010; Meyerhoff and Liebe 2010), the explanatory variables are grouped into three different categories including the study's characteristics, X_s, the landscape characteristics, X_l, and the site and socio-economic characteristics, X_s. The estimation model corresponds with the following equation:

$$WTP_i = \beta_0 + \beta_s X_{si} + \beta_l X_{li} + \beta_e X_{ei} + \varepsilon_i$$

where, β_0, β_s, β_l and β_e are regression coefficients, ε_i is independently and identically distributed (i.i.d.) error term and subscript *i* stands for study index.

The description of variables is provided in Table 2. The dummy variable *household* controls for whether the WTP is measured per person (=0) or per household (=1) (Barrio and Loureiro 2010). We reviewed only studies which report WTP values per person/year or per

[11] By way of comparison Brander and Koetse (2007) use 73 observations from 20 studies for valuating urban open space; Murphy, et al. (2003) use 83 observations from 28 studies for testing hypothetical bias in contingent valuation studies; Schlapfer (2006) uses 83 observations from 64 studies for a meta-analysis of estimating the income effect of environment-related public goods; Smith and Huang (1995) use 86 observations from 50 studies for meta-analysis of air quality valuation; Barrio and Loureiro (2010) use 101 observations from 35 studies for meta-analysis of forest ecosystems services; Noonan (2003) use uses 129 observations from 65 studies for a meta-analysis of valuation of cultural goods; Meyerhoff, and Liebe (2010) use 254 observations from 157 studies for analyzing the determinants of protest responses in environmental valuation studies; Shrestha and Loomis (2001) use 682 observations from 131 studies and Rosenberger, Loomis and Shrestha (1999) use 741 observations from 163 studies for meta-analysis of recreational value of natural resources.

household/year. Studies reporting WTP in other units (e.g. per visit/day) were excluded because insufficient data were available to convert the original values into per person or household values. The variable *sample* represents the number of respondents included in the survey.

According to the neo-classical economics framework, the price of a good reflects the willingness to pay for the additional quantity/quality of the good, i.e for small change in landscape in our case. We have attempted to measure the magnitude of the landscape change valued in the studies included in this paper by introducing a dummy variable *scenario_large_change*. The variable takes value 1 if the valued landscape quantity/quality change is large. A large change in landscape has been considered in cases when the study valued a scenario where for example a lot of action was envisaged on landscape improvement/ change or when production abandonment scenario was assumed. A small change in landscape was considered (i.e. *scenario_large_change* = 0) when the study valued a scenario with some action on landscape improvement/change, parcel consolidation, preservation of landscape, or intensification/extensification farm activities.

With dummy variable *general_public* we control for the type of respondents surveyed because the use and the non-use value of landscape may differ between the respondents. For example, visitors and residents may derive higher use value from the landscape and hence their WTP may exceed the value of an average consumer (i.e. *general_public*=1) who should have a lower use value from landscape because it includes both users (e.g. visitors) and non-users (e.g. non-visitors) of landscape (Garrod and Willis 1995).

Following other meta-studies we introduce variables *ce* and *closed_ended* to take into account the methodological variation between studies (Schlapfer 2006; Meyerhoff, and Liebe 2010). The dummy variable *closed_ended* takes value 1 if closed-ended question formats for valuation questions was used, and zero otherwise, i.e. if open-ended question format was used. Kealy and Turner (1993) examined the differences between open- and closed-ended question formats for valuation questions and found that these two ways of asking the valuation question lead to significantly different WTP for public goods (Kealy, Turner 1993, p. 327). The closed-ended WTP values were found to be always higher than the open-ended answers, irrespective of the specification of WTP-functions (see also Bateman et al. 1995). We also differentiate between the Choice Experiments technique (*ce*=1) and other type of elicitation techniques (e.g. CVM).

The dummy variable *facetoface* takes value 1 if surveys are conducted face to face interviews and zero otherwise. According to guidelines of the National Oceanic and Atmospheric Administration (NOAA) on the use of CV in natural resource damage assessments, face-to-face interviewing is likely to yield the most reliable results (Arrow et al., 1993). Other covariates describing study characteristics include year of survey variable (*year_survey*) and variable counting for the number of studies valuing landscape in a given region (*weight_region*).

We include several dummy variables on landscape characteristics in the regression in an attempt to more accurately reflect the heterogeneity in the landscape types valued in the studies.

An important methodological problem present when estimating the benefit transfer function is related to the additivity problem of individuals' utility functions. For a utility function to be additive the goods should be mutually utility independent (i.e. the attribute/good *i* is utility independent of the attribute/good *j* if preferences over *i* does not depend on the levels of *j*) (Fishburn, 1982; Keeney and Raiffa, 1993). In other words, the sum of partial utilities for each attribute of landscape is equal to the total utility of the complex good.[12] This can be extended also for the whole consumption basket of individuals: i.e. the sum of partial utilities for all goods included in the basket is equal to the total utility of the basket. However, the value of landscape usually depends not only on own quantity but also on quantity of other agricultural public goods (e.g. food security) as well as on private goods (e.g. car). In general, the willingness to pay for landscape decreases with its provision thus valuation varies considerably with total quantity supplied. Additionally, market prices and quantities of other goods cause substitution or complementarily effects.[13] Most landscape valuation studies do not take into account substitution and complementarily relationships (Lima e Santos 2001). The quantities and underlying economic situation of evaluation case studies vary strongly by study. These variations (level of landscape, substitution and complementarily) causes problem to benefit transfer and for aggregation of landscape valuations over regions. For example, if valuation of landscape is estimated in region 1, where there are available also other agricultural public goods, then the transfer of this estimate for valuating the landscape (of the same quantity) in region 2, where there is zero supply of other agricultural public goods, will lead to undervaluation (overvaluation) of region 2 landscape if landscape and other public goods are substitutes (complements). Most valuation methods are prone to this bias usually leading to overstatement of the value of landscape (Lima e Santos 2001). Hoehn and Randall (1989), who used a single-household general-equilibrium model, have showed that substitution and complementarity do not cancel out in the presence of large number of public goods. As the number of outputs becomes large, the valuation of public goods leads to overvaluation, i.e. the substitution effect tends to prevail in large-number cases. Additionally, several evaluation studies who jointly value several multiple public goods suggest that substitutes are more frequent than complements (Lima e Santos 2001).

One way of addressing the additivity problem is by using a valuation approach which jointly valuates landscape as whole thus automatically taking into account substitution/complementarity effects. We attempt to control this problem by distinguishing whether the study values landscape as whole or a specific landscape feature (*feature_specific*).[14] Additionally, we include variable *multifunctionality* to account for the cases when landscape was incorporated in a valuation of a basket of multiple agricultural public goods. The aim was to take into account the possible existence of substitution/complementarity effects of landscape with other agricultural public goods (Table 2). However, it must be noted that in the framework of the present study we are not able to address completely the additivity problem related to the substitution/complementarity effects between landscape and private goods (i.e. for the whole consumption basket) . Therefore the results of this paper should be interpreted in light of this shortcoming.

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[12] Some recent studies support the idea that the additive form can be regarded as a reliable proxy of real utility functions for the valuation of environmental goods (Adamowicz et al., 1998; Hanley et al., 1998; Colombo et al., 2006; Jin et al., 2006 or Mogas et al., 2006).

[13] Two public goods *A* and *B* are substitutes (complements) when the marginal value of *A* is reduced (increased) by an increase (decrease) in the level of *B*.

[14] Note that the variable *feature_specific* might be correlated with dummy variable *ce* which takes value 1 if choice experiment is used by the study and zero otherwise (i.e. for CVM).

In order to measure the heterogeneity of landscape valued in the studies, we include several landscape specific variables in the regression. We consider landscape features such as mountainous land (*feature_mountain*), low land (*feature_lowland*), grassland and permanent crops (*feature_grassland_permanent*), protected area (*protected_area*) and the size of area valued (*small_area*). The variable *protected_area* reflects the possibility of higher value derived from landscape located in special areas such as in national parks, Nature 2000, LFA, or in other protected regions (Table 2).

Finally, the site and socio-economic variables, include the income level as measured by the gross domestic product per capita at the time of the survey (*gdp_capita*) and the geographical location of the valued landscape (*region_noneurope*). Another relevant variable is the utilised agricultural area (UAA) per person which may proxy for the landscape abundance (*uaa_person*).

The data sources for WTP values, variables on study characteristics and landscape characteristics are the exiting valuation studies reported in Table 1. Inflation and exchange rates used to convert the WTP to the 2009 price level and to euro, respectively, are extracted form the Eurostat and the OECD. The data on GDP per capita are extracted from the Eurostat and supplemented from the UN National Accounts Main Aggregates Database. Data on utilised agricultural area per person are calculated based on the data collected from the Eurostat, the FAO and the UN National Accounts Main Aggregates Database. Note that variables *gdp_capita* and *uaa_person* do not represent the actual values of respondents of the study surveys because in most cases they are not reported. Instead we use average values corresponding to the country in which the study was conducted.

The descriptive statistics of model variables are reported in Table 3. The average WTP for the whole samples and the European sample are 90 and 78 €/year, respectively. The simple average indicates that the difference between the WTP/household and the WTP/person is not significant. The average WTP/household is 96 €/year whereas the average WTP/person is 81 €/year. Studies estimating WTP/household are 60 percent of total, whereas the rest of studies estimate WTP/person (40 percent). Average sample size is 391 respondents. For the descriptive statistics of the rest of variables included in the regression see Table 3.

Empirical Results

We estimate an ordinary least squares (OLS) regression model with the Huber-White adjusted standard errors clustered by each study. Similar approach has been used in several meta-regressions (e.g. Brander, Florax and Vermaat 2006; Lindhjem, 2007; Barrio and Loureiro 2010; Meyerhoff and Liebe 2010). This approach allows correcting for correlation of errors within the observations of each study (Barrio and Loureiro 2010). The presence of multicollinearity was tested and judged not to be a serious problem in our dataset.[15] However, we estimate several regression models to account for potential multicollinearity among some of the variables.

The meta-regression results are reported in Table 4. Consistent with other similar studies, we estimate a semi-log model: the dependent variable and continuous independent variables

[15] The correlation coefficients are significantly smaller than 0.8 or 0.9 suggested by Gujarati (2003) and Kennedy (2003) to be indicative for the presence of multicollinearity if the coefficients exceed these values.

(*gdp_capita_r*, *uaa_person*, *sample*) are log-transformed (e.g. Brander, Florax and Vermaat 2006; Meyerhoff and Liebe 2010; Barrio and Loureiro 2010). We estimate two sets of models; for the full sample (models 1-7) and for the European sub-sample (models 8-14). The full sample includes both European and non-European studies, whereas the European sub-sample includes only studies valuating European landscape.

Overall estimated coefficients are fairly consistent in terms of sign and magnitude across all models except for some coefficients which are statistically not significant (e.g. *feature_mountain, feature_lowland, log_uaa_person, region_noneurope*). Roughly more than half of the variables are statistically significant in determining the WTP value and the models explain approximately 50 to 60 percent of the WTP variation. For the most part, the signs of the variables in the model presented in Table 4 are consistent with theoretical expectations and past research results as discussed above.

Although the variable *household* is statistically not significant, the results imply that when the WTP is measured per household its value tends to be higher than if measured per person. Similar holds for the variable *scenario_large_change* indicating that larger change in the quantity/quality of the valued landscape leads to higher WTP. The corresponding coefficient is significant for both the full sample and the European sub-sample. As expected, the *closed_ended* question formats leads to statistically significant higher valuation of landscape. Also studies implementing face-to-face interviews generate higher WTP, whereas studies applying choice experiment elicitation approach (*ce*) lead to lower values of WTP. Because studies using choice experiment approach tend to use closed ended question format, we have excluded the variable *closed_ended* in model 5 (full sample) and model 12 (European sub-sample) to test the robustness of the results. The *general_public* has an unexpected positive and statistically statistically sign for most estimated models. This could be due to the fact that direct users (such as residents and visitors) may be better able to separate benefits between the landscape they directly gain from and other landscapes. Thus they may elicit their true WTP for the specific landscape covered by the studies. On the other hand, general public may find it problematic to disentangle benefits from a specific landscape from their valuation of all country landscapes and thus may instead overstate the WTP by providing overall WTP for the whole country landscape not only for the one covered by the studies.[16] This behaviour may generate higher WTP for general public than for the direct users. However, there may be other reasons which may explain the unexpected sign of the variable *general_public* such as the identification problem of the use- and non-use value in the considered studies.

From the set of variables describing landscape characteristics only *feature_grass_permanent* and *multifunctionality* are statistically significant. The former variable is significant for both samples, the latter one only for the full sample. This indicates that landscape covered with grass and permanent crops is valued higher than the average landscape or other type of landscapes.[17] Studies which value landscape jointly with other agricultural public goods also

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[16] In a similar line of argument, Bergstrom, Dillman and Stoll (1985) find that informational structure of the contingent market affects valuation of landscape by US respondents. Respondents who did not receive information on the specific benefits of landscape protection against urban and industrial development have WTP higher approximately by $5.29 than those who did receive this benefit information. Their results indicate that without benefit information, respondents are unable to separate amenity value from other benefits such as food supply, local economic benefits, and/or economic development.

[17] Note that the baseline landscape for *feature_grass_permanent* is average landscape and arable land. Due to insufficient observations we are not able to identify the difference in the WTP for the arable land.

find higher WTP, i.e. the coefficient associated with the variable *multifunctionality* is positive. Further, studies which value landscape in small and/or specific regions/areas (*small_area*) imply lower WTP as compared to studies valuing landscape of large regions/areas. However, its coefficient is statistically not significant for majority models. This variable may be correlated with the variable *feature_mountain* because often valuated small and/or specific study regions tend to be located in mountain areas (e.g. Willis and Garrod 1992; Alvarez-Farizo et al. 1999; Tempesta and Thiene 2004; Marangon and Visintin 2007). In models 3 and 10 we test the robustness of the results in this respect by excluding variables *feature_mountain* and *feature_lowland* from the regression.

The coefficient of the GDP per capita variable (*log_gdp_capita*) is positive and highly significant – suggesting an elastic effect of income on the value of landscape. The variable proxying for the abundance of landscape (*log_uaa_person*) and the regional variable *region_noneurope* are statistically not significant.

Valuation of EU landscape

In this section we calculate the value of EU landscape based on the estimated benefit transfer function in the previous section. We use the 14 benefit functions as estimated in Table 4. We consider all 14 models to test for the sensitivity of the results with respect to the estimated parameters. We calculate the landscape value by land type and by EU Member State (MS) and then we sum over all land types and over all MS to obtain the value for the whole EU.

The independent variables included in the benefit transfer function are set to values as reported in Table 5. The independent variable *household* is set to zero because we attempt to obtain the WTP per person from the benefit transfer functions. The values of variables *gdp_capita* and *uaa_person* vary by MS. Following the guidelines of NOAA, we set the value of the dummy variable *closed_ended* to zero so that the WTP reflects the value of open-ended question format.

The objective of the paper is to estimate both the use and non-use value of agricultural landscape. For this reason we consider the WTA of general public (we set the variable *general_public* to 1) which is composed of resident/non-resident and visitors/non-visitors and it likely captures both values. We treat all beneficiaries in a given region equally by assuming that all have the same WTP. For an accurate measure of WTA one would need to control for the distribution of population types because the use and non-use values varies strongly between different types of consumers. The WTA depends on whether consumers are resident or non-resident and whether they are visitors or non-visitors with respect to the valuated agricultural landscape. One proxy to control for these effects is to take into account the distance of consumers from the landscape. The WTP may decrease with the distance (distance-decay effect) as residents located in the proximity of agricultural landscape may have both use and non-use value, whereas non-residents may derive mainly non-use value from the landscape.[18] We do not have sufficient evidence to control for these effects which may bias our result. However, the bias may be low if the original studies used for the

[18] For example, Bateman and Langford (1997) find that the WTP for preservation of wetland low lying area (which is mostly an ESA) against saline flooding in the Norfolk Broads (UK) declined from a mean value of £39/household/year at a distance of 20 km, to £13.90 at a distance of 110-150 km away from the Broads area.

estimation of the transfer function are based on a well designed representative surveys which may result in an accurate general public valuation of agricultural landscape.

We set variables *feature_mountain* and *feature_lowland* to zero as we cannot distinguish between mountain and low land in our dataset (Table 5). We consider two land types: grassland/permanent crops and arable land. As a result, the value of the land type dummy variable *feature_grassland_permanent* varies depending on the type of land valued. For grassland/permanent crops we set *feature_grass_permanent* equal to one, whereas for arable land we set *feature_grass_permanent* to zero. Note that due to insufficient observations on the WTP for arable land landscape, we were not able to identify the difference in its WTP with respect to an average landscape. For this reason, we set the WTP of arable land equal to the WTP of an average landscape (i.e. we set the variable *feature_grass_permanent* = 0). This may lead to a slight overestimation of landscape value derived from arable land because the WTP of an average landscape may be composed of both grassland and arable land. For the values of the rest of the variables used in BT see Table 5.

From transfer benefit function we obtain an estimate of WTP per person/year which varies by land type (grassland/permanent crops and arable land), and MS (because of variation in the GDP per capita, UAA per person and the land use structure). To obtain the WTP per hectare/year, we multiply the estimated WTP per person/year by the population density (persons between 15 and 74 years old per hectare of agricultural land).[19] Then the landscape value for MS is obtained by multiplying WTP/ha with total number of hectares distinguished by land type. The EU landscape value is the sum over 27 MS WTP estimates.

Using the estimated benefit transfer functions from Table 4, we obtain 14 WTP values. Table 6 and Table 7 report the minimum, maximum and mean WTP values by MS, weighted average value for the whole EU and for three years (1991, 2000 and 2009). Table 6 show the per hectare WTP for grassland and permanent crops and arable land. Table 7 presents the per hectare WTP for UAA (i.e. the average for all land) and the total WTP value in million euro. The hectare WTP values vary strongly between MS. As explained above, the variation is determined by land use structure, population density and GDP per capita. Consistent with the estimated BT function, the WTP for grassland and permanent crops show higher value than the arable land WTP (Table 6). The WTP for UAA is in between these two values as it is a weighted average of the WTP of grassland and permanent crops and the WTP of arable land (Table 7).

As reported in Table 6 and Table 7, the estimated mean WTP per hectare for EU in 2009 is 189, 113 and 142 €/ha for grassland/permanent crops, arable land and UAA, respectively. Their minimum and maximum values vary between -45 percent below and 20 percent above the mean value, respectively. The WTP values are positively correlated with GDP per capita. Highest WTP for agricultural landscape is observed in richer Old MS, whereas poorer Eastern New MS show much lower WTP levels for the period 1991-2009. MS with high population density (such as Belgium, Luxemburg, the Netherlands and Malta) report significantly higher WTP per hectare than other more land abundant countries.

According to the results reported in of Table 7, the total average value of the EU agricultural landscape represents €20.1 and €25.8 billion in 1991 and 2009, respectively, which is

[19] Land use data were extracted from the Eurostat and FAO, the GDP per capita from the Eurostat and the UN National Accounts Main Aggregates Database, and population data from the Eurostat. Consistent with other studies, we take into account only population in the age group 15 and 74 years old.

approximately 6 and 7.5 percent of the total value of EU agricultural production, respectively. Our sensitivity analysis show that the total WTP is in the range of €12.1 – 23.7 billion and €16.1 – 30.8 billion in 1991 and 2009, respectively. The year-to-year variation in the total WTP value is mainly due to the year-to-year change in the GDP per capita and land use. The country level total WTP is determined mainly by the size of the country in terms of the total agricultural area. Countries endowed with agricultural land report higher landscape value than less land endowed countries.

In general, our estimates are comparable with values available from other studies. For example, according to Drake (1992) the total value of landscape in Sweden in 1986 is €0.485 billion which is comparable to our mean estimate €0.703 billion in 1991. Yrjölä and Kola (2004) estimate the value of agricultural public goods in Finland at €0.354 billion in 2002 which is more conservative value than our estimate for landscape only (€0.327 billion in 2002). McVittie et al. (2005) calculations indicate that the total value of public goods in upland agriculture in UK in 2004 amounts between 0.906 and 1.568 billion pounds (between €1.336 and €2.310 billion). This however is not directly comparable to our estimate (4.9 billion in 2004) because first we valuate only landscape in the UK and second we cover all agricultural area. Krumalova (2002) estimates slightly higher value of landscape in the Czech Republic for 2001: between 3.9 and 4.9 billion CZK (between €0.114 and €0.144 billion) compared to our estimate of €118 billion for the same year. Moon and Griffith (2010) estimate the net WTP for agricultural public goods (total value of public goods minus negative environmental effects) in the US at $105 billion (€77 billion) in 2007 representing around one-third of the value of total agricultural production. This US figure is not directly comparable to our estimated value for the EU but both numbers are comparable in terms of the magnitude.[20]

Conclusions

The present paper provides a meta-analysis of agricultural landscape valuation studies, specifically information from more than thirty European and Non-European studies on landscape valuation has been gathered, and through the estimated benefit transfer function the paper attempts to calculate the value of the EU landscape for the period 1991-2009. Overall, the meta-regression results imply that main drivers of landscape values to society are income level, landscape type as well as methodological differences between studies significantly determine the landscape valuation elicited by respondents.

The estimated meta-regression allowed us to use valuation information of agricultural landscape from the existent studies to build the benefit estimate for the EU landscape. According to our estimates, the per hectare WTP in EU varies between 89 and 169 €/ha with an average value of 142 €/ha in 2009. Further our calculations indicate that the total value of EU landscape in 2009 is estimated to be in the range of €16.1 – 30.8 billion per year, with an average of €25.8 billion, representing around 7.5 percent of the total value of EU agricultural production. The relevance of the order of magnitude can be expressed by comparing this figure with the actual level of agricultural subsidies. The total value of CAP payments in 2009 were around €49.2 billion (European Commission 2011) amounting to €270 per hectare. The

[20] Note that our WTP estimates are reported in 2009 price level, whereas the values reported from the literature are in current prices. Further note that were necessary we have converted the original values from local currency to euro at the current exchange rate.

value of agricultural landscape as estimated in this paper is smaller than the present CAP support level. However, agriculture produces multiple public goods which we do not take into account in our paper. We value only one agricultural public good, i.e. the agricultural landscape. Accounting for the complete set of agricultural public goods, the overall non-market benefit of agricultural might be larger. Additionally, one needs to account for negative externalities of agricultural activities to provide a complete valuation analysis of non-market benefits and costs generated by the agricultural sector.

The results reported in this paper must be interpreted in light of the limitations which WTP data extracted from exiting valuation studies impose on the meta-analyses. Although we have attempted to control for various aspects of the heterogeneity in methodologies used in the valuation studies, we may have not been able to fully address all shortcomings which ultimately affect our valuation of the EU landscape. Particularly important shortcomings, besides those discussed in the paper, relate to the representativeness of the regional coverage of the valued landscape, local specificity of valued landscape, differences in elicitation methodology and differences in valuation scenario. Some EU regions are not well represented in the literature whereas other ones are better represented. New MS and some Western and Central European regions tend to be underrepresented whereas studies from GB and Ireland are more abundant. Many studies value a specific landscape in a given location and/or socio-economic context limiting its extrapolation to other regions. Differences in the methodological approach between studies may pose problems of comparability of results between studies. The difference in the valuated scenario (e.g. marginal value of landscape versus value of a large change in the quantity/quality of landscape) is an additional factor which may pose problem for comparability of landscape valuations between studies. These issues are beyond the possibility of the present paper but are necessary to be tackled to provide an improved estimation of the value of EU agricultural landscape generated to society. Addressing these shortcomings is a promising area for future research.

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Figure 1. Value of public good

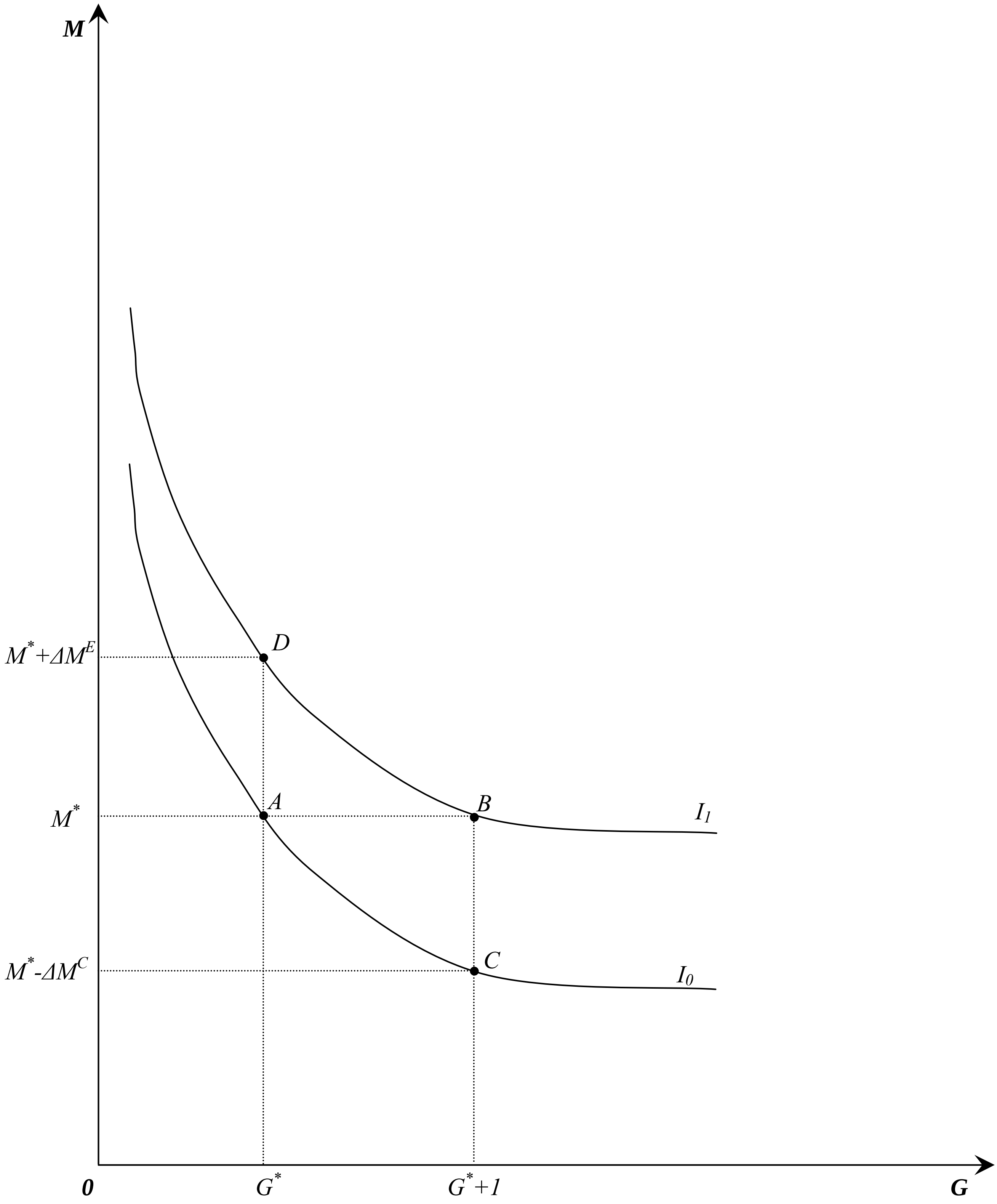

Table 1: **Summary table of European landscape valuation studies**

Author	Method	Sample / year of survey	Type of landscape: value	Unit	Region	Survey type
Drake (1992)	CVM (O/E)	Two surveys: 1089 general public from all Sweden; 152 general public from Uppsala county/ 1986	WTP for the preservation of Swedish agricultural landscape relative to 50% of agricultural land being covered with spruce forest: - all Sweden survey: 468.5 SEK (68 ECU) for all landscape types - Uppsala survey: 729.4 SEK for all landscape types - Uppsala survey: grain production: 100 index; grazing land 191 index; wooded pasture 241 index	SEK per person per year	Sweden	Face to face
Borresch *et al*. (2009)	CE (DE)	420 from residents /2007	Shift from intensive arable cultivation (status quo) to: - grassland dominated landscape: 48.48 - to "multifunctional" landscape: 87.68 - to high price scenario (with higher rate of cereals area): -16.43 - to intensive scenario (with larger fields): -13.17	€ per household and year	Wetterau region, Hesse (Germany)	Face to face
Marangon and Visintin (2007)	CVM (DE)	Italy: 360 residents, Slovenia: 236 residents and non-residents / 2006	Shift form status quo vineyard landscape to - abandonment of production and loss of traditional landscapes (Italy): 72 (Collio), 113 (Colli Orientali del Friuli) 375 (whole region). - parcel consolidation and loss of traditional landscapes (Slovenia), residents: 239, non-residents: 38	€ per household and year	Italy: Collio and Colli Orientali del Friuli; Slovenia: Brda	Face to face
Marangon, Troiano and Visintin (2008)	CVM (DE)	Italy: 200 residents, Slovenia: 200 residents / 2006	Shift form traditional olive landscape to abandonment of production and loss of traditional landscapes: 25.59 for combined border region.	€ per household and year	Italy: Collio and Colli Orientali del Friuli; Slovenia: Brda	Face to face
Bateman and Langford (1997)	CVM (O/E)	310 general public, residents and visitors/ 1991	WTP for preservation of multifunctional wetland (low lying) area (mostly an ESA) against saline flooding: -visitors: 25.65-27.86 - non-visitors: 12.29 - all respondents: 23.29	£ per household and year	Norfolk Broads (UK)	Mail
Cicia and Scarpa (2000)	CVM (DE)	344 tourists /1997	Shift form current landscape to landscape characterised by abandonment of agricultural production: 60-80	€ per hectare of cultivated land and per year	Cilento National Park (Italy)	Face to face
Miskolci (2008)	CVM (O/E)	408 general public from the region /n.a.	WTP for formation and maintenance of rural landscape: (9.71*12)=116.52	CZK per person and year	South-East NUTS II Region (Czech R.)	Likely face to face
Kubickova (2004)	CVM (O/E)	1114 general public, 207 residents and 120 visitors/ 2003	Shift form current landscape to landscape characterised by abandonment of agricultural production: - General public: 268.17 - Residents: 245.83 - Visitors: 235.18 - All sample: 262.21	CZK per person and year	White Carpathians Area (Czech R.)	Face to face
Krumalova (2002)	CVM (O/E)	1000 general public / n.a.	Marginal value of WTP for landscape enhancement: 142	CZK per person and year	Czech R.	Likely not face to face
Pruckner (1994)	CVM (O/E)	4600 tourists/ 1991	WTP for landscape-cultivating activities: 9.20	Austrian shilling (ATS) per person per day	Austria	Face to face

Campbell, Hutchinson and Scarpa (2005)	CE (DE)	402 general public / 2003-2004	WTP for two actions (A Lot Of Action (L-A) and Some Action (S_A)) relative to the status-quo situation (No Action) aimed at improving the landscape attribute for: - Mountain land, L-A: 92.63; S_A: 45.18 - Landscape with cultural heritage, L-A: 62.76; S_A: 41.93 - Landscape with Stonewalls, L-A: 84.01; S_A: 54.69	€ per adult person per year	Ireland	Likely face to face
Campbell, Hutchinson and Scarpa (2006)	CE (DE)	600 general public / 2003-4	WTP for two actions (A Lot Of Action (L-A) and Some Action (S_A)) relative to the status-quo situation (No Action) aimed at improving the landscape attribute for: - Pastures, L-A: 89.58; S_A: 80.37 - Landscape with hedgerows, L-A: 53.38; S_A: 19.86 - Landscape with wildlife habitats, L-A: 91.82; S_A: 51.63	€ per adult person per year	Ireland	Likely face to face
Bullock and Kay (1997)	CVM (DE)	1350 general public from Southern and Central Scotland; 150 visitors /1994	WTP for landscape characterised by extensified grazing relative to the status-quo of intensive grazing for - General public: 83 - Visitors: 69	£ per household and year	Central Southern Uplands (Scotland, UK)	Postal, face to face and self competition
Alvarez-Farizo et al. (1999)	CVM (O/E)/	Breadalbane: 302, Machair: 358 general public, residents, and visitors /1994-1996	WTP for preservation of traditional agriculture with ESA which will generate environmental improvements of landscape relative to current situation: - Breadalbane (average): 25.21 - Breadalbane (postal): 23.50 - Breadalbane (face to face): 19.80 - Machair (coastal plain on five islands) (postal and face to face): 13.44 - Both regions combined: 36.00	£ per household and year	Breadalbane, in Highland Perthshire, and Machair in the Western Isles (Scotland)	Face to face and postal
Johns et al. (2008)	CE (DE)	Between 300 and 345 general public/ 2005	WTP for marginal change in landscape attributes relative to the current situation: -North West: 7.68 -Yorkshire and the Humber: 18.64 -West Midlands: 7.44 -East Midlands: 41.81 -South West: 20.59 -South East: 19.85	£ per household and year	Seven severally disadvantaged areas from England (UK)	Face to face
Hanley *et al.* (1998)	CVM and CE (DE)	CVM: 235-325 UK general public; residents, and visitors; CE: 256 residents and visitors /1994-1996	WTP to maintain ESA scheme which will generate environmental improvements of landscape relative to 'no ESA' situation: - CVM, general public (mail): 47, general public (face to face): 60, visitors: 98. - CE (face to face): 107.55 (quadratic model), 182.84 (linear model).	£ per household and year	Breadalbane, in Highland Perthshire (Scotland)	Face to face and mail
O'Leary *et al.* (2004)	CE (DE)/ Nine study	600 general public/2003	WTP for two actions (A Lot Of Action (L-A) and Some Action (S_A)) relative to the status-quo situation (No Action) aimed at conservation or enhancement of landscape attribute for: - Mountain land, L-A: 61; S_A: 39 - Landscape with cultural heritage, L-A: 70; S_A: 39 - Landscape with Stonewalls, L-A: 52; S_A: 21 - Pasture landscape: L-A: 43; S_A: 30 - Landscape with wildlife habitats/biodiversity, L-A: 77; S_A: 23 - Landscape with hedgerows, L-A: 37; S_A: 0	€ per person per year	Ireland	Face to face
Yrjölä and Kola (2004)	CVM (O/E)	1375 general public/ 2002	WTP for multifunctional agriculture including landscape: 93.81	€ per person per year	Finland	Computer interviewing

						system
Bonnieux and Le Goff (1997)	CVM (DE)	400 residents/1995	WTP for restoration of landscape, biodiversity and ecological functions relative to the current situation: 199-303	French Franks (FF) per household and year	Cotentin in Lower-Normandy (France)	Face to face
Willis and Garrod (1992)	CVM (O/E)	300 residents and 300 visitors/ 1990	WTP to preserve today's landscape relative to the abandoned landscape (abandoned agricultural production): - residents: 24.05 - visitors: 24.56	£ per household and year	Yorkshire Dales National Park (UK)	Face to face
Garrod and Willis (1995)	CVM (O/E and SE)	1845 general public/ 1993; 279 +250 residents and visitors from South Downs/ 1992	WTP to maintain the current ESA landscape (i.e. ESA relative to no ESA scheme): Open-ended question: - residents: All English ESA landscape: 67.46; South Downs ESA landscape: 27.52 - visitors: All English ESA landscape: 94.29; South Downs ESA landscape: 19.47 - general public: 36.35 (All English ESA) Closed -ended question: - general public: 138.37 (All English ESA)	£ per household and year	South Downs, England (UK)	Face to face
McVittie *et al*. (2005)	CVM (DE)	190 general public and residents/ 2004;	WTP to maintain multifunctional upland agriculture including landscape: 46.985 (general public and residents)	£ per household and year	England (UK)	Postal
Moran et al. (2007)	CE (DE)/	673 general public/ 2003	WTP to enhance landscape appearance relative to current landscape: 27.49 WTP to enhance public access to landscape relative to current situation: 29.43	£ per person and year	Scotland (UK)	Face to face
Haile and Slangen (2009)	CVM (DE)	180 residents/ 2005	WTP for management of nature, landscape, monumental farm buildings and the creation of access to farmer's lands through AES: 64.50	€ per household per year	Winterswijk (Netherland)	Postal
Vanslembrouck and van Huylenbroeck (2005)	CVM (O/E)	108 visitors/ 2000	WTP for maintenance of agricultural landscape (maintenance of hedgerows, pillard-willows, farm beautification, etc.): 24.34	€ per household per year	Oost-Vlaanderen province (Belgium)	Completed on a voluntary basis
Tempesta and Thiene (2004)	CVM (O/E)	253 visitors/ 2003	WTP for conservation of mountain meadows: 3.25	€ per person per year	Cortina D'Ampezzo (Italy)	Face to face
Hasund, Kataria and Lagerkvist (2011)	CE (DE)	Arable land survey:1163, Grassland survey: 1474; general public/2008	Marginal WTP for landscape feature relative to reference landscape feature: - linear and point field elements of arable land: (-11) -240 - permanent meadows and pastures: 89-224	Marginal WTP SEK per person per year	Sweden	Mail
Bowker and Didychuk (1994)	CVM (O/E)	93 visitors/ n.a.	WTP for preservation of agricultural land against development: between 49.07 and 86.20	US $ per household per year	Moncton, New Brunswick, (Canada)	Face to face
Chang and Ying (2005)	CVM (DE)	906 general public/ 2001	WTP to maintain paddy rice fields for their water preservation and landscape protection functions: 1777.92 NT $ (about 50.80 US $)	NT/US $ per household per year	Taiwan	Computer assisted telephone interview
Moon and Griffith (2010)	CVM (DE)	1070 general public/ 2008	WTP to support multifunctional agriculture through subsidies relative to no subsidy situation: 515	WTP US $ per person per year	US	Online survey
Rosenberger and	CVM (DE)	171 general public/1993-94	WTP to protect ranch land open space:	WTP US $ per	Routt County	Postal

Walsh (1997)			- Steamboat Springs valley: 72-121 - Other valleys in Routt County: 36-116 - Routt County: 107-256	household per year	(US)	
Bergstrom, Dillman and Stoll (1985)	CVM (O/E)	250 general public/1981-82	WTP for agricultural landscape protection against urban/industrial development: 5.70-8.94	WTP US $ per household per year	Greenville County, South Carolina (US)	Postal
Kashian and Skidmore (2002)	CVM (O/E)	630 Muskego property owners /1998	WTP for agricultural landscape preservation against urban development: 64	WTP US $ per household per year	Muskego, Waukesha County (US)	Postal
Ozdemir (2003)	CA (DE)	173 residents/ 2002	WTP for Conservation Easement Programs aimed at protecting agricultural land from development: 123-207	WTP US $ per household per year	Maine (US)	Postal
Beasley, Workman and Williams (1986)	CVM (DE)	119 residents/ 1983	WTP for protecting agricultural land against: - moderate levels of housing development: 76 - housing dominated landscape: 144	WTP US $ per household per year	Palmer and Wasilla, South-Central Alaska (US)	Face to face

Notes: Contingent Valuation Method (CVM); Choice Experiments (CE) Choice Modelling (CM); analytical hierarchy process (AHP); Conjoint Analysis (CA)
Closed-ended question: DC; open-ended question O/E.

Table 2: Variable description

Variable	Description
wtp	Dependent variable. WTP value in euro (in 2009 price level)
Study characteristics	
household	= 1 if the WTP unit is per household; 0 otherwise, if the unit is per person
year_survey	Year of survey
sample	Number of respondents
scenario_large_change	= 1 if the valued landscape quantity/quality change is large (e.g. a lot off action, production abandonment); 0 otherwise for small change in landscape quantity/quality (e.g. some action, parcel consolidation; preservation of landscape in general, intensification/ extensification)
general_public	= 1 if WTP is for general public (average consumer); 0 otherwise (i.e. resident, visitor)
ce	= 1 if choice experiment is used in sample; 0 otherwise
closed_ended	= 1 if dichotomous question format is used in sample; 0 otherwise
facetoface	= 1 if surveys are conducted face to face; 0 otherwise
weight_region	Number of studies valuing landscape in a given region
Landscape characteristics	
protected_area	= 1 if the study area (or main part of it) belongs to protected region (e.g. LFA, ESA, national park, Nature 2000, denominations of origin); 0 otherwise.
small_area	= 1 if the study values small/specific area/region; 0 otherwise (i.e. if the valued area is large, e.g. NUTS region, big geographical region, country)
multifunctionality	= 1 if the landscape value is embedded in the valuation of multifunctionality (i.e. the study values multifunctionality and landscape is one component of it); 0 otherwise
feature_mountain	= 1 if the study values mountainous (highland) landscape; 0 otherwise
feature_lowland	= 1 if the study values low land landscape; 0 otherwise
feature_grassland_permanent	= 1 if the study values (predominantly) grasslands and/or permanent crops; 0 otherwise
feature_specific	= 1 if the study values landscape specific feature such as cultural heritage, wildlife habitats/biodiversity/flora and fauna, hedgerows or stonewalls; 0 otherwise
Site and socio-economic characteristics	
gdp_capita_r	Gross domestic product per capita of the year of the survey (in 2009 price level)
uaa_person	Utilised agricultural are (UAA) per person
region_noneurope	= 1 if the study is conducted non-European region; 0 otherwise

Table 3: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
wtp (household & person)	96	90.27	78.35	5.02	362.79
wtp europe (household & person)	74	77.54	66.05	5.02	336.19
wtp household	58	96.18	76.08	10.53	299.87
wtp person	38	81.25	81.89	5.02	362.79
Study characteristics					
household	96	0.60	0.49	0	1
year_survey	96	1998	7.31	1982	2008
sample	96	391	282	62	1375
scenario_large_change	96	0.42	0.50	0	1
general_public	96	0.63	0.49	0	1
ce	96	0.38	0.49	0	1
closed_ended	96	0.64	0.48	0	1
facetoface	96	0.68	0.47	0	1
Landscape characteristics					
protected_area	96	0.50	0.50	0	1
small_area	96	0.39	0.49	0	1
multifunctionality	96	0.14	0.34	0	1
feature_mountain	96	0.35	0.48	0	1
feature_lowland	96	0.08	0.28	0	1
feature_grass_permanent	96	0.53	0.50	0	1
feature_specific	96	0.26	0.44	0	1
Site and socio-economic characteristics					
gdp_capita	96	29366	8958	8189	46027
uaa_person	96	0.80	0.64	0.04	2.36
UK and Ireland	96	0.54	0.50	0	1
Rest of Europe	96	0.23	0.42	0	1
Non-Europe	96	0.23	0.42	0	1

Table 4: Meta-regression results (dependent variable: log_WTP)

VARIABLES	Full sample							European sub-sample						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
household	0.221	0.234	0.240	0.242	0.0886	0.285	0.217	0.504	0.501	0.399	0.548	0.502	0.622	0.503
log_sample	-0.0960	-0.0920	-0.0833	-0.0947	-0.0728	-0.0769	-0.0956	-0.0839	-0.0847	-0.0654	-0.0911	-0.0422	-0.0517	-0.0897
scenario_large_change	0.316*	0.314*	0.331*	0.316*	0.0278	0.309*	0.340*	0.436**	0.436**	0.444**	0.436**	0.324*	0.425**	0.449**
general_public	0.403*	0.411*	0.376	0.404*	0.344	0.408*	0.415*	0.560*	0.559*	0.520*	0.554*	0.438	0.592**	0.585**
closed_ended	0.904***	0.894***	0.907***	0.910***		0.919***	0.928***	0.687***	0.689***	0.641***	0.685***		0.704***	0.716***
facetoface	0.797***	0.800***	0.749***	0.792***	0.827***	0.821***	0.837***	0.826***	0.826***	0.752***	0.812***	0.815***	0.897***	0.869***
ce	-1.835***	-1.823***	-1.829***	-1.837***	-1.382***	-1.836***	-1.800***	-1.655***	-1.658***	-1.650***	-1.652***	-1.270***	-1.657***	-1.632***
weight_region		-0.0760							0.0145					
small_area	-0.453*	-0.453*	-0.400*	-0.458*	-0.413	-0.429	-0.438	-0.341	-0.341	-0.333	-0.351	-0.282	-0.248	-0.311
multifunctionality	0.596*	0.602*	0.639**	0.602*	0.543	0.597*	0.599*	0.388	0.386	0.414	0.379	0.337	0.406	0.408
feature_mountain	-0.00907	-0.00118		-0.00948	0.251	0.0481	-0.138	-0.194	-0.195		-0.196	-0.0557	-0.144	-0.300
feature_lowland	0.216	0.216		0.216	0.503	0.232	0.105	-0.00826	-0.00797		-0.0125	0.0167	-0.0397	-0.103
feature_grass_permanent	0.494***	0.500***	0.486***	0.494***	0.681***	0.472**	0.523***	0.384**	0.383***	0.393**	0.375***	0.441**	0.331*	0.404**
feature_specific							-0.307							-0.229
protected_area						-0.212							-0.307*	
log_gdp_capita_r	1.437***	1.454***	1.478***	1.421***	1.867***	1.388***	1.475***	1.232***	1.229**	1.343***	1.206**	1.522***	1.163**	1.261***
log_uaa_person				0.0208							0.0463			
region_noneurope	0.164	0.160	0.0831	0.126	0.569*	0.0455	0.0674							
Constant	-11.19**	-11.37**	-11.64***	-11.02**	-15.41***	-10.74**	-11.54***	-9.279*	-9.245*	-10.45**	-8.922*	-12.20***	-8.730*	-9.541**
Observations	96	96	96	96	96	96	96	74	74	74	74	74	74	74
R-squared	0.600	0.600	0.597	0.600	0.513	0.606	0.607	0.563	0.563	0.557	0.563	0.508	0.580	0.569

Robust standard errors

*** p<0.01, ** p<0.05, * p<0.1

Table 5: The values of independent variables on the benefit transfer function

	Value	Note
household	0	per person
log_sample	5.7	average sample size
scenario_large_change	0	small scenario
general_public	1	general public
closed_ended	0	open question format
facetoface	1	face to face interview
protected_area	0	not protected area
ce	0	not ce methodology
small_area	0	large area
multifunctionality	0	no multifunctionality
feature_mountain	0	average landscape
feature_lowland	0	average landscape
feature_grass_permanent	varies by land type	
feature_specific	0	not specific feature of landscape
log_gdp_capita	varies by MS	
log_uaa_person	varies by MS	
weight_region	0.37	average value
region_noneurope	0	Europe
Constant	1	

Table 6: The estimated value per hectare WTP for grassland and permanent crops and arable land (€/ha/year in 2009 prices)

	Grassland and permanent crops									Arable land								
	1991			2000			2009			1991			2000			2009		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Belgium	336	498	590	478	648	787	548	729	891	170	319	383	242	414	506	278	465	573
Bulgaria	0.1	1	2	1	4	6	3	11	17	0.05	1	1	0.3	2	4	2	7	12
Czech R.	2	10	16	12	32	44	43	88	107	1	7	12	6	21	31	22	56	77
Denmark	145	189	231	218	261	327	232	276	346	73	121	149	111	166	210	118	176	223
Germany	273	383	459	335	450	547	310	427	516	138	244	296	169	287	352	157	273	332
Estonia	2	7	10	4	12	18	13	30	39	1	4	7	2	8	13	7	19	28
Ireland	16	29	34	67	87	106	94	118	145	8	19	24	34	55	68	47	75	94
Greece	24	51	63	37	71	83	98	159	183	12	33	45	19	45	60	49	102	127
Spain	31	54	62	46	78	89	80	125	145	15	35	45	23	50	63	41	80	97
France	96	139	165	121	169	203	112	154	185	48	89	106	61	108	130	56	98	119
Italy	166	241	286	181	267	316	213	315	372	84	154	184	92	171	203	108	201	241
Cyprus	49	103	127	112	197	226	230	369	427	25	66	91	57	126	163	116	237	295
Latvia	1	5	8	3	10	15	7	19	26	1	4	6	1	6	11	4	13	19
Lithuania	1	5	7	2	6	9	7	18	25	1	3	5	1	4	7	3	12	18
Luxembourg	322	390	487	622	778	1030	939	1234	1676	163	248	314	405	492	663	645	779	1078
Hungary	2	9	14	6	18	26	13	32	42	1	6	10	3	12	18	7	21	30
Malta	199	475	626	541	1089	1345	639	1257	1538	101	307	450	274	701	966	324	809	1104
Netherlands	358	530	627	596	783	959	725	920	1139	181	339	407	302	499	617	367	586	733
Austria	124	176	211	171	228	277	206	269	329	63	113	136	87	145	178	104	172	212
Poland	1	7	11	7	21	30	14	37	50	1	4	8	3	14	21	7	24	36
Portugal	24	53	68	49	93	110	57	107	126	12	34	48	25	60	79	29	69	90
Romania	0	2	4	1	4	7	4	14	20	0	2	3	0	3	5	2	9	14
Slovenia	13	33	45	57	116	141	105	187	216	6	22	32	29	74	101	53	120	155
Slovakia	1	7	11	5	17	26	32	71	88	1	4	8	3	11	18	16	46	64
Finland	136	182	221	163	219	266	170	225	274	69	116	142	83	140	171	86	144	177
Sweden	243	300	373	275	339	422	209	280	340	123	191	240	139	216	271	106	179	219
UK	131	203	236	292	378	464	179	265	313	66	130	158	148	241	299	91	170	203
EU	86	129	151	130	181	217	131	189	224	43	79	94	59	104	125	62	113	135

Table 7: The estimated total WTP and per hectare WTP for UAA (in 2009 prices)

	WTP per hectare of UAA (€/ha/year)									Total WTP (million €)								
	1991			2000			2009			1991			2000			2009		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Belgium	242	396	471	331	502	613	382	567	695	333	545	647	462	701	855	521	774	949
Bulgaria	0.1	1	1	0.5	3	5	2	9	14	0.4	4	9	3	16	29	11	44	69
Czech R.	2	8	13	7	24	35	27	65	85	7	32	55	32	102	149	97	230	302
Denmark	79	126	155	118	172	218	128	184	234	220	351	433	312	457	578	337	487	617
Germany	182	289	349	220	338	412	202	318	386	3,115	4,959	5,979	3,760	5,760	7,035	3,408	5,370	6,514
Estonia	1	5	8	2	9	13	9	23	32	2	7	11	2	9	13	8	22	30
Ireland	15	28	32	59	79	97	82	107	132	66	122	143	262	351	430	342	448	553
Greece	19	43	55	28	58	72	67	123	146	97	222	285	161	331	409	256	470	555
Spain	23	45	53	34	64	75	59	101	117	689	1,339	1,607	868	1,616	1,909	1,344	2,298	2,675
France	68	109	130	84	131	158	74	116	140	2,061	3,322	3,951	2,511	3,896	4,698	2,599	4,067	4,918
Italy	119	192	228	133	215	255	155	253	299	2,091	3,367	4,008	2,078	3,357	3,984	2,067	3,370	3,994
Cyprus	34	79	104	78	153	187	152	279	331	5	11	15	11	22	27	18	34	40
Latvia	1	4	7	2	8	12	5	15	21	2	11	17	3	12	20	9	28	39
Lithuania	1	3	5	1	4	7	4	13	19	2	11	19	3	15	25	12	36	52
Luxembourg	252	327	411	524	634	845	800	1019	1393	32	41	52	71	85	114	105	133	182
Hungary	2	7	11	4	13	20	8	23	32	10	44	72	21	77	116	46	133	188
Malta	108	320	463	323	772	1036	394	909	1201	1	4	6	3	8	10	4	9	12
Netherlands	278	444	526	444	636	782	530	739	918	548	874	1,037	874	1,252	1,540	1,019	1,419	1,764
Austria	99	150	180	137	194	237	162	227	278	344	522	625	462	656	800	513	719	882
Poland	1	5	9	4	15	23	9	27	39	17	91	159	78	279	426	138	425	615
Portugal	17	42	56	38	78	96	49	95	115	69	174	232	149	305	375	180	351	424
Romania	0	2	4	1	3	6	3	11	17	4	28	53	8	46	82	40	148	226
Slovenia	11	30	41	47	101	128	86	162	193	9	26	36	24	52	66	40	76	91
Slovakia	1	5	9	4	14	21	21	53	71	2	13	22	9	33	51	41	102	137
Finland	69	117	143	84	141	172	88	145	178	176	297	363	185	311	381	201	333	409
Sweden	144	209	262	156	232	290	121	193	236	482	703	881	465	689	864	370	593	725
UK	105	174	203	238	327	403	147	231	273	1,783	2,948	3,439	3,687	5,064	6,230	2,365	3,703	4,383
EU	60	99	117	87	134	161	89	142	169	12,168	20,068	23,697	16,514	25,502	30,667	16,128	25,823	30,795