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Using choice experiments to explore the spatial distribution of willingness to pay for rural landscape improvements

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Abstract

We report findings from a choice experiment survey designed to estimate the economic benefits from policy measures which improve the rural landscape under an agri-environment scheme in the Republic of Ireland. Using a panel mixed logit specification to account for unobserved taste heterogeneity we derive individual-specific willingness to pay estimates for each respondent in the sample. We subsequently investigate the existence of spatial dependence of these estimates. Results suggest the existence of positive spatial autocorrelation for all rural landscape attributes. As a means of benefit transfer, kriging methods are employed to interpolate willingness to pay estimates across the whole of the Republic of Ireland. The kriged WTP surfaces confirm the existence of spatial dependence and illustrate the implied spatial variation and regional disparities in WTP for all the rural landscape improvements.

Keywords

landscape valuation
spatial distribution
choice experiments
non-market valuation

JEL Classification

C25; Q0; Q2; Q24

Introduction

After more than fifty years of European Union (EU) agricultural policies mainly designed to support farm incomes through support of farm commodity prices, there has been a significant shift in emphasis. With an increased focus on area-based payments and payments for the supply of environmental goods, agri-environmental schemes have become an important component within the Common Agricultural Policy (CAP). Within this context, the Rural Environment Protection (REP) Scheme was introduced in the Republic of Ireland in 1994 (DAF, 2004). Designed to pay farmers for carrying out farming activities in an environmentally friendly manner, the Scheme is aimed at creating incentives for farmers to maintain and improve the broadly defined rural environment, and the rural landscape.

Landscape conservation and improvement is currently one of the priorities of the revised CAP and the vision of a multifunctional agriculture it intends to promote (Randall, 2002). The policy measures of the REP Scheme contribute to various rural landscape attributes, and hence a multi-attribute valuation approach, which enables the estimation of attribute values and hence marginal effects, is warranted. At the same time, the non-use nature of rural landscapes favors the use of a stated preference methodology employed for the estimation of existence benefits (see Bateman et al (2002a) for an explanation of the suitability of stated preference methods in this context). For these reasons, choice experiments are the preferred technique. In choice experiments respondents are asked to choose their preferred alternative among several hypothetical alternatives in a choice task. Experimental design theory is used to construct the alternatives, which are defined in terms of their attributes and the levels these attributes can take. By analyzing the choices made by respondents it is possible to reveal the factors which influence their choice. For an overview of choice experiments see, for example, Alpízar et al (2001) or Louviere et al (2003). In this paper, we report results from a choice experiment that was carried out to elicit willingness to pay (WTP) estimates from the general population for major farm landscape improvement measures within the REP Scheme in the Republic of Ireland.

While calculating the benefits is very useful for policy evaluation, a further, yet often overlooked issue pertinent to policy appraisal relates to their spatial distribution. Detailed information on spatial distribution of WTP is useful as it helps policy makers and program administrators design programs that are coherent with public preferences. Spatial variations in WTP may be a consequence of a number of underlying factors, many of which vary by spatial location. Indeed, the socio-demographic profile of respondents is likely to have a significant bearing on the geographical distribution of WTP. Moreover, since rural environmental landscapes themselves are spatially arranged (Bateman et al 1999; Bockstael, 1997; Geoghegan et al, 1997), it is also conceivable that the predominant agricultural activity and the ensuing landscape quality within a particular locality are also likely to affect the WTP for rural landscape improvements of local respondents. Despite the many advantages, stated preference studies rarely adequately clarify or address the inherently spatial patterns of WTP (Eade and Moran, 1996; Bateman et al, 2002b; Johnston et al, 2002). Aggregate measures of WTP, while useful, can obscure local patterns of heterogeneity (Troy and Wilson, 2006). Exploratory spatial data analysis provides different insights about WTP: its distribution, regional and local outliers, regional trends, and the level of spatial autocorrelation. Furthermore, given that the distribution of benefits are likely to be both spatially and socially uneven (Bateman et al, 2006), evaluating the regional nature of benefits delivers advantages from the political and policy analysis viewpoints.

Comparing regional variations in WTP using choice experiments typically requires separate models to be estimated for each region and/or the inclusion of additional location variables in the econometric model (see, for example, Willis and Garrod, 1999; Birol et al, 2006). While both these methods can be adequately used to compare WTP across a small number of regions, they are arguably less suited for making comparisons across a relatively large number of regions. In the case of separate models, relatively large samples would usually be needed to enable statistically robust comparisons to be made across many different regions–which are often unattainable due to budget and time constraints. When using location variables, the inclusion of a relatively large number of dummy variables to represent the different regions may lead to an unreasonable increase in the number of parameters to be estimated which would reduce the statistical significance of the coefficients of the attributes one wishes to estimate. In our analysis of the choice data we use a panel mixed logit specification to account for unobserved taste heterogeneity. Implicit to this formulation are estimates of WTP distributions for the improvement of separate rural landscape features. As a means of benefit transfer, kriging methods are employed to extend across the whole of the Republic of Ireland the local WTP estimates derived from the collected data. The resulting data are mapped and used to illustrate the implied spatial variation and regional disparities in WTP for the different rural landscape improvements. It would appear that this is the first paper presenting landscape valuation results by using this approach. In this respect, this is a novel contribution to the literature on the valuation of environmental and natural resources using the choice experiment methodology. Evidence in this paper shows that such an approach overcomes the potential limitations of the approaches listed above to examine the spatial nature of WTP and is a very suitable means of examining the spatial dimension of WTP estimates derived from choice experiments.

The rest of this paper is organized as follows. We begin with an outline of the design of the choice experiment, including the attributes and experimental design. Next, we specify and explain the mixed logit model used to obtain individual-specific WTP estimates for each of the landscape attributes and report the relevant results. Subsequently, we explore and discuss the spatial distribution of the WTP estimates. Finally, we provide a number of conclusions and policy implications.

Survey design

The choice experiment exercise reported here involved several rounds of design and testing which included a multi-disciplinary team of landscape architects, policy specialists and economists. This process began with the gathering of opinions from those involved in the design and implementation of the REP Scheme. Having identified the policy relevant attributes, a series of focus group discussions with members of the public were held. To ensure a geographical spread and to enable the identification of potentially different perspectives, five focus group discussions were held in different locations around the Republic of Ireland. The groups ranged in size from seven to twelve participants. The aims of the focus group discussions were fourfold: to highlight the criteria and issues that the general public felt were of importance to the rural environment and to the countryside as a whole; to produce, and refine, a list of interpretable attributes, and levels thereof, that could later be used in choice experiment survey; to shed light on the best way to introduce and explain the choice sets; and, finally, to provide a platform to test draft versions of the questionnaire. Following the focus group discussions pilot testing of the survey instrument was conducted in the field. This pilot testing had the objective of checking whether the wording and format of the questionnaire was appropriate and if respondents were able to understand the choice experiment exercises. Altogether, 21 pilot interviews on the general public were conducted by interviewers who had specific experience in piloting procedures.

In the final version of the survey the choice experiment contained four important landscape attributes: Mountain Land, Stonewalls, Farmyard Tidiness and Cultural Heritage. Following recommendations from the focus group discussions three levels were used to depict each landscape attribute according to the level of action made to conserve or enhance it. Feedback from verbal protocols during the focus group discussions highlighted the necessity to denote each of the landscape attributes using the same labels. A Lot Of Action, Some Action and No Action were judged to be the most appropriate. While the A Lot Of Action and Some Action levels represented a high level and an intermediate level of improvement achievable within the REP Scheme respectively, the No Action level represented the unimproved or status-quo condition. Image manipulation software was used to prepare photo-realistic simulations to represent the landscape attributes under different management practices and levels of agricultural intensity. This involved the manipulation of a ‘control’ photograph to depict either more of or less of the attribute in question. This method was used so that on the one hand the changes in the attribute levels could be easily identified while holding other features of the landscape constant. On the other hand the respondent would not perceive as ostensibly unrealistic the computer generated landscape illustrations. The use of computer edited photographs, or photomontages, within landscape valuation studies are not new. Previous studies include Hanley et al (1998), Álvarez-Farizo and Hanley (2002) and Garrod et al (2002).

Different stocking densities in an upland area reflecting overgrazing and soil erosion were used to depict the Mountain Land attribute. The Stonewalls attribute illustrated the aesthetic consequence of their condition and their removal on the overall appearance of the countryside. Similarly, the Farmyard Tidiness attribute portrayed a farmyard at different states of tidiness and the Cultural Heritage attribute showed the impact that different management practices have on old farm buildings and historical features. Testing in focus group discussions and the pilot study ensured a satisfactory understanding and scenario acceptance by respondents. As examples, the images used to depict the Hedgerows and Stonewalls landscape attributes are presented in figure 1. For the remaining images, interested readers are referred to Campbell (2006).

The cost attribute was described as the expected annual cost of implementing the alternatives represented in the choice questions. This attribute was explicitly described as the value that the respondent would personally have to pay per year, through their Income Tax and Value Added Tax contributions, to implement the alternative. As a result, all resulting welfare estimates are individual rather than household values. These are realistic payment vehicles for EU funded and government funded agricultural policies.

The choice experiment consisted of a panel of at least six repeated choice tasks. For each choice task respondents were asked to indicate their preferred alternative. Each choice task consisted of two experimentally designed alternatives, labeled Option A and Option B, and a status-quo alternative, labeled No Action, which portrayed all the landscape attributes at the No Action level with zero cost to the respondent. When making their choices, respondents were explicitly asked to consider only the attributes presented in the choice task and to treat each choice task independently. In an attempt to minimize hypothetical bias, respondents were also reminded to take into account whether they thought the rural environmental policies were worth the payment asked of them and were made aware that rural landscapes are embedded in an array of substitute and complementary goods.

Since different experimental designs can significantly influence the accuracy of WTP estimates (Lusk and Norwood, 2005), it is important to use an experimental design that maximizes an efficiency criterion, or equivalently minimizes an error criterion, such as the *D*-error. Given the national scope of this study, and the cost of surveys of this kind, sample size was also an issue. To increase sampling efficiency a sequential experimental design with a Bayesian information structure was employed (Sándor and Wedel, 2001). Starting from a conventional main effects fractional factorial in the first phase, a Bayesian design was employed in the second wave of sampling. The design for the final phase incorporated information from the first and second phases. An assessment of the efficiency and robustness of the experimental design obtained with this procedure is beyond the scope of this paper, instead the interested reader is directed to Scarpa et al (forthcoming) and Ferrini and Scarpa (forthcoming).

In order to achieve a spatially representative sample, the sampling approach for the survey was firstly stratified according to 15 broad regions and five different community types. This approach was to ensure that all data generated could be analyzed geographically, in addition to a range of urban and rural classifications. Within each of these broad regions, a number of primary sampling units, that is Electoral Divisions, were chosen. In total 100 Electoral Divisions were selected. The second stage of the sampling procedure involved sampling individuals within each of the pre-selected Electoral Divisions. Within each Electoral Division, the nucleus of each cluster of interviews was an address selected at random. In order to limit interviewer bias the interviewers followed a random route procedure (for example first left, next right, and so on) calling at every fifth house until six interviews were completed from within the pre-selected Electoral Divisions. In total the survey was administered by experienced interviewers to a random sample of 766 respondents drawn from the Irish adult population in 2003/4. Of these, 600 respondents agreed to participate. Thus, the overall response rate was 78 percent, which is in line with similar studies in the Republic of Ireland.

Mixed logit specification and results

Mixed logit models provide a flexible and computationally practical econometric method for any discrete choice model derived from random utility maximization (McFadden and Train, 2000). The mixed logit model obviates the three limitations of standard multinomial logit by allowing for random taste variation, unrestricted substitution patterns, and correlation in unobserved factors (Train, 2003). Mixed logit does not exhibit the strong assumptions of independent and identically distributed (*iid*) error terms and its equivalent behavioral association with the independence of irrelevant alternatives (IIA) property. Mixed logit models also accommodate the estimation of individual-specific preferences for individual n by deriving the conditional distribution based (within sample) on their known choices $\boldsymbol{x}_n$ and $\boldsymbol{y}_n$ (that is prior knowledge) (Train, 2003; Hensher and Greene, 2003; Sillano and Ortúzar, 2005). These conditional parameter estimates are strictly same-choice-specific parameters, or the mean of the parameters of the sub-population of individuals who, when faced with the same choice task, made the same choices. This is an important distinction since it is impossible to establish, for each individual, their unique set of estimates but rather identify a mean, and standard deviation, estimate for the sub-population who made the same set of choices in the panel (Hensher et al, 2005). Individual-specific WTP estimates can be achieved by applying Bayes' theorem to derive the expected value of the ratio between the landscape attribute parameter estimate (φ) and the parameter estimate for the cost attribute (γ) for individual n:

$$E\left[\mathrm{WTP}_n\right] = E\left[-\frac{\varphi_n}{\gamma_n}\right] = \int_{\boldsymbol{\beta}_n} \boldsymbol{\beta}_n P\left(\boldsymbol{\beta}_n \mid \mathbf{y}_n, \mathbf{x}_n\right) \; d\boldsymbol{\beta}_n, \tag{1}$$

where $\boldsymbol{\beta}_n$ is a vector of parameters for individual n. It is well known that given two outcomes A and B, Bayes' theorem relates $P(B|A)$ to the conditional probability of $P(BA)$ and the two marginal probabilities $P(A)$ and $P(B)$ as follows:

$$P(B \mid A) = \frac{P(A \mid B)P(B)}{P(A)}. \tag{2}$$

So, substituting in

$$E\left[\mathrm{WTP}_n\right] = E\left[-\frac{\varphi_n}{\gamma_n} \mid \mathbf{y}_n, \mathbf{x}_n\right] = \int_{\boldsymbol{\beta}_n} -\frac{\varphi_n}{\gamma_n} \frac{P(\mathbf{y}_n, \mathbf{x}_n \mid \boldsymbol{\beta}_n)P(\boldsymbol{\beta}_n)}{P(\mathbf{y}_n, \mathbf{x}_n)} \; d\boldsymbol{\beta}_n,$$

$$= \int_{\boldsymbol{\beta}_n} -\frac{\varphi_n}{\gamma_n} \frac{P(\mathbf{y}_n, \mathbf{x}_n \mid \boldsymbol{\beta}_n)P(\boldsymbol{\beta}_n)}{\int_{\boldsymbol{\beta}_n} P(\mathbf{y}_n, \mathbf{x}_n \mid \boldsymbol{\beta}_n)P(\boldsymbol{\beta}_n) \; d(\boldsymbol{\beta}_n)} \; d\boldsymbol{\beta}_n,$$

$$= \frac{\int_{\boldsymbol{\beta}_n} -\frac{\varphi_n}{\gamma_n} P(\mathbf{y}_n, \mathbf{x}_n \mid \boldsymbol{\beta}_n)P(\boldsymbol{\beta}_n) \; d(\boldsymbol{\beta}_n)}{\int_{\boldsymbol{\beta}_n} P(\mathbf{y}_n, \mathbf{x}_n \mid \boldsymbol{\beta}_n)P(\boldsymbol{\beta}_n) \; d(\boldsymbol{\beta}_n)}. \tag{3}$$

With knowledge of the parameter estimates this can be approximated by simulation as follows:

$$\hat{E}\left[\mathrm{WTP}_n\right] = \frac{\frac{1}{R}\sum_R -\frac{\hat{\varphi}_n}{\hat{\gamma}_n} L\left(\hat{\boldsymbol{\beta}}_{nr} \mid \mathbf{y}_n, \mathbf{x}_n\right)}{\frac{1}{R}\sum_R L\left(\hat{\boldsymbol{\beta}}_{nr} \mid \mathbf{y}_n, \mathbf{x}_n\right)}, \tag{4}$$

where L is the logit probability and R is the number of repetitions or draws. In this way the individual-specific WTP estimates are obtained conditional on all the information from the choice experiment interview.

In this paper such probabilities are approximated in estimation by simulating the log-likelihood with 100 shuffled Halton draws. For further details on shuffled Halton sequences see Bhat (2001; 2003) and Hess and Polak (2003).

A key element of the mixed logit model is the assumption regarding the distribution of each of the random parameters. Random parameters can take a number of predefined functional forms, the most popular being normal and lognormal. However, it is well known that these mixing distributions can imply behaviorally inconsistent WTP values, due to the range of taste values over which the distribution spans (Train and Weeks, 2005). This is due to the presence of a share of respondents with the ‘wrong’ sign under normal distributions, and the presence of fat tails in under lognormal distributions. This is of particular importance in a study concerned with improvements from the status-quo, on which taste intensities are expected to be positive. After evaluating the results from various specifications and distributional assumptions we follow Hensher and Greene (2003) and opt for a bounded triangular distribution in which the location parameter is constrained to be equal to its scale. While this constraint prevents the testing of the statistical significance of the scale parameters, it forces the distribution to be bounded over a given orthant, the sign of which is the same as the sign of the location parameter–thus ensuring strictly positive WTP values across the entire distribution. To allow for heterogeneous preferences among respondents for all attributes within the choice experiments they are all specified as random. In practice, for all random parameters associated with the various categories of rural landscape improvements it is assumed that $\beta \sim \tau(\theta)$, where θ is both the location and scale parameter of the triangular distribution $\tau(\cdot)$. This includes the cost attribute, which is bounded to the negative orthant. See, for example, Hensher et al (2005) for a description of the triangular distribution in this context.

The output from the mixed logit model is reported in table 1. At convergence, the log-likelihood function is -3775.39 which exceeded the log-likelihood function of basic multinomial logit model. While the log-likelihood function was found to be higher under the same mixed logit model specification but with all attributes specified with normal mixing distributions, over 40 percent of the resulting individual-specific WTP estimates were found to be negative, thus substantiating the use of the constrained triangular distributions.

The mixed logit model in table 1 is statistically significant with a χ^2 statistic of 1901.68 against a χ^2 critical value of 16.92 (with 9 degrees of freedom at alpha equal to 0.05) and has an acceptable model fit (pseudo-R^2 value of 0.201). Since the location and scale parameters are constrained to be equal, without loss of generality only the location parameters are reported. An examination of these parameters reveals that they are significant and with the expected sign and relative magnitudes. As respondents had higher preferences for the A Lot Of Action level vis-à-vis the Some Action level for all landscape attributes, theoretical expectations of marginal utilities are also observed. Results from Wald-tests verified this finding for all attributes except for the Cultural Heritage attribute. In this case, the estimated coefficients for A Lot Of Action and Some Action are found to be relatively comparable; suggesting that respondents were largely satisfied provided the Some Action level was reached.

Kernel smoothed distributions of the WTP estimates, based on the individual-specific welfare measures (equation (4)), for each of the landscape attributes are presented in figure 2. For all attributes there exists overlap between the WTP distributions for the A Lot Of Action (continuous line) and Some Action (dashed line) levels of landscape improvement. Overlapping WTP in this instance is due, in part, to the fact that the attributes were specified as having a triangular distribution in which the mean and scale were equal. Under these conditions densities start at zero, rise to the mean and then decline to zero again at twice the mean. Therefore, overlapping and symmetrical distributions and more leptokurtic, or peaked, distributions for attributes and/or levels with lower WTP values are to be expected. Despite the overlap in WTP, with the exception of the Cultural Heritage attribute, it is apparent that as one moves from the estimates obtained for A Lot Of Action to those obtained for Some Action the WTP distributions shift markedly to the left indicating a lower WTP. This is also supported by the fact that the Some Action distributions are more leptokurtic for the Mountain Land, Stonewalls and Farmyard Tidiness landscape attributes. To test differences in both the locations and shapes of the A Lot Of Action and Some Action distributions Kolmogorov-Smirnov tests were conducted. These results confirmed that the WTP distributions for the two levels of improvement are significantly different for all attributes except for Cultural Heritage. Therefore, the implied monotonicity of the two levels of action is adequately reflected in the magnitude of individual-specific WTP estimates for the Mountain Land, Stonewalls and Farmyard Tidiness landscape attributes. In the case of the Cultural Heritage attribute, however, respondent are thus found to be indifferent between the two levels of landscape improvement. It can be seen that respondents have highest preference for landscape improvements concerning Mountain Land and least for relating to Cultural Heritage.

Spatial distribution of WTP estimates

To elucidate the geographical dimension of WTP, the individual-specific WTP estimates are averaged for each Electoral Division, thus providing WTP estimates for 100 sampling points across the Republic of Ireland. Table 2 reports summary statistics from this analysis for each of the rural landscape improvements. To detect whether the mean WTP estimates obtained for the sampled Electoral Divisions are spatially autocorrelated the Moran's *I* statistics are reported in table 3. The spatial weights matrix used to impose the neighborhood structure consists of the five nearest sampled Electoral Divisions. For all rural landscape improvements, the Moran's *I* statistics are positive, with very highly significant *z*-values. Accordingly, this substantiates the existence of strong positive spatial autocorrelation processes and nation-wide spatial clustering of WTP for improvements of different rural landscape attributes. As revealed by the magnitude of the Moran's *I* values, the highest degrees of spatial autocorrelation, and hence global clustering, are found for improvements associated with Mountain Land and Cultural Heritage at the A Lot Of Action level.

With spatial interpolation, the mean individual-specific WTP values from the sampled Electoral Divisions can be used as a method of benefit transfer by predicting WTP values for all locations. The interpolation method of ordinary kriging is adopted for this study because, as indicated in table 3, the WTP values exhibit a large degree of spatial autocorrelation. Kriging is a geostatistical technique that is based on the assumption that nearby values contribute more to the interpolated values than distant observations. In other words, sampled Electoral Divisions that are close in distance should have a smaller difference in mean WTP than those farther away from one another. Kriging can thus be used for benefit transfer by predicting WTP for points that are between the sampled Electoral Divisions. In kriging the surrounding measured values are weighted to derive a prediction for an unmeasured location. The general kriging formula used to interpolate the WTP values is formed as a weighted sum of the data:

$$\hat{Z}\left(\mathrm{WTP}_0\right) = \sum_{i=1}^{n} \omega_i Z\left(\mathrm{WTP}_i\right), \qquad (5)$$

where $\hat{Z}(\text{WTP}_0)$ is the predicted WTP estimate at an unsampled location, ω_i is an unknown weight for WTP at the i^{th} location, $Z(\text{WTP}_i)$ is the mean individual-specific WTP at the i^{th} Electoral Division and n is the number of measured values. The rational for using kriging is that it is considered an optimal spatial interpolation technique since it provides the best linear unbiased estimate (BLUE) of the value of WTP at any point in the coverage (Burrough and McDonnell, 1998). For further discussion on the theory of kriging and its implementation see, for example, Isaaks and Srivastava (1989), Cressie (1993) and Wackernagel (1995).

The kriged surfaces of WTP for all rural landscape improvements are displayed in figure 3. To enable straightforward comparisons across the different rural landscape improvements the stratifications are kept constant for all maps. The stratifications are equidistant in intervals of €10 per year, with progressively darker shades corresponding with progressively higher WTP values. Visualization of the kringed surfaces clearly indicates that the relative magnitudes of the WTP values appear to be quite consistent across all rural landscape improvements. This suggests that the relative intensities of tastes for the different landscape attributes are correlated across space. In the main, highest values are found in the west. Interestingly, to a greater extent than in the east, the landscape in the west is characterized largely of upland heath and blanket bog, which typifies the Mountain Land attribute. Stonewalls are also frequently used as field boundaries in the west. Higher population densities and the incidence of larger centers of population, such as Dublin, are also likely to have lead to lower WTP values in the east. As illustrated by the noticeably darker shades, higher WTP values are observed for A Lot Of Action compared to Some Action for all attributes except Cultural Heritage, which is consistent with earlier inferences. A further discernible finding is the varying degrees of geographical variability and concentration in WTP for the different rural landscape improvements. Whereas there is a strong indication that WTP values for improvements concerning Mountain Land at the A Lot Of Action are spatially diverse, no such pattern is evident for Stonewalls at the Some Action. Correspondingly, we also observe substantial differences in the coefficients of variation (table 2) and the extent of spatial autocorrelation (table 3) between these two rural landscape improvements.

Summary and policy implications

We report findings from a choice experiment that was carried out to address the value of a number of rural landscape improvement measures under an agri-environmental scheme in the Republic of Ireland. The attributes in question are the improvement of: Mountain Land, Stonewalls, Farmyard Tidiness and Cultural Heritage. Each of these attributes was represented under three different management practices according to the level of action made to conserve and/or enhance it: A Lot Of Action, Some Action and No Action. Since valuation of landscapes are very subjective, and verbal descriptions can be interpreted differently on the basis of individual experience, each level of improvement was qualified and presented to respondents by means of digitally manipulated images of landscapes to accurately represent what is achievable within the policy under valuation.

We also attempt to take stock of some of the main advances in the areas of multi-attribute stated preference techniques. In particular, following recent results in market research, a sequential experimental design with an informative Bayesian update to improve the efficiency of estimates was implemented. Using a mixed logit specification, individual-specific WTP estimates were derived. These were subsequently analyzed to highlight the fact that they exhibited a large degree of spatial autocorrelation. As a method of benefit transfer we also interpolate WTP for the rural landscape improvements, using the kriging method, across the entire Republic of Ireland. The maps clearly identified spatial variation and regional disparities in the WTP values.

The results reported in this paper have important policy implications. The results provide signals for policy makers regarding the economic magnitude and spatial distribution of the local economic value of rural landscape improvements. The combination of the comprehensiveness and openness to all farmers throughout the country makes the REP Scheme a unique agri-environment scheme in the EU. However, evidence from the kriged WTP surfaces identified that the benefits are not evenly distributed throughout the country. A logical step would be to thus use this inference to strategically extend and broaden the Scheme with regional-specific objectives tailored to reflect the landscape character types, underlying environmental conditions and the geographical distribution of benefits. This could partially be achieved by providing relatively higher levels of financial incentives to farms for the provision of rural landscape improvements where they are most valued by the local population.

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Table 1. Mixed logit model.

Attributes	Beta	*t*-ratio
Mountain Land: A Lot Of Action	1.041	16.240
Mountain Land: Some Action	0.598	10.090
Stonewalls: A Lot Of Action	0.870	14.911
Stonewalls: Some Action	0.531	9.504
Farmyard Tidiness: A Lot Of Action	0.794	14.055
Farmyard Tidiness: Some Action	0.502	9.174
Cultural Heritage: A Lot Of Action	0.587	10.217
Cultural Heritage: Some Action	0.577	9.864
Cost	-0.012	-10.641
Log-likelihood	-3775.39	
χ^2	1901.68	
Pseudo-R^2	0.201	

Table 2. Summary statistics of WTP for rural landscape improvements across Electoral Divisions.

Attributes	Mean (Euro/year)	Standard Deviation (Euro/year)	Coefficient of variation (Percent)
Mountain Land: A Lot Of Action	135.21	42.09	31.13
Mountain Land: Some Action	76.32	14.38	18.84
Stonewalls: A Lot Of Action	104.42	23.33	22.35
Stonewalls: Some Action	65.09	10.84	16.65
Farmyard Tidiness: A Lot Of Action	98.56	21.38	21.69
Farmyard Tidiness: Some Action	61.45	12.85	20.91
Cultural Heritage: A Lot Of Action	77.82	20.56	26.42
Cultural Heritage: Some Action	72.94	15.22	20.87

Table 3. Spatial autocorrelation in mean WTP for rural landscape improvements across Electoral Divisions.

Attributes	Moran's *I*	*z*-value
Mountain Land: A Lot Of Action	0.512	9.382
Mountain Land: Some Action	0.384	6.855
Stonewalls: A Lot Of Action	0.414	7.616
Stonewalls: Some Action	0.241	4.520
Farmyard Tidiness: A Lot Of Action	0.322	5.831
Farmyard Tidiness: Some Action	0.426	7.802
Cultural Heritage: A Lot Of Action	0.522	10.086
Cultural Heritage: Some Action	0.427	7.681

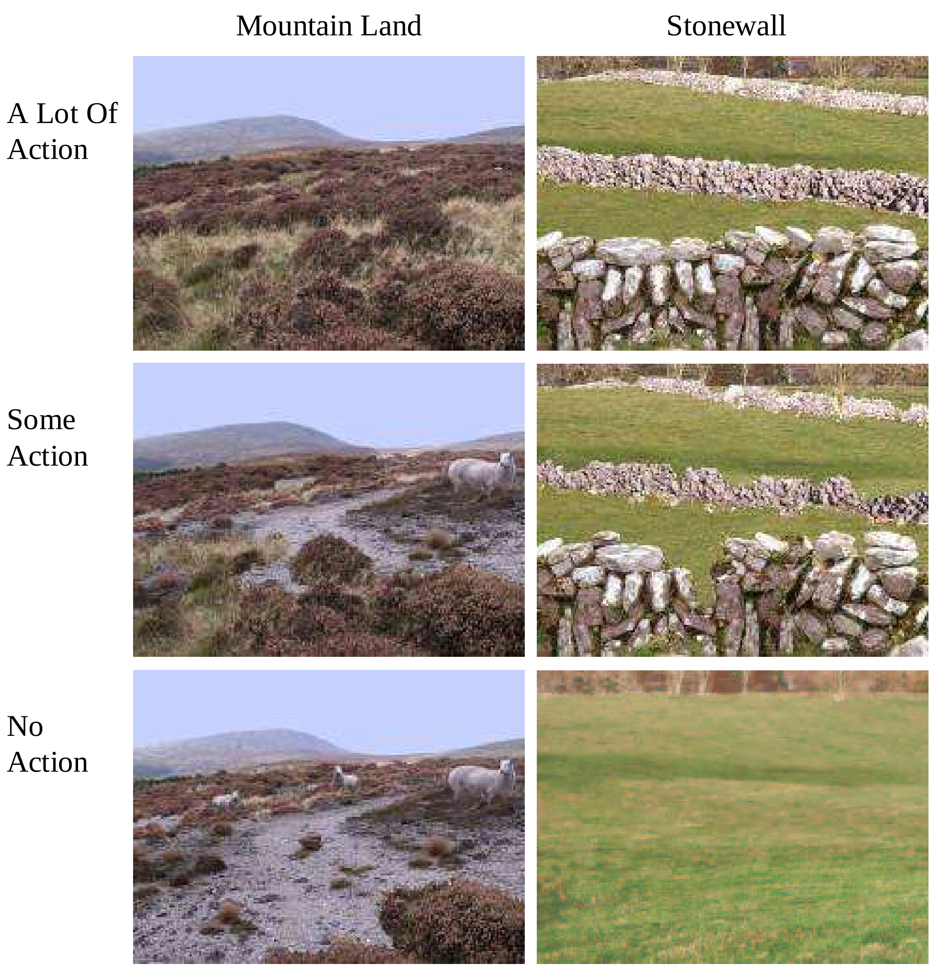

Figure 1. Images used to represent the Hedgerows and Stonewalls landscape attributes.

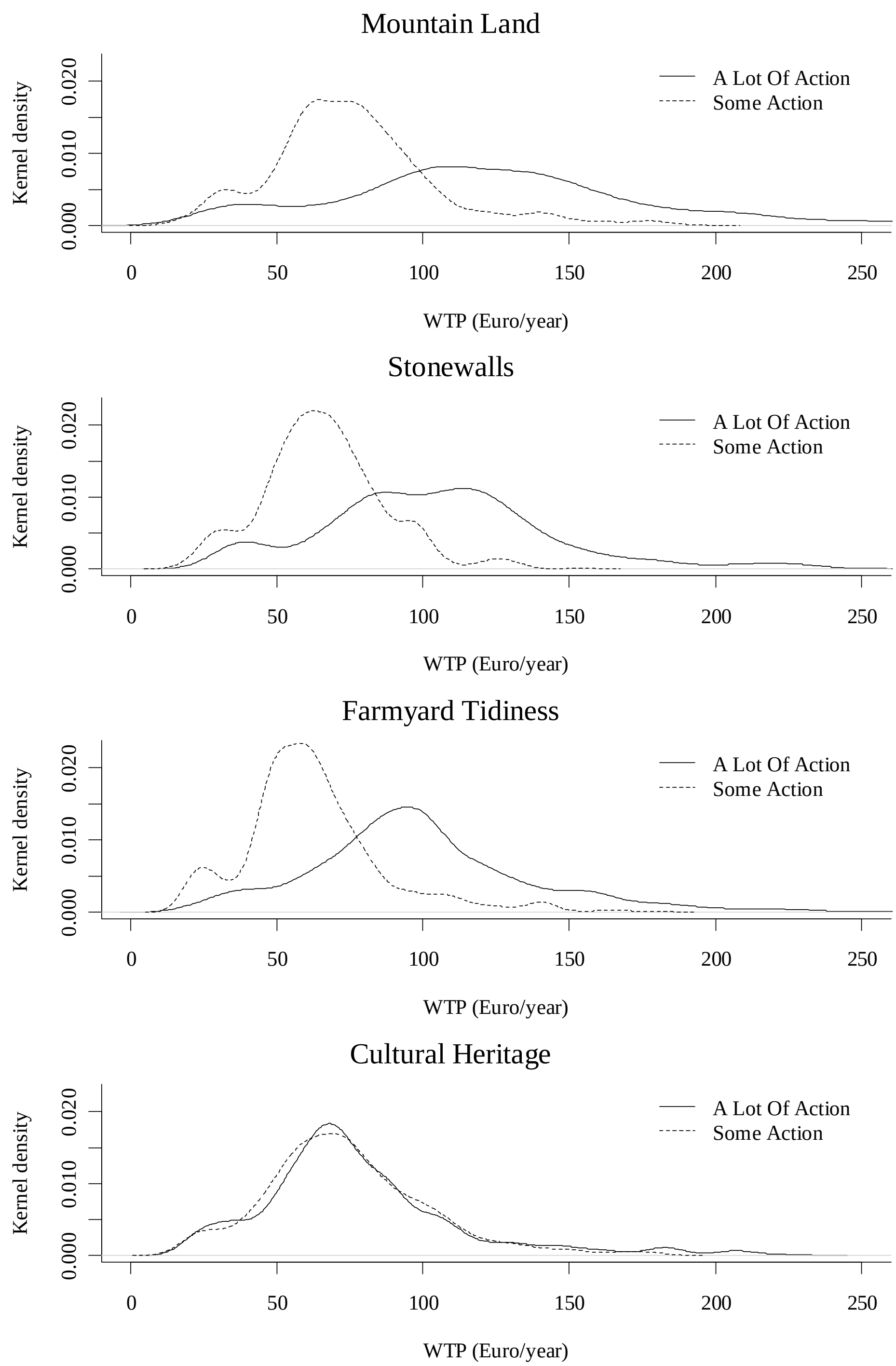

Figure 2. Individual-specific WTP distributions for the rural landscape attributes.

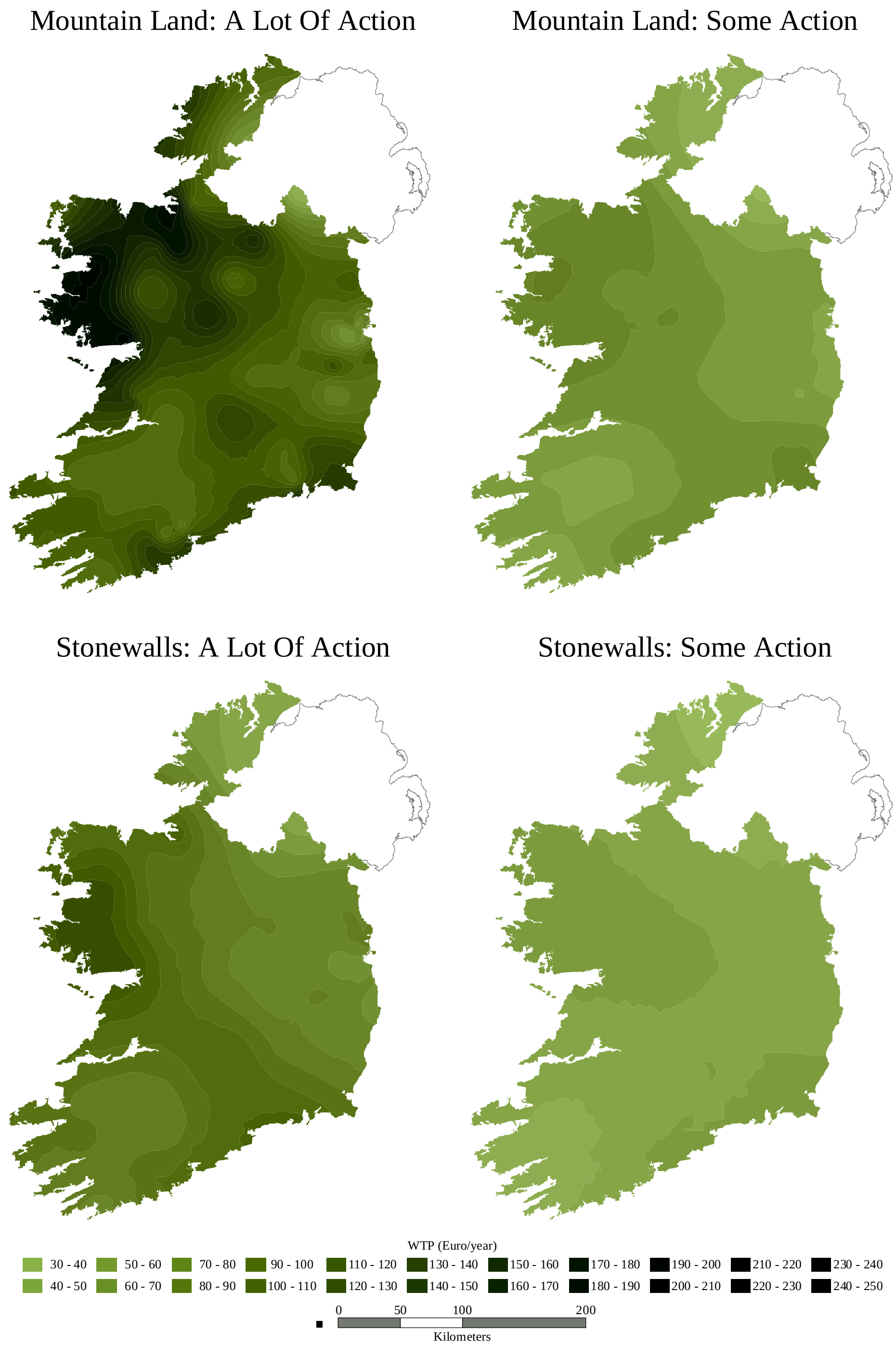

Figure 3. Spatial distributions of WTP for the rural landscape attributes.

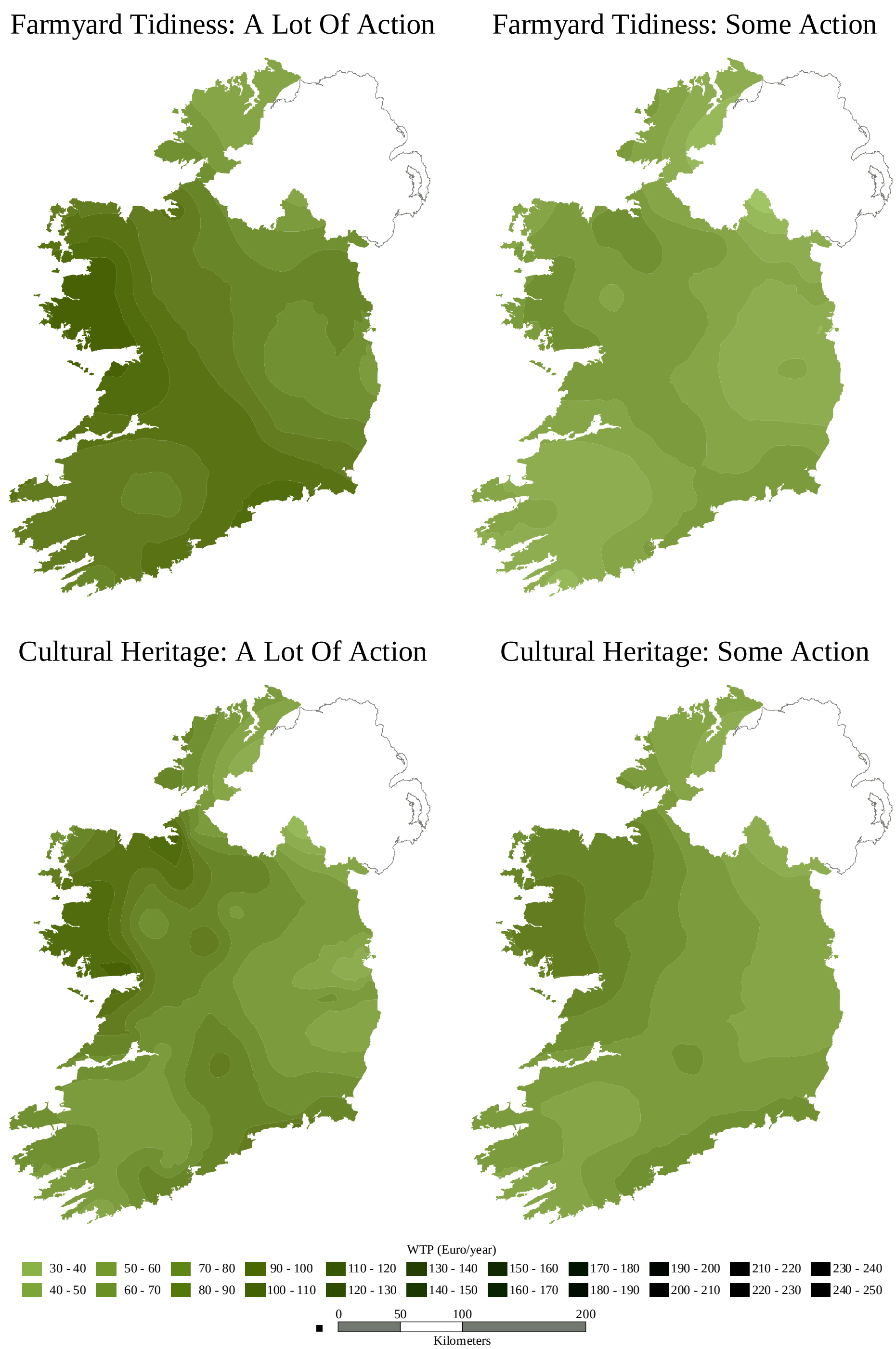

Figure 3. (continued).