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Stephen Hynes, Danny Campbell and Peter Howley

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Department of Economics
National University of Ireland, Galway

http://www.economics.nuigalway.ie

A Choice Experiment versus a Contingent Valuation approach to Agri-Environmental Policy Valuation.

Stephen Hynes[1*], Danny Campbell[2] and Peter Howley[3]

1. Socio-Economic Marine Research Unit, J.E. Cairnes School of Business and Economics, National University of Ireland, Galway
2. Institute of Agri-Food & Land Use, Queen's University Belfast
3. Rural Economy Research Centre, Teagasc, Athenry, Galway, Ireland

Abstract

The non-market value accruing from an agri-environmental scheme can be examined by assessing the public's willingness to pay for the policy outputs as a whole or by modelling the preferences of society for the component attributes of the rural landscape that result from the implementation of the policy. In this paper we examine if the welfare impacts from implementing an agri-environmental policy are significantly different if one uses a holistic valuation methodology such as contingent valuation or an attribute based valuation methodology such as choice experiments. It is argued that the valuation methodology chosen should be based on whether or not the overall objective is the valuation of the agri-environment policy package in its entirety or the valuation of each of the policy's distinct environmental outputs.

Keywords: landscape valuation, environmental goods and services, contingent valuation, choice experiments, attribute versus holistic values, latent class models, preference heterogeneity, environmental policy

JEL Classification: Q18, Q51.

* Stephen Hynes is the contact author (e-mail: *stephen.hynes@nuigalway.ie*), Office: +353 (0)91 493105, Fax: +353 (0)91 524130. The authors would like to acknowledge the useful comments received from the Professor David Harvey on an earlier version of the paper. This paper was written as part of a Rural Stimulus Funded project, financed by The Irish Department of Agriculture, Fisheries and Food.

1. Introduction

One of the main instruments used to deliver agri-environmental policy in Europe and America has been taxpayer funded voluntary incentive payments to farmers to encourage the production of non-commodity environmental outputs (Hynes and Garvey, 2009). Evaluation of the effectiveness of agri-environmental policy in protecting the rural environment and traditional farm landscapes has also become increasingly important in order to demonstrate value-for-money to taxpayers. The policy issues are dominated on the one hand by the need for a more effective delivery of environmental and landscape benefits, and on the other by the assessment of whether or not these benefits actually offset policy costs.

The requirement to value agricultural non-market outputs such as the provision of an aesthetically pleasing traditional rural landscape has resulted in a large number of studies using both revealed and stated preference methodologies (Pruckner, 1995; Bergland, 1997; Hanley et al., 1998a; Fleischer and Tsur, 2000; González and León, 2003; Campbell, 2007; Hanley et al., 2007 and Hynes and Hanley, 2009). Santos (2001) provides a comprehensive review of studies dedicated to the valuation of agricultural non-market goods while Swanwick et al. (2007) presents a more dedicated review of the environmental economic literature in relation to the valuation of agricultural landscapes in particular. Madureira et al. (2007) also provide an in depth review of methods for the economic valuation of agricultural non-market outputs and provide suggestions to facilitate the application of these methods in a broader decision making context.

Within the agri-environmental policy valuation literature the issue of whether people perceive landscapes as a "whole" or as a collection of particular characteristics, is something that has been hotly debated in recent years (Swanwick et al., 2007). Different economic valuation methodologies can be used to place a value on the non-market benefits accruing from an agri-environmental scheme by assessing the public's willingness to pay for the outputs as a whole or by modelling the preferences of society for the component attributes of the landscape that result from the implementation of the policy. Choice experiments (CE), for example, deal more explicitly with how society values relate to individual agricultural landscape components, and combinations of components, and are not so concerned with the overall landscape context. The Contingent Valuation Method (CVM) takes a more holistic approach by focusing on the value of perhaps moving from the status quo rural landscape to an alternative one that is protected under an agri-environmental scheme. In this case the alternative is presented to interviewees as a whole picture where particular changes in certain features or attributes of the landscape may also be highlighted.

According to Swanwick et al. (2007) the difference between the holistic approach to landscape valuation and the attribute based approach lies in how the landscape choices are organised and presented during the data collection process and how the data is then analysed. The way choice experiments are designed allows the landscape value to be broken down into individual attributes which is something that usually cannot be done in a contingent valuation exercise. But, as Swanwick et al. (2007) point out "this does not mean that the choices people make, and the thought processes they go through, are necessarily any different". While both CVM and CE can be used to estimate the value of a rural landscape protected under an agri-environmental policy, the CE approach has the advantage of being capable of measuring the marginal value of a change in the individual landscape characteristics (which have been specified by the researcher) while the CVM can usually only be used to value the agri-environmental landscape and any associated features as a single whole package.

In this paper we are concerned with the valuation of moving from the status quo agricultural landscape in the Irish countryside to an alternative landscape protected under an agri-environmental scheme which leads to stated improvements in certain features of the rural landscape. The paper sets out to uncover if the measured welfare impacts of this change in landscape is significantly different if one uses a holistic landscape valuation methodology such as contingent valuation (CV) or an attribute based valuation methodology such as CE. This is achieved through a survey of the Irish public where respondents were asked a CV question and also presented with a number of choice cards in a CE in order to ascertain the general Irish publics' willingness to pay for the protection of the traditional agricultural landscape under an agri-environmental scheme.

In what follows we will first discuss the use of holistic versus attribute based valuation methodologies for agri-environmental policy valuation in the literature with particular regard for studies that have compared CV and CE approaches. This is followed in section 3 with a description of the survey design and modelling approaches. Next, the estimation results are presented in section 4 and finally this paper concludes with a discussion of this paper's main findings and their implications for landscape and agri-environmental policy valuation.

2. Holistic versus attribute based methodologies for landscape valuation: a review of the literature

The CVM has been used extensively in estimating the valuation of environmental resources (see for example Pruckner, 1995; Bateman et al., 1996; Fleischer and Tsur, 2000; Dupont, 2004; Buckley et al., 2009; Hynes et al., 2010). The idea behind the CVM is to create a hypothetical or alternative market for the environmental good being examined. Respondents are then asked to state their maximum willingness to pay (WTP) for reaching or preserving the alternative state of the environmental resource or their minimum willingness to accept (WTA) for the loss of that state. In a CV study of an agricultural landscape protected under an agri-environmental policy, the landscape is valued as a whole. Particular features of the "alternative" landscape may be highlighted but they are presented as a bundle rather than the respondent being allowed to trade–off between attributes as is possible in CEs.

This holistic approach has been shown to avoid problematic issues such as separability and collinearity, which are often associated with other valuation methods such as the Travel Cost Method and the Hedonic Price Method (Willis and Garrod, 1993). According to Swanwick et al. (2007) this is due to the fact that the CVM is able to take into account the whole bundle of varying attributes in a spatial area and measure both their use and non-use value. The values derived by the CVM will however depend highly on the current state of the rural landscape and on the changes proposed to that landscape through the introduction of an agri-environmental scheme. The value of the same potential future landscape may also be different if the respondent to the CVM question is given different causes of the change in the landscape.

The environmental economics literature includes a host of studies that examine the valuation of agri-environmental schemes and agricultural landscapes using the CVM. These include Alvarez et al. (1999) who considered the value of Environmentally Sensitive Areas (ESA) status of the Machair in the Uists, England. This study focuses on a traditional grazing landscape and biodiversity. Hanley et al. (1998b) examined the Breadalbane ESA as valued by the general public, visitors and residents. Potential landscape change was conveyed using photos based on ecological succession models. In an Austrian example, Pruckner (1995) applied the CVM to evaluate the economic benefits associated with agricultural landscape-cultivating services provided as an input on behalf of the tourism sector in Austria.

Choice experiments differ from CVMs in that environmental attributes are varied in an experimental design and respondents make repeated choices between different bundles of environmental goods, which vary in terms of their attributes and the levels that these take. CE has become increasingly popular in recent times (see Boxall et al., 1996; Hanley et al., 1998a, 2003; Carlsson et al., 2003 and Colombo et al., 2009). In a CE framework, respondents are presented with a sequence of choice sets, each containing alternative descriptions of the rural landscape under examination, differentiated by its attributes and levels. By observing and modelling how respondents change their preferred option in response to the changes in the levels of the attributes, it is possible to determine how people trade-off between the landscape attributes (Bennett and Adamowicz, 2001). By including price/cost as one of the attributes of the good, the monetary welfare impact of moving from one landscape with particular attributes to an alternative landscape with attribute levels set to be representative of what would result under a specified agri-environmental policy can be calculated. Use of this technique in the estimation of the value of agri-environmental policy has been demonstrated repeatedly in the literature (e.g. Hanley et al., 2007 and Colombo et al., 2009).

Hanley et al. (1998a) point out that the final result of a CE valuation will be affected by the selection of attributes and how their levels are described. They further state that there is a large set of attributes that could be used to describe a rural landscape and the resulting welfare measure may be influenced by which ones are finally chosen. Also for some landscapes it may be possible to identify key attributes, but for others this selection will suffer from the "subjectivity" problem. As a result, the chosen bundle of attributes in the CE design may not fully explain the general public's perceptions. This is particularly true of landscape valuation where the landscape is varied and should be described using a large number of attributes.

There are numerous examples of the use of CEs for agri-environmental policy valuation in the literature. For example Hanley et al. (2001) report on choice experiments carried out in Cambridgeshire, Devon and Shropshire that considered public preferences for ancient hedgerows, new hedgerows, arable field margins and heather moorland, as landscape features. In a more recent example Colombo et al. (2009) examine a number of alternative modelling strategies that can be used in conjunction with a CE dataset on the preferences of respondents for conserving upland hill farming in the North West region of England. In a series of papers particularly relevant to our empirical study Campbell (2007), Campbell et al. (2008; 2009) and Scarpa et al. (2007; 2009) report the findings from a discrete-choice experiment designed to estimate the economic benefits associated with the Rural Environmental Protection Scheme (REPS) in Ireland. Results from this work indicated that the landscape benefits alone associated with this agri-environmental scheme were almost enough to equal the total cost of its provision.

If both the holistic approach and an attribute based approach to agri-environmental policy valuation described above uncover the same underlying preferences in the population for a particular environmental resource, and assuming the methodologies have been designed in a comparable manner then they should produce similar WTP estimates when the same changes in the environmental resource are being assessed. A number of studies have, however, found that both methods can lead to different WTP estimates (Boxall et al., 1996 and Stevens et al., 2000). Having said that, few studies in the literature have directly compared the holistic valuation approach to the attribute based approach for landscape valuation. One study that did was Hanley et al. (1998a). In this case the authors used attitudes towards forest landscapes in the UK as a case study. The CE design incorporated three attributes; shape of the trees; scale of felling and species mix. In the CV survey respondents were asked in an open-ended question to state their preference between landscape photographs in a pair/triple wise comparison and to state their maximum WTP to move from their least preferred to most preferred image.

In another study by Hanley et al. (1998b) both CVM and CE methodologies are compared in the valuation of the conservation benefits of Environmentally Sensative Areas (ESAs) in Scotland. The authors conclude that the CVM seems best suited to valuing the overall policy package and CEs to valuing the individual characteristics that make up this policy. Whilst the CE estimates were found to be greater than the CVM estimates, the 95% confidence intervals were found to overlap for both. In a more recent study, Madureira et al. (2007) present a comparison between the dichotomous choice CVM and CE elicitation formats designed to value preferences for multi-attribute variations in alternative landscape scenarios for the Northeast of Portugal. The main findings from this study were that the dichotomous choice CVM format can be used to measure preferences for multi-attribute variation and that this method also tends to give more conservative estimates of WTP as compared to CE.

Swanwick et al. (2007) point out that there are important conceptual differences between thinking about the agricultural landscape holistically, compared to thinking of it as a bundle of attributes and that landscape planning had tended to reject the latter idea as a way of describing how people think of landscapes. This means that CV and CE try to measure fundamentally different things. Moreover, “landscape values” are seen as greater than merely the aesthetic aspects of appearance, but also include notions of landscape history and current, past and future uses of the landscape. However we would argue that CE is still a suitable methodology to use when assessing the value of agri-environmental schemes. These schemes tend to be set up as a series of management tasks that target different attributes of the agricultural landscape. Valuation of the achievement (or not) of the tasks in relation to these different environmental attributes is exactly the type of valuation exercise that CE was designed for. This may be the reason why CE for agri-environmental policy valuation has accelerated in recent years.

Away from an agri-environmental policy valuation setting, a number of other studies have been concerned with determining if the CVM and CE will produce diverging welfare estimates when measuring the same environmental good. One such study was by Boxall et al. (1996) in which both CVM and CE responses were collected from a sample of recreationalists in the province of Alberta, Canada. The CVM model only allowed the derivation of welfare estimates from increasing one attribute (mouse population) to be ascertained whereas the CE allowed the welfare gains from increasing a variety of attributes such as distance from home to hunting area, quality of road access, access within hunting area, encounters with other hunters and forestry management operations in the area. The study found the CVM welfare estimate from increasing the moose population was over 20 times higher than the alternative CE valuation. The authors largely attribute this difference to respondents ignoring substitution possibilities (i.e. the option to visit alternative sites to the one contained in the WTP question) when answering the CVM valuation question.

Further studies which found significant differences between WTP estimates derived from CEs and CVMs include Barrett et al. (1996) who concluded that CE estimates for two types of water purification programs were four to five times higher than the corresponding CV estimates. Similarly Stevens et al. (2000) in a study of the willingness of non-industrial private forest landowners to pay for activities that are compatible with ecosystem management also found CE estimates were significantly higher than the valuations obtained from the CV approach. Jin et al. (2006) using residents' preferences for solid waste management policy changes in Macoa as their empirical context compared welfare measures from a double-bounded dichotomous CVM and a CE. The authors reported that they were no significant differences between the values derived from the two methods. Finally, Christie and Azevedo (2009) explored the relationship between the CVM and CEs by conducting validity tests between a CE model and a repeated CVM over a range of levels of improved water quality at Clearlake, IA, USA. In all of the comparative studies reviewed above the CE models used did not account for taste heterogeneity in the population by using mixed modelling approaches. By not doing so they have been producing biased welfare estimates. We account for this issue by using a discrete mixture approach as our CE model.

This paper adds to the above literature in a number of respects. Firstly, it compares a CVM model using the payment card elicitation format to a CE model. This is the first time these two elicitation formats have been compared in the literature. Secondly, the study is also one of the first to elicit responses to both a CVM questions and a CE from the same sample of respondents rather than using a split sample as is done in other studies that have examined the difference in welfare estimates from the CVM and CE. Also, our study is a national level study whereas most case-studies that attempt to value particular landscapes or agro-ecosystems are usually defined at local or regional scales. Attempts to generate value estimates at a national level are scarce (Drake, 1992 and Pruckner, 1995 being two exceptions).

Finally, no previous paper has accounted for taste heterogeneity in the CE model when comparing the use of the CVM and a CE in agri-environmental policy valuation. The CVM implicitly accounts for taste heterogeneity across the population as WTP is modelled as a function of the socio-economic characteristics (e.g. age, gender, etc) and environmental preferences (e.g. member of environmental group or likert scale dummies for views on particular landscape attributes) of the respondents but discrete choice models used with CE data tend to model the choice made as a function of the attributes of the good not of the respondent (as the respondents characteristics or preferences do not vary across the choice options). CE models for agri-environmental policy valuation used in previous comparisons to the CVM in the literature have employed the basic conditional logit model that cannot control for taste heterogeneity. We use a Latent Class Modelling procedure for the CE that allows for taste heterogeneity in the preferences of the population. This is a significant contribution to the literature reviewed above as it has been previously shown that welfare estimates can be significantly different when one compares the results from a conditional logit and a latent class or other model that accounts for taste heterogeneity (Hynes et al., 2008).

3. Research design and valuation methodologies

In order to obtain information relating to the Irish publics' attitudes towards the rural environment and, in particular, to estimate the public good benefits resulting from conserving the traditional Irish farming landscape a survey of 1005 individuals living in Ireland was conducted between November 2008 and January 2009. A quota controlled sampling procedure was followed to ensure that the survey was nationally representative for the population aged 18 years and above. The quotas used here were based on known population distribution figures for age, sex and region of residence taken from the Irish National Census of Population, 2006. Pilot testing of the survey instrument was conducted prior to the main survey. Along with expert judgment and observations from earlier focus group discussions, results from the pilot were used to refine the questions asked in the main survey[1]. Respondents were given both a CV question and a series of choice experiments to ascertain their WTP for measures aimed at protecting the traditional rural landscape. The order in which the CV question and the CE choice sets were presented to respondents was also continuously rotated. Summary statistics for the sample are presented in table 1.

For the CVM question, respondents were first informed that: *"There are a number of possible future agricultural landscapes that may exist in 2030. An ever expanding world population, higher demand for food, and land being used to produce renewable energy and green materials to replace petroleum based products such as plastic could result in agriculture in Ireland becoming much more intensive. For these reasons, the environmental pressures on the rural landscape in Ireland may increase. Therefore, under future Common Agricultural Policy reform it may be the case that farmers will be paid more for conservation activities rather than for the security of food production.*

Individuals in the survey were then asked the following question:
"Bearing in mind the importance or unimportance of conserving traditional landscapes for you personally; if you could be sure that your money would go towards protecting traditional rural landscapes in Ireland only, would you be prepared to pay to support agricultural activities contributing to the protection of the traditional farm landscape as portrayed in this show card (see figure 1)."

Those who answered the question in the affirmative were then presented with a payment card showing the bid amounts of €20, €35, €50, €65, €80 and €95 and were

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[1] A number of one to one discussions with Professor Nick Hanley of Stirling University, in relation to a number of similar type CE studies conducted by him on aspects of the British countryside (see for example Hanley et al. (1998b) and Hanley et al. (2007)) were also extremely useful in choosing attribute levels and informing our CE design.

asked: ‘‘of these bid amounts which would be the maximum you would be willing to pay (€) each year into a conservation fund to support those agricultural activities contributing to traditional farm landscape preservation”[2]. Following Cameron and Huppert (1989), the response is interpreted not as an exact statement of willingness to pay but rather as an indication that the WTP lies somewhere between the chosen value and the next larger value above it on the payment card. Recent applications of the payment card method in the literature include Krupnick et al. (2006), Ryan and Watson (2008) and Hynes and Hanley, (2009). The main advantages and disadvantages of the payment card format as opposed to other methods aimed at eliciting WTP are not reviewed here but are fully discussed by Boyle et al. (1997), Blamey et al. (1999) and Fonta et al. (2010). In this questionnaire the price range used in the payment card was based on the responses to the pilot study which utilized the open-ended elicitation format (see Haab and McConnell, 2002). Information was also provided to the pilot participants in an attempt to minimize any potential bias in responses to the open-ended WTP question since these would be used to construct the bid amounts used on the payment card[3].

Following Hynes and Hanley (2009) the WTP responses to the CVM question was treated in a parametric model, where the WTP value chosen by each respondent was specified as: $\text{WTP}_i = \mu_i + \varepsilon_i$. where μ_i is the deterministic component and ε is the error term. It is assumed that $\varepsilon \sim N(0,\sigma^2 I)$. The chosen Generalized Tobit Interval model employs a log-likelihood function adjusted to make provision for point, left-censored, right-censored (top WTP category with only a lower bound) and interval data. For individuals $i \in C$, we observe WTP_i, i.e. point data and for respondents $i \in L$, WTP_i are left censored. Individuals $i \in R$ are right censored; we know only that the

[2] Respondents were told the money put aside for this conservation fund would involve an increase in general taxation (income and/or VAT tax) levels. Respondents were also asked to remember that they already pay for the protection of rural landscapes generally through income and/or VAT tax through the Rural Environment Protection Scheme.

[3] To seek to minimize respondents’ expression of preferences not truly reflecting their willingness to pay on account of ‘embedding’, respondents in the pilot were reminded that this was one of a number of landscape typed that could be promoted. To minimize hypothetical bias respondents in the pilot were also reminded about their budget - what they could afford to spend just on this site and particularly what they were actually paying for - the characteristics and facilities of the protected landscape. Respondents were told that the Irish agricultural research organization Teagasc was using this information for the development of agricultural policy. They were told also that their answers might actually result in increased taxation payments.

unobserved WTP_i is greater than or equal to WTP_{Ri}. Finally respondents $i \in I$ are intervals; we know only that the unobserved WTP_i is in the interval $[WTP_{1i}, WTP_{2i}]$. The log likelihood is given by:

$$\ln L = -\frac{1}{2}\sum_{i \in C} w_i \left\{ \left(\frac{WTP_i - x\beta}{\sigma} \right) + \log 2\pi\sigma^2 \right\} + \sum_{i \in L} w_i \log \Phi \left\{ \left(\frac{WTP_{Li} - x\beta}{\sigma} \right) \right\}$$

$$+ \sum_{i \in R} w_i \log \left\{ 1 - \Phi \left(\frac{WTP_{Ri} - x\beta}{\sigma} \right) \right\} + \sum_{i \in I} w_i \log \left\{ \Phi \left(\frac{WTP_{2i} - x\beta}{\sigma} \right) - \Phi \left(\frac{WTP_{1i} - x\beta}{\sigma} \right) \right.$$

where $\Phi()$ is the cumulative distribution function of the normal distribution, respectively, and w_i is the weight of the *i*th individual. Since our data is unweighted, w_i is simply set equal to 1.

The Generalized Tobit model assumes normality of the error terms. However, since the dataset has a relatively high proportion of individuals that report WTP = 0 it may be the case that this assumption of normality is unrealistic. With this in mind we test the normality assumption and also estimate a "Two-Part Model" which consists of a probit model to estimate the probability that an individual is willing to pay something (Pr(WTP >0)) and an OLS regression, applied only to the sub-sample who have indicated they will pay something, to estimate the Willingness to Pay amount (*E*(WTP|WTP>0)). The two parts are assumed independent and are estimated separately. Following Fonta et al. (2010) the mid point between the stated WTP figure and the next higher value presented on the payment card was used in the Two-Part approach as the dependent variable.

In the survey we also employed a choice experiment framework as an alternative approach to estimating the public good benefits resulting from conserving the traditional Irish farming landscape under an agri-environmental scheme. In the CE exercise each respondent *i* was asked to identify a preferred farming landscape choice *j* among a given set of alternatives. Each landscape choice has the same set of attributes but with differing levels. Focus groups with members of the general public were used to identify relevant countryside landscape attributes for inclusion in the study. Through the focus groups we identified the attributes associated with "Irish farm landscapes" that the general Irish population want to see supported under future reforms of the Common Agricultural Policy (CAP).

The final attribute list was comprised of the presence of wild flora and fauna on farm, the utilisable agricultural land under rapeseed, willow and other bio fuels, the condition of field boundaries (stone walls and hedges) and the quantity of cattle and/or sheep in the landscape. The attributes and their levels are further described in table 2. Attributes and their levels were informed by both focus group participants and agricultural experts[4]. The payment vehicle used in the choice experiment was an increase in general taxation. The reasons for using this payment vehicle include the fact that agricultural policy and programmes are generally paid for through taxation and that participants of the focus groups indicated that taxation was their preferred payment option. The tax levels were €10, €20, €40, €80, with a baseline of no increase. These tax levels were chosen based on focus group discussions and pilot results.

To increase sampling efficiency, when the parameters are unknown, a sequential experimental design with a Bayesian information structure, based on the minimisation of the D_b-error criterion, was employed.[5] For the pilot version, the experimental design was based on rudimentary knowledge of the sign and magnitude of the parameters—gained from focus group discussions, relevant literature and stakeholder opinions. The main survey employed a Bayesian design based on the multinomial logit parameter estimates obtained from the pilot study data. The final design consisted of two versions of eight choice tasks. Each choice task contained three alternatives: option A, option B and a status quo. The status quo alternative represented a continuation of current levels in all the landscape attributes and therefore a zero additional tax (price) was associated with the status quo alternative. Generic alternatives A and B contained variations in the attribute levels, but with a

[4] Prior to carrying out the choice experiment respondents were firstly presented with a preamble on why alternative possible future agricultural landscapes may exist in 2030 along with a short description of the Common Agricultural Policy. To further inform respondents about the choices they were being asked to make the interviewer worked through a mock choice card with each interviewee explaining what each attribute and level in the alternative options meant. Respondents were encouraged to ask clarification questions on any aspect of the choice task at this point.

[5] For a comprehensive overview of the efficient experimental design literature the interested reader should see Scarpa and Rose (2008).

positive tax price, representing modification to current policy support. Since choice scenarios involving both large increases to livestock and bio-fuel crops were deemed unfeasible, a level constraint was also added to the experimental design process to insure these levels would not appear together in any of the choice cards.

Data from the CE was analyzed by employing the theoretical framework of random utility models (McFadden, 1974). In an empirical application of the random utility model (RUM) it is assumed that individual *i*'s indirect utility function *U* can be represented by two separable components:

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt}$$

U_{ijt} is the indirect utility of individual *i* from landscape choice *j* in choice occasion *t*. V_{ijt} is the deterministic part of the indirect utility function and ε_{ijt} is the stochastic part. Whenever the utility from landscape *j* is greater than the utility from all other landscapes *J*-1, landscape *j* will be chosen. The RUM model can be specified in different ways depending on the distribution of the error term. If the error terms are independently and identically drawn from a type I extreme value distribution, with constant variance $\pi^2/6$, the RUM model can be specified as a conditional logit (McFadden, 1974). This implies that the probability of choosing landscape *j* is given by:

$$\Pr\left(j_{it}\right) = \frac{\exp(V_{ijt})}{\sum_{j=1}^{J}\exp(V_{ijt})}$$

where $\Pr\left(j_{it}\right)$ is the probability that landscape *j* is chosen by individual *i* in choice occasion *t*. The observed utility V_{ijt} is usually assumed to be linear in the parameters so that: $V_{ijt} = \beta' x_{ijt}$ where x_{ijt} is a vector of observed variables relating to respondent *i*, alternative *j* and choice occasion *t*. Frequently, researchers employ the basic conditional logit model to analyse this type of choice data. However, this model is not able to control for sources of correlations between alternatives, and as a result the independence from irrelevant alternatives property (IIA) does not hold. Also, the basic conditional logit model cannot handle situations where the unobserved part of the utility function is correlated over the sequence of choice occasions made by a single respondent. Finally, it should also be noted that since a single-parameter estimate is generated for each choice attribute in the conditional logit model this implies preference homogeneity across respondents.

Therefore, to account for dependence across repeated choices made by the same respondent and to allow for heterogeneity in respondents' preferences, we make use of the panel data latent class model (LCM) (Boxall and Adamowicz, 2002; Hynes et al., 2009). The LCM captures heterogeneity by assuming that the underlying distribution of preferences can be represented by a discrete distribution, with a small number of mass points that can be interpreted as different groups of individuals. The difference between the LCM and other mixed logit models is that the mixing of taste intensities takes place over a finite group of taste segments, rather than over continuous value distributions (Scarpa and Thiene, 2005)[6]. Preferences in each "latent" (i.e. unobserved) class, *c*, are assumed homogeneous; but preferences, and hence utility functions, are allowed to vary between groups. Within the latent class structure and assuming utility is linear in β, the probability of respondent *i*'s sequence of choice would be given by:

$$\Pr(y_i \mid \beta, x_i) = \prod_{t=1}^{T_i} \left[\sum_{c=1}^{C} \pi_c \frac{\exp\left(V_{iy_{it}t}(\beta_c)\right)}{\sum_{j=1}^{J} \exp\left(V_{ijt}(\beta_c)\right)} \right]$$

where y_i gives the sequence of choices over the T_i choice occasions for respondent *i*, i.e., $y_i = \left\langle j_{i1}, j_{i2}, \ldots, j_{iT_n} \right\rangle$ and π_c represents the class membership probability. In this panel version of the LCM, β_c represents the vector of unique class-specific parameters. Once the parameters of the model are estimated, a weighted average of the parameters can be derived as follows: $\hat{\beta} = \sum_{c=1}^{C} \hat{\pi}_c \hat{\beta}_c$ (see Greene and Hensher (2003) for further details).

In this paper, we compare the CVM and latent class CE models in terms of the welfare measures that they imply. For the CVM Generalized Tobit Interval model we

[6] We also estimated the conditional logit model and a Random Parameters Logit (RPL) model. The LC model however proved to be the best fit for the data. The results of the conditional logit and RPL are not shown here but are available from the authors upon request.

can directly predict the WTP of respondents for the conservation of the traditional farm landscape using the estimated model. For the CE latent class model we use the Hicksian welfare measure for a change in one or more landscape attributes which is based on the compensating variation log-sum formula described by Hanemann (1984). The expected welfare gain (or loss) associated with a change in landscape attributes, based on the latent class model, can be estimated by calculating the weighted sum of the welfare measures in all classes, weighted by the class membership probabilities:

$$CV = \sum_{c=1}^{C} \hat{\pi}_c \left\{ \frac{1}{\hat{\gamma}_c} \left[\ln\left(\sum_{j=1}^{J} \exp\left(\hat{V}_c^1\right)\right) - \ln\left(\sum_{j=1}^{J} \exp\left(\hat{V}_c^0\right)\right)\right]\right\}$$

where $\hat{V}_c^0$ and $\hat{V}_c^0$ represent the deterministic part of the indirect utility function before and after the landscape change under consideration based on the estimated class-specific parameters within latent class *c* and $\hat{\gamma}_c$ is estimated cost attribute within class *c*. To insure consistency in the valuation exercises across the two methodologies, respondents were presented in the CVM show card (Figure1) with the appropriate levels of the attributes that are associated with a conserved traditional farm landscape[7]. These same attributes and levels were also used in the CE. The CVM and CE model results are presented in the next section along with the resulting welfare estimates.

4. Results

Results from the CVM Generalized Tobit and Two-Part Model

A Generalized Tobit Interval model was first used to estimate individuals' WTP for the conservation of the traditional rural landscape. In our chosen model, *WTP = f (Gross Income, Gender, Third Level Education, Have Children, Family member in farming, Non-Dublin Resident, Unemployed or Unable to Work, Number of Household Members).* The same explanatory variables were used in both the probit and OLS components of the Two-Part Model. These explanatory variables were

[7] Discussions with Environmental Specialists in the Irish Agricultural Research Agency Teagasc also aided in choosing the attributes and the appropriate levels to use in the required agri-environmental policy scenario.

chosen based on a review of the literature and *a priori* expectations of the characteristics that we believed should influence WTP. The regression results from the Generalized Tobit (plus a footnote on the distribution of WTP by censorship type) and the Two-Part Model are presented in table 3. Forty seven per cent of the respondents reported that they would be willing to pay something towards the conservation of the traditional rural landscape.

Individuals who stated they were not willing to pay because the price was too much, were considered interval observations of between €0 and the lowest bid amount on the payment card, €20[8]. Individuals who stated they were not willing to pay because they could not afford to pay anything or did not visit the countryside enough to justify it were considered as point observations of €0. Respondents who gave other reasons for not being WTP were considered as protest bids and excluded from the analysis. Of the €0 WTP responses, 111 were treated as legitimate bids while 422 were treated as protest bids. These later observations were excluded from the analysis. The total final number of responses used in the CVM analysis was therefore 580.

The Wald χ^2 statistic shows that, taken jointly, the coefficients in the Generalized Tobit Interval model are significant at the 1% level. In relation to personal characteristics, as expected, income and third level education were both found to have a significant and positive effect on willingness to pay for the conservation of the traditional rural landscape. Individuals with children and those with siblings or parents involved with farming were also more likely to be WTP a higher amount. As expected, unemployed or incapacitated individuals were willing to pay less than their employed counterparts. Respondents resident outside of Dublin County (where over 25% of the Irish population reside and which is home to the Irish capital city of the same name) were also found to be willing to pay less than those living in Dublin. This may be an indication that visitors to the countryside from the city may have a greater appreciation for an agri-environmental policy protected rural landscape than those that actually live in it. As expected the outcome of a Lagrange Multiplier test is a rejection of the normality assumption underlying the tobit modelling approach. For this reason

[8] These individuals had already answered 'yes' to the question '….*would you be prepared to pay to support agricultural activities contributing to the protection of the traditional farm landscape as portrayed in this show card…'.* Only 4 individuals actually fell into this category.

we also explore the use of a simple Two-Part Model which allows for the possibility that the zero and positive WTP values are generated by different decision making mechanisms.

Similarly to the Generalized Tobit, the χ^2 and F statistics in the Two-Part Model shows that, taken jointly, the coefficients in the Probit and OLS models, respectively, are significant at the 1% level. The two-part models (probit + OLS for WTP>0) show that the magnitudes and signs of the coefficients for factors affecting the willingness to pay decision differ from the factors affecting actual amount to pay decision in a number of respects. The estimates of the Probit model indicate that only the covariates for Gross Income, Have Children and Family Member in Farming are statistically significant determinants of the probability of willingness to pay. The coefficients in the second part of the two part model have the same sign as those in the first part, except for Gender*,* but in this model all covariates are statistically significant, at least at the 10% level. Given the assumption that the two parts of the model are independent, the joint likelihood for the two parts is the sum of the two log likelihoods which equals -5537. By comparison the log likelihood for the Generalized Tobit Interval model was -1483 which indicates that the Generalized Tobit fits the data better[9]. Having said this it is noticeable that the size and significance of the coefficients in the OLS component of the Two-Part model are almost identical to those of the Generalized Tobit. In what follows we will produce welfare estimates for both CVM modelling approaches.

Results from the Latent Class Model

In our chosen latent class model, the indirect utility for any landscape option is assumed to depend on the levels of the attributes of that landscape. The same

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[9] Although the results are not presented we also ran a Heckman two stage model where in the first step, a vector of parameters is obtained from a probit estimation and an Inverse Mills Ratio (IMR) is calculated for each respondent. In the second step, the least squares regression for the amount to pay is estimated including IMR as an additional independent variable and we also adjusted the standard errors for heteroskedasticity. Since the results of the Heckman model showed that the error terms of willingness to pay and the amount to pay decisions are uncorrelated (rho = -0.02) and the p-value of the IMR coefficient (p=0.67) indicates that omitted variable bias is not introduced in the amount to pay decision. The uncorrelated error terms, the results of a likelihood ratio test which proved that the hypothesis that the two parts of the model are independent cannot be rejected and the insignificance of the IMR coefficient suggests that the Two-Part model (probit + OLS for WTP>0) is a sufficient method for modeling the determinants of WTP decisions. In addition, the two-part model is easier to estimate and interpret.

attributes are allowed to enter the utility function of all three generic landscape options with the levels varying in the first two. The third landscape has the same attributes as the first two but the levels are held constant across all choice sets in landscape 3 to represent the fact that this is status quo situation representing the no policy change scenario. We also assume that the socio-economic characteristics of respondents may influence their preferences for alternative attributes and levels and therefore include an income and 'family involved in farming' variable in the model as well. Because these socio-economic variables do not vary between choices for any given respondent they are interacted with the status quo option. By doing so we are able to determine if higher income or having a family member involved in farming is more likely to result in a respondent choosing the status quo option.

A grouped alternative specific constant for landscape options 1 and 2 (the non-status quo options) was also included in the model specification. The attribute levels (apart from cost) are treated as dummies in the model specification with the status quo level of no change in attribute level being always taken as the base case. The final chosen model assumes that *U = f(Flora and Fauna, Bio Fuels, Field Boundaries, Cattle and Sheep, Family Member involved in Farming, Gross Income, dummy for the non status quo options, Cost)*. Further details on attributes and their levels are given in table 2. On completion of the choice sets respondents were asked if, in making their choices, they had ignored any of the landscape characteristics. Only those who indicated that they had not ignored any of the attributes and options were included in the final analysis. This resulted in 915 usable observations in the model, each of whom was presented with 8 choice sets containing 3 landscape options[10].

With respect to the definition and testing of hypothesis on the number of classes in the latent class model the conventional specification tests used for maximum likelihood estimates (likelihood ratio, Lagrange multipliers and Wald tests) are not valid as they do not satisfy the regularity conditions for a limiting chi-square distribution under the

[10] We also specified models based on the same sample of 580 observations that were used in the CVM model. These models resulted in worse fitting specifications with fewer significant explanatory variables. We therefore chose to use the full available sample instead. Because those who legitimately chose the non-payment status quo option in the CV scenario are also included in the specification we believe the comparison between both model results is no less valid.

null (Hynes et al., 2008). Therefore, in order to decide the number of classes with different preferences, we use an information criteria statistic developed by Hurvich and Tsai (1989). We use the Akaike information criterion and its corrected form (based on sample size), the consistent Akaike information criterion. The number of classes that minimize each of the measures suggests the preferred model. These statistics provide guidance on the number of latent classes to choose but as Scarpa and Thiene (2005) point out this decision also requires the discretion of the researcher. We hence choose only to report in table 4 the LCM estimates for 2 classes even though the information criteria statistic were lowest for the four-class model. We reject the 4 class model as one of its classes has a positive cost attribute parameter and also both the 3 and 4 class models displayed mostly insignificant attribute coefficients in one or two of their classes, respectively.

The two-class model specification allocated 57% of respondents to class one and 43% to class two. As expected both Class 1 and 2 parameters show positive preferences toward improving the presence of wild flora and fauna on the farm and towards the improved maintenance of field boundary walls and hedgerows, although in the case of Class 2 not at an acceptable statistically significant level. There is a mixture of preferences in terms of a moderate increase (30%) in the quantity of bio-fuel crops in the landscape with positive preferences shown in class 1 and negative preferences shown in class 2. The weighted implicit price for this attribute however implies an overall negative WTP for this 30% increase (€-5.12 per person per year). There is also a negative preference displayed for a large increase (60%) in this attribute across both classes.

Class 1 utility parameters also exhibit positive and significant preferences for the cattle and sheep alternatives that offer both a moderate decrease and a moderate increase (30%) in the levels of this landscape attribute. The moderate increase in cattle and sheep is negative but insignificant in class 2. The positive preferences for both a moderate increase and decrease in cattle and sheep for members of class 1 would seem to suggest that the utility of respondents in this class is increased with moderate change away from the status quo in any direction. This result may be unique to the level of the dummy chosen, reflecting the fact that 30% change in cattle and sheep in the landscape is not a dramatic enough change for respondents to be able to distinguish a definite directionality of preferences[11]. The dummy for a large increase in cattle and sheep in the landscape (60%) is negative and significant in class 2 but insignificant and positive in class 1.

Importantly, the cost coefficients in both classes are negative and significant at the 1% level. Both cost parameters display a low absolute value which would seem to indicate that the Irish public are willing to pay a relatively large amount of money for the farm landscape features that are important to them. A priori we would have expected that having a member of the family actively involved in farming would have significantly influenced a respondent's preferences for alternative landscape types (as it does in the CVM model) but this interaction term is insignificant in both classes. As expected, a respondent's income level does have a significant impact on landscape preferences. Those on lower incomes are significantly more likely to choose the status quo option which obviously is associated with no change in taxation payable by the respondent.

Welfare estimates

The welfare estimates derived from both modelling approaches are presented in table 5. Using the Generalized Tobit Interval model, the average individual WTP for ensuring the protection of the traditional rural landscape was estimated at €44.49 per person per year with an associated 95% confidence interval of €43.82 to €45.15 while the equivalent figure for the Two-Part Model was €35.92 per person per year with an associated 95% confidence interval of €34.83 to €38.01. The interval based model used in this analysis takes into account the fact that each individual may be willing to pay some monetary amount between his maximum stated figure and the next higher value presented on the payment card. As such it is a more accurate method than simply using the stated value of each respondent in the sample in the modelling process. The mid point between the stated figure and the next higher value presented on the payment card was used in the Two-Part Approach.

[11] It may also reflect that the latent classes are not fully capturing the unobserved preference heterogeneity in relation to this attribute. It is possible that the taste intensities for this attribute in particular cannot be adequately portrayed using a latent class structure or standard distributions implemented in existing packages which are typically uni-modal. The distribution of preferences for this attribute may also be affected by outliers (cf. Campbell et al. (2010)) or by attribute non-attendance, both of which can influence the sign and magnitude of the estimated parameters. Both these issues go beyond the scope of this paper. We leave an exploration of these issues for a subsequent paper.

The compensating surplus estimate and 95% confidence interval calculated using the results of the latent class model, and shown in table 5, represent respondents' average WTP to move from the state of the world given in the baseline (the no change scenario) to the state of the world that results from the change in a number of the landscape attributes. In our case this corresponds to the same changes described in the CVM question, i.e. improved conservation of wild flora and fauna on the farm and for every 1km of field boundaries, 700m are fully maintained. It was assumed that there would be no changes in the other attributes from current levels. Table 5 presents the compensating surplus figure for both classes and the weighted average (across classes) compensating surplus figure. The weighted average compensating surplus figure that would result from the pursuit of this agri-environmental policy scenario was calculated to be €59.51 with and associated confidence interval of €37.16 to €81.85.

5. Discussion and Conclusions

In this paper we have been concerned with the comparison of a holistic approach to an attribute based approach for the valuation of the non-market benefits derived from an agri-environmental programme that achieves certain stated changes in the Irish agricultural landscape. We employed a CVM Generalised Tobit and a Two-Part Model as the holistic approach and a CE latent class model as the attribute based approach in the valuation exercise. We were also particularly interested in examining if the measured welfare impacts from the stated changes in the agricultural landscape were significantly different across the two approaches. We believe that the welfare estimates generated from the modelling approaches employed may be more comparable that in previous comparative studies as we have implicitly accounted for taste heterogeneity in the CE model through the use of the LCM while the CVM approaches already allow for taste heterogeneity in the preferences of the population as the chosen explanatory variables control for them. Previous CVM versus CE studies simply used the conditional logit as the CE model which cannot account for taste heterogeneity in the population.

In our study we found that the attribute based CE approach provided a welfare estimate (weighted average WTP) that was €15 higher than the holistic CVM approach (Generalized Tobit estimates). However, on examination of the confidence intervals, the difference between the three methodologies was insignificant at the 95% level. In fact the confidence interval for the Generalized Tobit estimates is completely contained within the CE (weighted class averaged) confidence interval. This is a similar result to that found by Hanley et al. (1998b). The calculated average welfare estimates from both valuation approaches are lower than a number of other studies that have estimated the value of protected agri-environmental landscapes in Ireland and abroad. This may be a reflection of the downturn in the economic fortunes of Ireland prior to the collection of the survey which would have resulted in a lower WTP additional taxation on the part of the Irish public.

For example, estimates from Campbell (2007) and Campbell et al. (2008) of the average WTP per person per year for environmental benefits associated with specific improvements to the rural Irish landscape as a result of implementation of the Rural Environmental Protection Scheme ranged from €90 to €210 depending on the model specification used. Elsewhere, the contingent valuation method used by Drake (1992) to estimate the Swedes' willingness to pay to preserve the agricultural landscape was estimated at €78 per household per year while the overall WTP for the ESA policy that preserves traditional Scottish agriculture was calculated at £107.55 per household per year by Hanley et al. (1998a). Also, Visintin (2004) assessed the value that Slovenians attached to the landscape policy that protects the traditional "mosaic" landscape against the expansion of a mono-cultural rural landscape. She estimated that the average willingness-to-pay to preserve the "mosaic" agricultural landscape was €239 and €38 per household per year for residents and non-residents respectively.

The insignificant difference in welfare estimates from the two landscape valuation approaches in this study have potentially important implications in terms of which valuation methodology should be chosen when estimating the value of an agri-environmental policy. The attribute based approach allows the researcher to examine the general trade-offs which society is willing to make between attributes of the countryside. The CVM on the other hand presents the respondent with a specific change in the agricultural landscape that would result from the introduction of a particular agri-environmental policy and elicits a response that is unique to that particular case and to the combined stated changes in the landscape features. How the respondents make trade-offs between the agricultural landscape features presented in a CVM question cannot be measured. In regard to its ability to allow for the estimation of the marginal willingness to pay values for specific landscape attributes as well as the total WTP for a particular landscape type with a set level of each attribute, the attribute based CE approach has therefore a distinct advantage over the CVM.

Having said this, it should be kept in mind that a CE is limited by design to the inclusion of only a small number of landscape attributes in each choice option presented to respondents. The total value of the agri-environmental policy in this case is obtained by estimating the value of the utility associated with the particular attribute levels of an agri-environmental policy included in the experimental design but there may be other attributes that are important that are not included in the CE. The attributes contained in an agri-environmental policy valuation study are also subjectively chosen by the researcher (usually with the help of focus groups and expert opinion) and therefore it is possible that the chosen attributes will not adequately explain the general public's perceptions of the rural landscape. While attributes may be specified in a CVM question as well it is also possible to present an actual photo (as was done in this study) or artists impression of the agricultural landscape scenario (as was done by Garrod and Willis, 1993) to the respondent which perhaps better assists the respondent to form their impression of that particular landscape option than is possible though the choice options presented in a CE.

This implies that the CVM is perhaps more suited than CEs in valuing the overall agri-environment policy package or the conserved landscape as a whole if we can assume that the researcher is able to "draw an accurate picture" of the landscape change scenario. Also, where there are monetary or time constraints the CVM may offer a faster and usually more cost effective approach to agri-environmental valuation. Piloting and questionnaire design needs to be considered carefully in any CVM study but the process is usually shorter, as is the interviewing time, than the extensive time and effort that is needed in designing, setting up and carrying out a choice experiment.

Ultimately, if, as was found in this paper, both the holistic and attribute based methods result in, statistically, the same overall welfare estimates then the selection of which method to be used by the researcher/policymaker should be based on whether or not the overall objective is the valuation of the agri-environmental policy package in its entirety or the valuation of separate environmental outputs of the policy. If the agri-environmental policy under consideration is targeted at only a small number of agricultural or environmental features or the researcher or policy maker is concerned with the estimation of the marginal willingness to pay values for specific landscape attributes to aid in agri-environmental policy design then the CE approach offers more scope. On the other hand, where the policy maker is just interested in establishing whether an agri-environmental scheme's total non-market benefits outweigh its cost of implementation or where the number of possible landscape attributes are large and varied or where there are significant resource constraints in terms of the valuation survey then a holistic CVM approach may be more applicable.

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Tables

Table 1. Summary Statistics of Respondents in Landscape Preference Survey

Variable	Mean	Std. Dev.	Min	Max
Gender - Proportion of Respondents who are male	0.52	0.50	0	1
Age in years	42.20	15.97	18	92
Proportion of Respondents who are Married	0.52	0.50	0	1
Proportion of Respondents who have Children	0.62	0.49	0	1
Proportion of Rural Residents	0.43	0.50	0	1
Willingness to Pay for Landscape Conservation*	37.22	29.30	0	95
Proportion with Third Level Education	0.30	0.46	0	1
Proportion of Respondents with direct Family Links to Farming	0.44	0.50	0	1
Income (€, yearly)	28761	17871	6000	90000
Number of Household Members	2.45	1.18	1	9

* This figure is for the subset of respondents who gave a positive or legitimate zero response.

Table 2. Landscape attributes and levels used to describe choice alternatives

Attribute	Description	Levels
Cattle and Sheep	Change in quantity of cattle and/or sheep in landscape	Moderate Decrease (-30%) **No change (0%)** Moderate Increase (30%) Large Increase (60%)
Biofuel Crops	Change in utilisable agricultural land under rapeseed, willow and other bio fuel crops	**No change (0%)** Moderate Increase (30%) Large Increase (60%)
Field Boundaries	Condition of field boundaries (stone walls and hedges)	Poor: For every 1km, 50m is fully maintained **No Change: For every 1km, 400m is fully maintained** Good: For every 1km, 700m is fully maintained
Flora and Fauna	Presence of wild flora and fauna on farm	Rapid decline **No change** Improved conservation
Cost	Amount paid per person per year through higher tax payments.	**€0,** €10, €20, €40, €80

Note. The status quo levels of these attributes are shown in BOLD text.

Table 3. CVM regressions of WTP for protecting the traditional rural landscape

Generalized Tobit Model		Two Part Model	
		Probit Model	**OLS Model**
Variables	**Coefficient**	**Coefficient**	**Coefficient**
Gross Income	0.26 (0.06)***	0.01(0.01)***	0.29 (0.07)***
Gender	-5.97 (-2.59)**	0.17 (0.13)	-5.01 (2.47)**
Rural	-5.01 (-3.06)*	-0.13 (0.15)	-5.10 (2.83)*
Unemployed or Unable to Work	-8.33 (-4.73)*	-0.03 (0.23)	-8.52 (4.70)*
Children	10.16 (2.51)***	0.29 (0.13)**	9.78 (2.55)***
Third level Education	5.31 (2.80)*	0.24 (0.15)	5.14 (2.79)*
Family Member in Farming	7.45 (2.48)***	0.53 (0.13)***	7.73 (2.47)***
Number of Household Members	2.08 (1.05)**	0.06 (0.05)	2.01 (0.99)**
Constant	28.07 (4.73)***	-0.15 (0.23)	24.90 (4.45)***
Log likelihood	-1483	-5537	
χ^2 (8) statistic (F statistic for OLS)	79.08	54.47	10.55

Robust standard errors in parentheses. (*) indicates significant at 10%; (**) indicates significant at 5%; (***) indicates significant at 1%.
The Interval regression contains 0 left censored observations, 33 right censored observations, 63 uncensored observations and 484 interval observations.

Table 4. Latent Class Model (2 Classes)

	Class 1	Class 2
Flora and Fauna Decline	-0.51 (0.08)***	-0.13 (0.35)
Flora and Fauna Improvement	0.53 (0.07)***	0.50 (0.37)
Bio-fuel Crops (+30%)	0.13 (0.06)**	-0.65 (0.29)**
Bio-fuel Crops (+60%)	-0.09 (0.07)*	-0.27 (0.29)
Field Boundaries: Poor	-0.48 (0.08)***	-1.90 (0.66)***
Field Boundaries: Good	0.22 (0.06)***	0.10 (0.26)
Cattle and Sheep (-30%)	0.37 (0.07)***	-0.06 (0.29)
Cattle and Sheep (+30%)	0.71 (0.08)***	-0.73 (0.36)**
Cattle and Sheep (+60%)	0.05 (0.10)	-1.03 (0.46)**
Non Status quo Landscape Option	0.44 (0.127)***	-4.80 (0.46)***
Family Member Involved in Farming	-0.14 (0.09)	-0.21 (0.05)
Gross Income (€/1000)	-0.01 (0.01)***	-0.05 (0.27)***
COST	-0.01 (0.01)***	-0.02(0.01)***
Class membership probability Estimates	0.57 (0.02)***	0.425 (0.02)***
log-Likelihood	-5063.56	

Notes: Figures in parenthesis indicate the values of the standard errors. *** indicates significant at 1%, ** indicates significant at 5%, * indicates significant at 10%.

Table 5. Compensating surplus for Agri-Environmental Farm Landscape (all figures are in € per person per year).

Model Used	Mean	Std. Err.	95% Confidence Interval
Payment Card WTP			
Generalized Tobit	44.49	0.34	(43.82, 45.15)
Two-Part Model	35.92	0.56	(34.83, 38.01)
Choice Experiment WTP			
Class 1	28.73	22.49	(-15.35, 72.81)
Class 2	82.27	10.91	(60.86, 103.67)
Full Latent Class Model*	59.51	11.40	(37.16, 81.85)

*This is the weighted WTP for the scenario estimated by considering the class probabilities in the Latent Class Model

Figures

Figure 1. CVM Show card.

Quantity of cattle and/or sheep in landscape	No change on current levels
Percentage of utilisable agricultural land under rapeseed, willow and other bio fuels	No Change on current levels
Condition of field boundaries (stone walls and hedges)	Good: For every 1km, 700m is fully maintained
Presence of wild flora and fauna on farm	Improved conservation on current levels

Figure 2. Example choice card.

	Landscape A	**Landscape B**	**Landscape C**
Change in quantity of cattle and/or sheep in landscape	Moderate decrease on current levels (-30%)	Moderate Increase (+30%)	No change (+0%)
Change in utilisable agricultural land under rapeseed, willow and other bio fuels	Moderate Increase (+30%)	No change (+0%)	No change (+0%)
Condition of field boundaries (stone walls and hedges)	Poor: For every 1km, 50m is fully maintained	Good: For every 1km, 700m is fully maintained	No change: For every 1km, 400m is fully maintained
Presence of wild flora and fauna on farm	Rapid decline	Improved conservation	No change
Increase in tax payments by you each year	€40	€80	€0
Which do you like best?	☐	☐	☐