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Accounting for Negative, Zero and Positive Willingness to Pay for Landscape Change in a National Park.

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Abstract

In contingent valuation, despite the fact that many externalities manifest themselves as costs to some and benefits to others, most studies restrict willingness to pay to being non-negative. In this paper, we investigate the impact of allowing for negative, zero and positive preferences for prospective changes in woodland cover in two UK national parks, the Lake District and the Trossachs. An extended spike model is used to accomplish this. The policy implications of not allowing for negative values in terms of aggregate benefits are also investigated, by comparing the extended spike model with a simple spike making use of only zero and positive bids, and a model which considers positive bids only. We find that ignoring negative values over-states the aggregate benefits of a woodland planting project by up to 44%.

Keywords: contingent valuation, national parks, negative WTP, spike models.

JEL Classification: D6, Q2

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1. Introduction

Contingent Valuation (CV) has been the most widely used stated preference method for environmental valuation. Since the publication of NOAA panel report (Arrow et al. 1993) the use of close-ended choice questions have largely replaced open-ended questions as the elicitation format to disclose respondents' willingness to pay (WTP). The dichotomous choice format asks respondents if they are willing or not to pay an offered amount for a specific environmental change, and typically does not allow people who would suffer a loss in utility from the proposed change (such as re-introducing wolves in a national park) to express their negative WTP. Indeed, several authors (e.g. Carson et al, 1992, Bateman et al. 2002) advise the use of distributional assumptions that rule out negative WTP. Similarly, payment card, payment ladder and open-ended CV designs tend to preclude negative values from being expressed. In a referendum-style CV exercise, respondents who do not agree with paying the posted bid may either have a "genuine" zero WTP, have a negative WTP or else can be expressing a protest answer. Whilst respondents who hold a "genuine" zero and those who express a "protest" WTP can be easily identified by using follow-up questions, and the resulting welfare measures corrected (Jorgensen and Syme, 2000), negative WTP statements where allowed are usually considered a sort of protest answer and either excluded from analysis or assigned a value of zero; whilst many survey designs will not even reveal negative WTP responses.

Using valuation approaches which rule out negative WTP may provide biased estimates welfare change from project or policy execution in circumstances where a significant fraction of the sample actually dislike the proposed change (in the case of an environmental "improvement"). More importantly, when aggregate values are calculated, the exclusion of negative WTP may lead to erroneous conclusions about the net social benefits of the proposed change.

One way of including negative WTP would be to allow respondents to state a positive WTP to prevent the proposed increase in a "good" from going ahead, as suggested by Clinch and Murphy

(2001). However, this will not always allow for credible hypothetical markets to be designed, and means that the researcher required to combine compensating and equivalent surplus measures of the same change. An alternative approach is to allow those who would lose out from an increase in the environmental good to express their willingness to accept compensation (WTA) for allowing the changes in question, whilst those who prefer the option state a positive WTP for the same change. However, there are often considerable problems in using WTA measures in CV. Such scenarios may lack credibility, may be in violation of assumed property right allocations, and can give rise to high levels of protest responses (Hanley, Shogren and White, 2006). These reasons led the NOAA panel to advise against the use of WTA scenarios in CV, whilst policy-makers have also sought to avoid WTA-based CV designs (Arrow et al, 1993). It might thus be preferable to allow respondents who prefer not to have the environmental change in question to state a positive WTP for a "symmetrically opposite" change: thus, instead of asking WTP for an additional 50 hectares of wetland for those who have a positive preference for wetland, one might ask those who have a negative preference for wetland (for example, because they think of wetlands as breeding grounds for mosquitoes) to state their WTP for a 50 hectare *reduction* in wetland area. This is the approach we follow here.

The design used here allows us to include positive, negative and zero WTP for an increase in woodland cover in the econometric estimation of mean WTP for future landscape management in a National Park. This is achieved using a two-stage approach. First, we ask respondents to disclose their preferences towards future landscape management options in two national parks. In particular we determine whether individuals prefer increasing or decreasing the forested areas in these two parks. To respondents who show a preference for a reduction of the forested areas in the Park we ask their maximum WTP for a hypothetical logging project that would result in a reduction of the area of woodland in the park to 20% of the Park's total area, from a baseline of 30% woodland cover. For respondents who preferred an increase of the forested area we ask their maximum WTP for a project that would plant broadleaf and mixed woodlands in the park to increase the forested area to 40% of the Park's total area. Making the important assumption that a positive WTP for the felling option is symmetrical to a negative WTP for the planting option, it is possible to combine the two set of answers in the same log-likelihood function and calculate an overall measure of WTP. We show how this assumption is consistent with a utility function which is linear around the change in question. This treatment of preferences allows, we argue, a much more realistic estimate of the population mean WTP value, and of aggregate benefits from woodland change. The welfare estimates obtained from this extended model can then be compared to those resulting from a model which includes only positive and zero WTP bids, and a model with positive bids alone.

The next section summarises some previous studies where positive and negative WTP values have been modelled. Section 3 describes the study design whilst Section 4 explains the methodological approach followed. Section 5 presents and discusses the results, after which some conclusions are drawn regarding the consequences of extending the modelling framework to negative WTP for aggregate welfare measures and cost-benefit analysis.

2 Previous studies.

There have been rather few studies that explicitly account for the existence of negative WTP alongside positive and zero WTP, and different approaches have been proposed in the literature to address the problem. Clinch and Murphy (2001) modelled positive and negative WTP in a two-stage process. Firstly, they modelled the dichotomous decision for approval /disapproval of a project. In a second stage they modelled the positive WTP for implementing the project (amongst those who approved) and the positive WTP (expressed as the WTP to avoid the project) amongst those who disapproved. In this second stage they allowed "genuine" zero WTP values. They found, as would be expected, that ignoring welfare losses of the disapprovers produces a significant overestimation of the benefit generated by the proposed project. Note that, in this case, WTP measures to avoid a welfare decrease are combined with WTP measures to gain a welfare increase: in other words, equivalent and compensating surplus measures are treated as commensurate.

An and Ayala (1996) and Werner (1999), using a double bounded elicitation format, estimated a mixture model where they split people who answered *no* to both bid questions into two groups: the first made up by people who were assumed to have a WTP included between zero and the minimum bid offered, and the second composed of individuals who were assumed to have a zero WTP. The authors concluded that the mixture model was preferred to a conventional double bounded model and (again) produced lower estimates of mean WTP than the strictly positive WTP model.

Kriström (1997) estimated a spike model to allow for a nonzero probability of zero WTP in referendum CV data. In its simplest form this model divided the sample into respondents with zero WTP and those with positive WTP. He found that the spike model was a better representation of the distribution of stated WTP especially if there is a large number of zero answers. Kriström (1997) also presents an extension of the simple spike model allowing for the inclusion of negative WTP, but did not estimate the model parametrically in the extended spike model case. This is the addition we provide to Kriström's paper. This approach has also been used by Nahelhaul-Munoz et al (2004). Our study differs from Nahelhaul-Munoz et al (2004) in that they used a WTA measure for allowing an undesirable project to go ahead as an estimate of WTP to prevent the project happening. Given the important conceptual differences that exist between WTP and WTA (Hanemann, 1991), here we ask for WTP bids on both sides of the "zero value" in the WTP distribution.

3.Study design

The study was conducted in two UK national parks, the Lake District National Park, located in North-West England, and Loch Lomond and the Trossachs National Park, located in central Scotland.

These areas were chosen as case studies because they have long been important tourism destinations, and have a history of public argument over the extent of woodland cover. The dominance of forestry, especially coniferous plantations, in the Loch Lomond and Trossachs ("the Trossachs") National Park has resulted in a very different landscape from the Lake District National Park. Two-thirds of the Trossach's woodlands are coniferous, and woodland is the dominant land use. The forest park contained within the current National Park was one of the earliest such areas to be created (1953) in the UK and was designed to provide recreational opportunities as well as commercial returns. The Trossachs became one of Scotland's first National Parks in 2002. About 70% of the Scottish population live within one hour's drive of the park and total tourist numbers were estimated at 2.18 million in 2003 (Loch Lomond and the Trossachs National Park Authority, 2005), whilst around 15,000 people actually live within the park. Many of the Trossachs' forests are popularly regarded as poorly designed, and restructuring these forests to accommodate landscape and other concerns is currently a major issue for the Park authority and Forestry Commission.

The Lake District was established as a National Park in 1951 and is the largest national park in England. It currently attracts around 12 million visits per annum, whilst around 42,000 people actually live in the Park (Lake District National Park Authority, 2003). Concerns have been expressed over both the establishment and management of woodlands in the Lake District, and the area is often seen as a cultural icon of "Englishness". In addition, with the overriding emphasis on biodiversity and landscape in both parks, the restoration and expansion of native broadleaved woodland has also been a major focus for debate and action (White, 2002). Both parks support important areas of native woodland of high conservation value.

In the questionnaire, respondents (drawn from a sample of local residents and tourists) were told how much woodland cover currently existed in the area and the nature of this cover, whilst being shown a map indicating current forest areas. Note that, although it is likely that people other than local residents and visitors care about changes in landscape in the Parks, no sampling was undertaken of anyone other than local residents and tourists. The survey was undertaken in the summer of 2005 by a market research firm, using in-person intercept surveys of tourists at popular locations, and a random sample of local households questioned in their own homes. We obtained 502 responses in the Lakes and 504 in the Trossachs, divided equally between tourists and local residents.

For the Lake District sample, respondents were told that:

"Woodlands and forest cover around one-third of Lake District National Park, and are regarded by some as being important to its special qualities. Currently, this woodland is made up of a mixture of broadleaved woods with species such as oak and ash; and plantations of single evergreen species such as Norway Spruce. Land owners within the park are interested in harvesting the timber, but this would have effects on the landscape. The National Park Authority has to decide how to balance these opposing interests."

They were then told that the Park Authority had to decide what strategy to pursue over the next 20 years, and that two broad options existed:

Option 1: If the National Park Authority decides to reduce the forest coverage, this will be carried out by cutting down some of the plantations of evergreens. This would leave about 20% of the National Park still covered in forest.

Option 2: If the National Park Authority decides to increase the forest coverage, this will happen by planting a mix of mainly broadleaved trees such as oak and ash. These new plantings will bring the total wooded area to about 40% of the National Park.

Notice that the nature of the change in forest cover is not identical between the "increase" and "reduce" scenarios. The only realistic scenario in either National Park for new planting is that this new planting would be of native broadleaved trees such as oak and ash. The only realistic scenario for a reduction in tree cover is that this would be achieved by felling of exotic conifer plantations.

Respondents then completed a "strength and direction of preference" score card, indicating which of these two scenarios they preferred, and how much they preferred it. This was accomplished using a 9-point scale of numbered boxes (Figure 1). Ticking a box in the range 1-4 indicated a preference for Option 1 above, with lower values implying a stronger preference for less woodland (respondents were offered an explanation as to how to complete this section). Ticking a box numbered 6-9 implied a preference for Option 2, with higher values implying a stronger preference for additional woodland. Ticking Box 5 was equivalent to preferring to keep the current situation (status quo) rather than have either of the two change options. Responses to this question thus yield an ordinal measure of preferences towards future landscape change in the relevant Park.

After expressing their preferences towards the felling or planting project, respondents were faced with the CV exercise. Dependent on whether an individual preferred Option 1 (reducing forest cover) or Option 2 (increasing forest cover), they were asked their maximum Willingness to Pay to have this option go ahead. Sampling was split between local residents and visitors; for the former group, the bid vehicle was an increase in local taxes; for the latter, it was an increase in car parking fees in the area (these are implemented by the Park Authority). Reasons why such payments were necessary to secure the option were provided; for instance, for Option 1 the following text was read to respondents:

"Once the trees had been felled, the National Park Authority would need money to restore the landscape, for example by removing tree stumps and encouraging wild flowers and plants to re-grow in the felled areas. Given limited government resources, the Park Authority will need extra funds for the logging project. Money <u>*dedicated*</u> *for this purpose would be collected by increasing local council taxes. This increase would last for 10 years. The only way that the felling project (Option 1) could go ahead is if these extra funds were raised."*

Those preferring the status quo (by ticking box 5) were not asked their WTP[2]; instead, along with those refusing to give any positive payment amount for either Options 1 or 2, they were asked why this was in order to distinguish protest bids from genuine zeros (Bateman et al, 2003). The elicitation format used was a payment card showing 4 amounts. Individuals were asked whether they would definitely pay, probably pay, or definitely not pay each amount individually[3]. This design allows for a degree of uncertainty in how much value respondents place on a given environmental change (Ready, Navrud and Dubourg, 2001). Payment levels were based on a pilot survey in each area of 50 respondents which used an open-ended design. Respondents were reminded that the contribution they made would be dedicated to only this specific project, and that there may be other projects to which he/she may be willing to contribute to. They were then asked if they were sure about their responses to the four amounts on the payment card, and offered the chance to change any or all responses.

4 Methodology

As pointed out by Clinch and Murphy (2001), it is important to take account of both gainers and losers when valuing an increase in the quality of a public good. Given that individuals typically cannot choose the level of the public good they consume, Hicksian Compensating (CS) and Equivalent Surplus (ES) measures are appropriate for welfare measurement. The CS measures the maximum an individual is WTP for a specified increase in the quality of a public good or his/her minimum WTA compensation for a deterioration in the quality of a public good. The ES measures their maximum WTP to avoid a reduction in the good, or minimum WTA to go without an increase. However, if the change in environmental quality exhibits features of both a public good and a public bad, it is necessary to choose appropriate surplus measures which allow measurement of the loss of utility as a result of an

[2] In retrospect, asking people who preferred the status quo how much they were willing to pay to either (i) stop an increase in woodland or (ii) stop a decrease in woodland would have been useful, although it is not clear which is the more reasonable scenario to select.

increase in the provision of the good to those who prefer less of it, as well as gains in utility to those who would feel better off. However, eliciting WTA values has been proven to be challenging in the CV literature, because the necessary scenarios are difficult for respondents to believe, and because of a higher incidence of protest bidding in WTA experiments. Moreover, as is well known, gain and loss measures cannot be simply exchanged: substantial differences have been found between WTP and WTA values for the same change in a public good (List and Shogren, 2002). Several reasons have been put forward to explain these differences in the literature. Kahneman and Knetsch (1990) suggest that an endowment effect arises when people "experience" the good in question and WTA measures for accepting a decline are higher than WTP for an improvement. Finally, Hanemann (1991) demonstrates that the difference between WTA and WTP can be explained by income and substitution effects, in the sense that when the WTP is a large proportion of income and when the elasticity of substitution is low, a larger difference between WTA and WTP is expected.

In this paper, to avoid the practical difficulties of using WTA values to evaluate losses for those people who prefer less woodland cover to more if a project to expand woodland cover is proposed, we assume that the WTP for the felling option can be considered as a proxy of the negative WTP (ie a cost in welfare terms) for the planting option. It is important to note that by assuming that the WTP for the felling option can be considered as a proxy of negative WTP for the planting option we assume that:

1) WTP for reducing the good in question is symmetric to the WTA to tolerate an increase (in the sense of the minimum compensation payment needed to restore people to their pre-change utility level); and

2) WTA to tolerate an increase can be used as a proxy of WTP to avoid an increase of the undesirable good.

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[3] In the econometric analysis we considered that respondents were willing to pay the offered amount only if they chose the option: " definitely I am willing to pay this amount".

It was not realistic to take the approach of Clinch and Murphy (2001) in our case and ask those who prefer less woodland to state their maximum WTP to avoid an increase. Assumption 1 requires the utility function to be linear in the neighbourhood of the prospective change. This is a strong assumption which is only likely to hold, as a workable approximation, for small changes in the quality of the good of interest, when the environmental good in question has many substitutes and the income effect is not substantial[4]. Clinch and Murphy (2001) show that the second assumption is reasonable in the case of an environmental good which is substitutable and where WTP is not a large proportion of income. These conditions are considered to apply here, since the environmental change is small (the maximum change is 10% of the forest cover), easily substitutable and reversible (future planting or felling forest in a national park can be used to reverse the project) and there are many similar areas close to (indeed within) each park; whilst the income effect involved is negligible given the low WTP values stated.

To explain this, let Z be an index of environmental quality, where the proposal is a change from the current conditions Z_0 to some new condition Z_1. It is convenient to define $Z_1 = Z_0 + \varepsilon$, for $\varepsilon > 0$. Individuals are endowed with a smooth indirect utility function, $V(Z,m)$, where m is income. We assume that when $m_1 > m_0$, then $V(Z,m_1) > V(Z,m_0)$, for all feasible Z. The project induces a change of utility: $V(Z_1,m)-V(Z_0,m)$. Suppose that there are two types of individuals, those who like the project (g) and those who dislike it (b). We assume that income is identical in the two groups[5]. For those who like the project, we let the change be positive, in the sense that $V_g(Z_1,m) > V_g(Z_0,m)$. Symmetrically, for those who dislike the project, the change is negative, $V_b(Z_1,m) - V_b(Z_0,m) < 0$.

Consider now a mirror project, in which the level of Z falls to $Z_1 = Z_0 - \varepsilon$. The question to be answered is the welfare significance of the two projects. Consider the Compensating Surplus for each of the two projects for the group which dislikes the change:

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[4] In these conditions, Hanemann's key result is that WTP and WTA should not differ significantly. Using a linear utility function we will show how these two CS measures are also symmetric, although we note that Hanemann considers a single change in a public good, not two changes.

For an increase in Z: $V_b(Z_0,m) = V_b(Z_0 + \varepsilon, m + CS_b^{WTA})$

For a decrease in Z: $V_b(Z_0,m) = V_b(Z_0 - \varepsilon, m - CS_b^{WTP})$

For those who dislike increases in Z, individuals in this group must be paid (the absolute value of) CS_b^{WTA}. Symmetrically, because such individuals prefer downsizing of Z, they are willing to pay something for this to happen, the maximum payment being CS_b^{WTP}. Because the projects are symmetric in terms of their effects on Z, assuming that $CS_b^{WTA} = - CS_b^{WTP}$ requires the utility function be linear[6].

Our survey design collects information on WTP for an *increase* in forest cover for those who prefer more trees and on WTP for a *decrease* in forest cover for those who prefer less woodland in the two national parks. To estimate the distribution of overall WTP we adopted the extended spike model proposed by Kristrom (1997), assuming a logistic distribution with a cumulative density function equal to:

$$
\begin{aligned}
F_{wtp}(A) &= [1+\exp(\alpha-\beta^*A)]^{-1} && \text{if } A<0;\\
F_{wtp}(A) &= [1+\exp(\alpha)]^{-1} && \text{if } A\to 0^-;\\
F_{wtp}(A) &= [1+\exp(\chi)]^{-1} && \text{if } A\to 0^+;\\
F_{wtp}(A) &= [1+\exp(\chi-\delta^*A)]^{-1}\,. && \text{if } A>0. \qquad (1)
\end{aligned}
$$

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[5] We tested for income differences between individuals who chose the felling and the planting option and observed that no significant differences exist.

6 Let us show this by means of a simple numerical example. Suppose that for a person who prefers more of the good, utility is not linear, V= ln (Z) + ln (m). Let Z0 = 2, ε= 1 and m = 2. At the status quo conditions utility V(Z0,m) = 1.39. When the quality of the environmental good increases by ε = 1, the utility V(Z1,m) = 1.79 and the individual is willing to pay CS=0.676. The opposite case is when the environmental quality decreases ε = −1. Utility V(Z1,m) = 0.69. To restore his utility at V(Z0,m), we must pay him CS = −2. However, if we assume a linear utility function such as V= Z + m, it is easy to demonstrate that, for any individual who either likes or dislikes the project, the negative of the individual WTP for having the improvement is the same as individual WTA for putting up with worsening well-being. In the status quo V(Z0,m) = 4; when the quality of the environmental good increases ε= 1, V(Z1,m) = 5 and this individual is willing to pay CS=1 to have the increase. When the environmental quality decreases ε = −1, V(Z1,m) = 3 so that to restore his utility at 4, we must pay him CS = −1.

Where_F_{wtp} (A) is the probability that an individual's WTP is lower than the amount A; α and χ are interpreted as the marginal utility of the landscape change and β and δ the marginal utility of income[7]. These cumulative density functions are joined with respondents' answers in a log likelihood function that is maximised to obtain parameter estimates. The probability of the spike is determined by:

$$p^{-}= [1/1+\exp(\alpha)]$$
$$p^{+}= [1/1+\exp(\chi)] \qquad (2)$$

where p^- represents the probability that WTP is strictly less than 0, and where p^+ characterizes the probability that WTP is negative or equal to 0. The first should be similar to the proportion of people that state a negative WTP, whilst the second should be similar to the proportion of respondents that state a negative or a zero WTP. The probability of the spike is calculated by subtracting p^- from p^+.

Under the extended spike model, mean WTP is estimated by solving the integral:

$$E(WTP) = \int_0^\infty 1 - F_{wtp}(A)dA \; - \int_{-\infty}^{0} F_{wtp}(A)dA$$
$$E(WTP) = \frac{\ln[1+\exp(\chi)]}{\delta} - \frac{\ln[1+\exp(-\alpha)]}{\beta} \qquad (3)$$

where the first integral sums the positive WTP for the planting project whilst the second integral sums the positive WTP for the logging project. Since the discontinuity at zero does not contribute to the integral it does not affect the mean WTP estimate. As Kristrom (1997) pointed out, the marginal utility

[7] This version of the extended spike model allows the marginal utility of income and of landscape change to be different in the negative and positive axes, being more flexible to possible differences in the shape of the distribution on both sides of the spike at zero.

of money must be positive in order for the mean to exist in this model, so that an indispensable condition to estimation of the mean is that both slope coefficients β and δ are positive.

5. Results

Figure 2 shows the distribution of preference scores towards future landscape change in the two areas, categorised by whether people are local residents or tourists. In the Lake District sample, a large number of preference votes were for the no-change status quo option (211 out of 502). Amongst those preferring a change, more expressed a preference for Option 2 (increasing woodland cover) than decreasing it, since the number of people giving a score in the 1-4 range (70) was less than the number giving a score in the 6-9 range (220). Preference scores for those preferring a change in the current woodland area are evenly distributed across the 1-4 and 6-9 range. Also, visitors and residents do not differ in their preferences (figure 2): the percentages of visitor and citizens choosing the logging, current situation or planting option are essentially the same[8].

In the Trossachs sample, a majority of respondents are in favour of an increase in woodland cover, with the highest number of votes going to the strongest expression of preference for this option. An equal number of respondents – 97 – voted in favour of the status quo and a reduction in woodland planting. For the Trossachs, preferences do differ between visitors and residents ($\chi^2_2 = 30.20$, $p \leq 0.001$): residents are more likely to prefer the logging option and visitors the planting option. There are thus clear differences across all treatments between the Trossachs and Lakes samples in terms of what woodland future is preferred, with the highest preferences going towards the status quo in the Lakes and an increase in woodland in the Trossachs. The focus on woodlands as a recreational asset in the Trossachs, not found in the Lake District, and the longer tradition of forest planting in the Trossachs, may partly explain this result.

[8] A statistical test confirmed this lack of significant difference between visitors and tourist preference scores.

Turning to the contingent valuation exercise, Table 1 shows the number of people who stated a negative, neutral or positive WTP for the proposed project in the two national parks. Note that the total number of respondents differs from the sample described at the beginning of this section due to incomplete surveys or protest answers, since some people refused to respond to the CV payment card despite completing the preference question. Table 2, columns 2 and 3, shows the estimated coefficients for the extended spike model for the Lake District and Trossachs samples[9]. Columns four to seven describe other models, whose comparison with the extended spike model will be commented on later, and which will allow us to identify the error resulting from either excluding zero and/or negative WTP. Both extended spike models are highly significant (LR “lakes” = 1511.50; LR “Trossachs” = 1546.46; sign $\alpha \leq 0.0001$). In both cases, the coefficients estimated for the marginal utility of income (β and δ) are positive, which as noted above is a necessary condition for welfare measurement. Coefficients on income are also roughly equivalent for winners and losers. Looking at the parameter estimates (χ and α) for the marginal utility of landscape, it can be seen that both are positive for the Trossachs. For the Lake District sample, χ is negative but α is positive. This reflects the proportion of those in the Lake District sample who prefer more woodland versus less woodland or the status quo.

In the Lake District sample all the coefficients are highly significant. According to model coefficients $p^- = 11\%$ and $p^+ = 58\%$ giving a differential mass probability at zero of 47%. From Table 1, note that 51 people stated a positive WTP for the felling project, 211 a WTP of 0 and 186 a positive WTP for the planting option. The proportion of people with strictly negative WTP in this sample is 11% (51/448) whilst the proportion of people with a negative or zero WTP is 58% ((51+211)/448), percentages that correspond to the probabilities estimated by the model. These values also indicate that in the Lake District national park only a minority of people (42% = 1-0.58) have a positive WTP for increasing the forest areas.

[9] Data to allow a complete replication of these results are available upon request from the authors.

In the Trossachs sample all coefficients are highly significant and the estimated proportions of strictly negative or negative and neutral WTP are lower, $p^- = 12\%$ whilst $p^+ = 34\%$ giving a mass at zero of 22%. The observed proportion of respondents who stated a negative WTP for the planting project was 13% ((52/388) whilst the proportion declaring a zero WTP was 24% (95/388), percentages which again are very close to those estimated by the model. In contrast to results for the Lake District, in the Trossachs national park the majority of respondents (62%) are willing to contribute to increase the forested areas in the park.

A conclusion from the previous two paragraphs is that the extended spike model does a good job of representing the distribution of the sample in terms of people with positive, negative and "neutral" (ie zero on both sides) Willingness To Pay. Moreover, from these coefficients we can estimate net WTP for future landscape woodland areas management in the two national parks by applying formula (3). In the Lake District the "overall" mean WTP is equal to £0.93 (95% confidence interval £0.69-£1.17) whilst in the Trossachs mean WTP is somewhat higher, £1.74 with a 95% confidence interval that extends over £1.38 to £2.10. The positive WTP value in both cases indicates that overall the planting project is preferred to the logging project in both National Parks; the higher WTP in the Trossachs is a sign of the larger proportion of people who prefer the planting project than the stats quo in this national park, relative to Lake District national park.

Any public action potentially generates winners and losers. If we had modelled the WTP for the planting project including genuine zeros but ignoring the possibility that some of these are negative values (as is typical in the literature), all respondents that dislike the planting project would have been assigned either a WTP of zero, or classified as protest answers and removed from the analysis. This traditional spike model generates coefficients described in columns four and five of Table 2. In the case of the Lake District National Park, the spike at zero sums up to a probability of 53% and the estimated mean WTP is £ 1.34 (95% confidence interval £1.11-£1.77). The spike probability coincides with the proportion of zero WTP responses, which are preferences for the status quo in our case (212 people out of 397). If we compare this mean WTP value with the value of the extended spike model we can observed that sample mean WTP is overestimated by 44%[10] due to the exclusion of negative WTP responses. The same is observed in the case of the Trossachs sample, where the estimated WTP is £2.49 (95% confidence interval £2.21-2.75) and the probability at 0 is 28%. The overestimation in mean WTP is about 43%.

The last two columns of table 2 show the coefficients of a simple logit model where only positive bidders were included in the estimation and the planting project is considered (that is, we ignore bids for woodland felling). In this case the mean WTP is equal to £2.72 (95% confidence interval £2.39-£3.05) for the Lake District sample and £3.32 (95% confidence interval £3.07-£3.57) for the Trossachs national park sample. For the felling alternative, mean WTP estimates equal £2.13 for the Lake District sample and £3.19 for the Trossachs national park sample. Using such figures would lead to an even bigger over-estimation of the net social benefits of more woodland planting in the two national parks.

6. Conclusions

This paper proposes a means of including negative, zero and positive preferences for a given environmental change in the estimation of the benefits of environmental change. We argue that it is important to allow for preferences of those who are opposed to the environmental change in question, even when researchers classify it as a “good”. Our method avoids the empirical problems associated with estimating willingness to accept measures of compensation for those who lose out. We then illustrate the impact of ignoring negative WTP on sample mean WTP. As expected, and as observed in

[10] We assume that the true WTP is the one estimated using the extended spike model.

previous studies, there is a significant reduction in WTP estimates when "genuine" zero or negative WTP are included in the analysis. Omitting them would overestimate the welfare change for a policy to plant more woodland in either of the two National Parks considered here.

From a policy analysis viewpoint, the effects of treatment on aggregate welfare measures are of even greater relevance. Table 3 shows the aggregate WTP values for the planting project resulting from considering the number of visitors of the park in the last year (for simplicity, we do not include in the calculation the aggregate values for local residents). Aggregate compensating surpluses are greatly overestimated when only positive bidders are considered in the model, inflating aggregate benefits from £11.16 million for the Lake District to £32.64 million. A similar over-estimation from ignoring negative values occurs in the Trossachs, from £3.79 million to £7.24 million. Even when negative values are included as zeros, the over-estimation ranges from £3.79m to £5.43m in the Trossachs to £11.16 to £16.08m in the Lakes (an increase of about 44%).

In our case, aggregate WTP for a project to extend the woodland area of both national parks falls significantly when we allow for the negative values held by people who prefer less to more woodland cover. The difference is quite large in this case, but we expect that it would be even bigger for more controversial environmental projects, for example the re-introduction of certain animal species such as wolves, or the building of large on-shore wind farms, where we expect differences in preferences across people affected by such projects to be more extreme. It is thus important for contingent valuation practitioners to (i) design surveys in a way which allows this diversity of preferences to be expressed and (ii) analyse the data in a way which recognises the existence of negative WTP for environmental "goods".

However, the analysis and argument above raises an interesting question. Cost-benefit analysis is about quantifying welfare changes for gainers and losers, and then applying the Kaldor-Hicks compensation test. For those who loose out from a resource change – such as people who would not vote for an expansion of woodland cover – the Kaldor Hicks test asks what is the least such individuals would accept in compensation, then subtracts this hypothetical compensation sum from the aggregate benefits to those who gain from the project to arrive at a figure for net social benefit or cost. Some authors (eg Knetch, 2005) have argued that, on ethical grounds, such hypothetical losses should be evaluated using willingness to accept compensation measures. Yet above we have argued for a treatment of winners and losers for an expansion of woodland cover using WTP to evaluate both gains and losses. If utility functions are non-linear around the change in question, there is thus a clear tension between the ethical basis of cost-benefit analysis and the practical evaluation of the net benefits of a change in the supply of public environmental goods. The symmetry of gains and losses therefore emerges as a key point at issue in applied welfare analysis of environmental change.

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Figure One – Strength and Direction of Preference Card

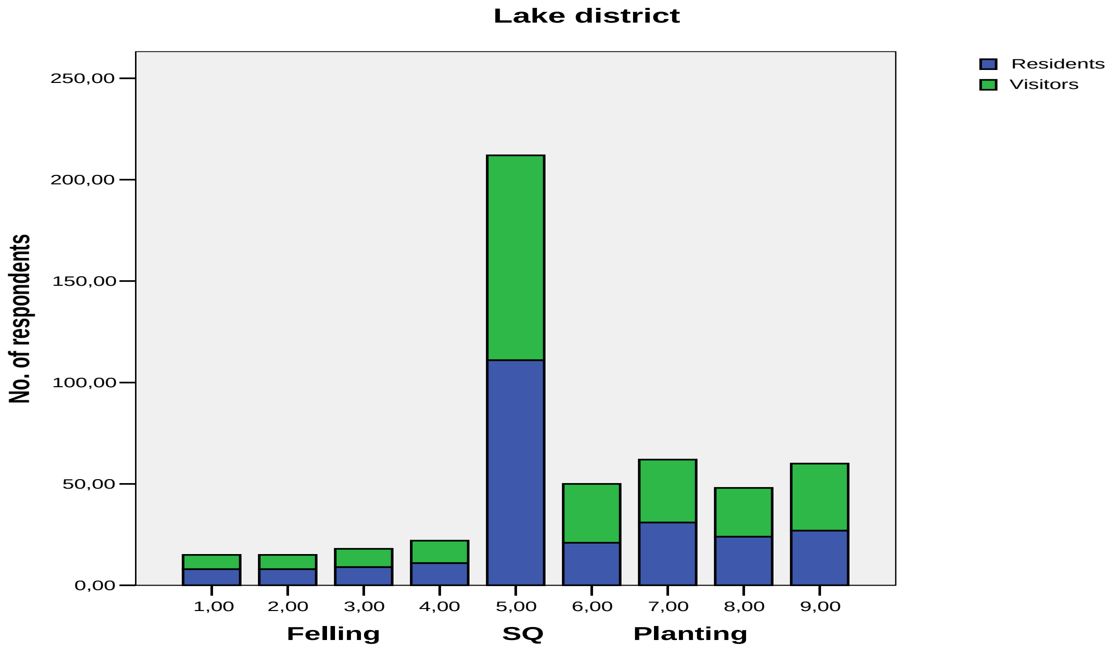
Option 1	Option 2	Option 3
I strongly prefer cutting down evergreens (conifer) plantations.	I prefer **current situation**;	I strongly prefer **planting** which increases the mixed forest areas

1	2	3	4	5	6	7	8	9
☐	☐	☐	☐	☐	☐	☐	☐	☐

Tick ONE box only

<<<I strongly favour felling **I strongly favour planting >>>**

Figure 2. Preference Scores for future woodland options



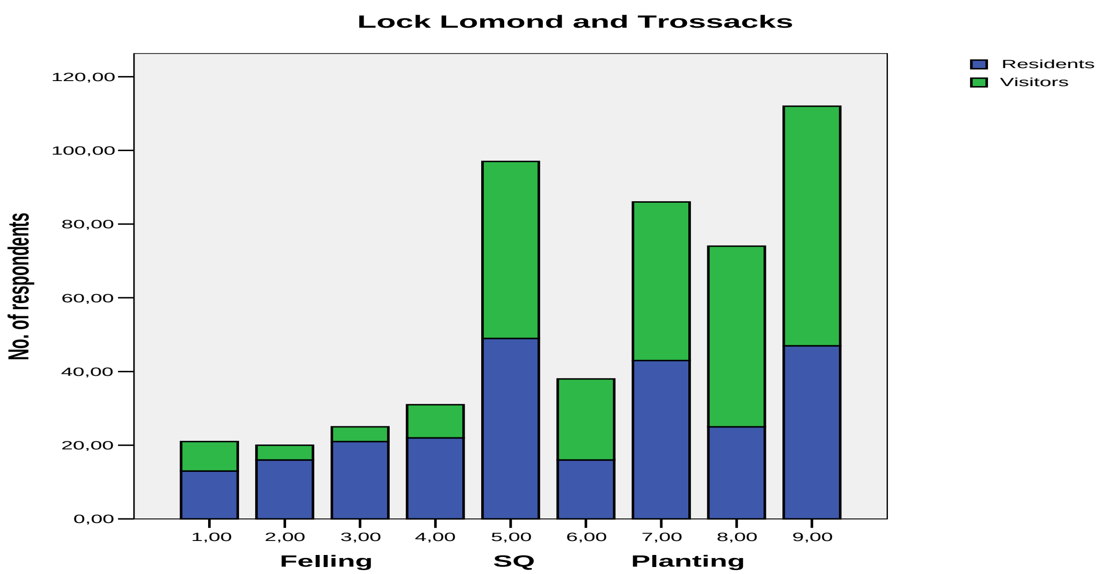


Table 1. Number of people who stated a negative, zero and positive WTP

	Lake District	Trossachs
Negative WTP	51	52
Zero WTP (preference for status quo)	211	95
Positive WTP	186	241
Total observations	448	388

Table 2. Model coefficients (*t*-values in parentheses).

Coefficients	Extended spike model Lake District	Extended spike model Trossachs	Spike model Lake District[b]	Spike model Trossachs[b]	Logit model Lake District[c]	Logit model Trossachs[c]
α	2.060 (13.90)	1.974 (13.69)				
β	0.463 (6.63)	0.309 (5.82)				
χ	-0.322 (-3.42)	.654 (6.80)	1.043 (1.06)	1.135 (10.38)	1.66 (8.05)	3.039 (13.21)
δ	0.457 (13.19)	0.494 (16.26)	0.478 (13.45)	0.568 (17.88)	0.674 (11.67)	0.928 (18.34)
Observations	448	388	397	336	186	241
Log likelihood	-755.75	-783.23	-532.45	-546.33	-225.17	-335.58
Likelihood Ratio (prob.)	1511.50 (0.000)	1566.46 (0.000)	1065.08 (0.000)	1092.67 (0.000)	510.34 (0.000)	671.15 (0.000)

[b] only positive WTP and zero WTP for planting are included

[c] only positive WTP for the planting option are included.

Table 3: Aggregate annual WTP by statistical treatment (figures in million of pounds per year).

Aggregate values for increase in woodland area to 40% of the national park in:	Extended spike model	Spike model	Logit model
The Trossachs	3.79	5.43	7.24
Lake District	11.16	16.08	32.64