Estimating the non-market costs and benefits of native woodland restoration using the contingent valuation method

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Summary

The restoration of native forests is an important priority for forestry and conservation organizations in the United Kingdom. The economic case for public sector support for native woodland restoration in the United Kingdom rests almost entirely on the provision of non-market benefits related to wildlife, landscape and recreational opportunities. This paper describes a discrete choice contingent valuation (CV) to estimate the value of the non-market benefits of restoring two native pinewood forests in Affric and Strathspey. If only the willingness to pay (WTP) of those who supported the restoration plan was considered, the average benefit estimate per household was £35 for Affric and £53 for Strathspey. When the compensation required by a small proportion of respondents who preferred the current moorland landscape, was estimated mean WTP was unchanged for Affric, but fell to £24 for Strathspey. The study highlights the need to take account of non-market benefits and costs when evaluating land use change, otherwise benefits may be overestimated and there is a possibility that the wrong projects will be selected. The sensitivity of CV values to the scope of the environmental change are also investigated and the issue

Introduction

The 'Caledonian' pinewood which once covered much of the Scottish Highlands has been dramatically reduced by fire, agricultural clearance and timber felling. Natural regeneration has been largely prevented as a result of over-grazing by sheep and deer (Steven and Carlisle, 1958), and the small fragments of woodland which survive today occupy around only 1 per cent (16000 ha) of the former range (RSPB, 1993). Some of the larger fauna which lived in the forest, such as the wolf (*Canis lupis* L.), and beaver (*Castor fiber* L.) are now extinct while other specialist pinewood species, such as the Scottish crossbill (*Loxia scotica* Hartent), Britain's only endemic bird species, and the

capercaillie (*Tetrao urogallus* L.) are endangered.

Following the 1992 Earth Summit in Rio de Janeiro, the protection and restoration of natural forests has emerged as an important international priority of environmental policy. In the UK, expansion of the native Caledonian pinewoods is being encouraged by government through the Woodland Grant Scheme. Since 1988, when a special grant scheme for native pinewoods was launched, over 15 000 ha of new native woodland have been approved at an estimated exchequer cost of over £12 million (Forestry Commission, 1996, personal communication).

Although commercial activities, such as timber production and stalking are possible in native pinewoods, the economic case for public sector support for woodland restoration rests on the provision of non-market public benefits (Gill, 1994). These include direct user benefits, primarily outdoor recreation, and passive-use benefits which derive from the desire to preserve or enhance resources for which an individual has no plans for personal use (McConnell, 1997). Potential motives for holding passive use values include concern for rare species and the environment (existence value), the desire to secure use of a resource at some point in the future (option value), and the wish to preserve the resource for the benefit of current or future generations (vicarious use value).

Although techniques such as the travel cost model have been applied to valuing the user benefits associated with recreational activity in commercial forests (e.g. Willis and Benson, 1989) they are less appropriate for native pinewoods because they cannot measure passive use values. Since there is 'no obvious or even subtle behavioural trial that can provide information about their value' (NOAA, 1993), passive use values can only be measured through actual payments to specific projects (e.g. charitable donations) or hypothetical survey techniques such as contingent valuation (CV).

CV is a survey-based approach which attempts to establish a monetary value placed on environmental goods and services. The underlying assumption of the approach is that people have true, but hidden, preferences for the environment which can be translated into monetary units through the creation of a hypothetical market in which respondents reveal their willingness to pay (WTP) or willingness to accept (WTA) for a specified environmental change. Although CV has been widely used in the US, and increasingly in the UK (e.g. Green and Tunstall, 1991; Macmillan *et al.*, 1996; Hanley *et al.*, 1997), its reliability has been widely questioned (e.g. Diamond and Hauseman, 1994). Two overlooked but important concerns, are the failure to value the environment in its pre-project state by estimating WTA compensation among losers (Macmillan, 1997), and the insensitivity of CV estimates to the scope of the environmental change (NOAA, 1993). The latter refers to the tendency for benefit estimates to be the same for a narrowly defined environmental good, as for a vastly more inclusive category.

This paper reports an application of CV to value the non-market benefits and costs of large-scale native pinewood restoration in two areas of the Scottish Highlands. In common with many other studies, it was initially decided to elicit only WTP for forest restoration on the assumption that compensation was unlikely to be required. However, as a small but significant proportion of respondents in the WTP survey indicated that they preferred the current landscape, non-market costs were also estimated from a second survey involving WTA compensation. The issue of scope is addressed by adjusting mean WTP estimates for part–whole bias and by providing a split-sample test which compared WTP for each forest individually with WTP for a plan to restore both forests together.

Development and implementation of WTP survey

Since values elicited via CV are contingent upon the information and market context described in the CV instrument, considerable effort was spent on developing a questionnaire which would allow respondents, who may be unfamiliar with native woodlands and inexperienced at valuation in a hypothetical context, to formulate a value for the woodland restoration plan. The questionnaire was composed of four sections:

Description of the environmental change

Following discussions with foresters and woodland ecologists the landscape impact, recreational opportunities, and important 'keystone' species of the target state (a restored native forest), were described with respect to the reference state (i.e. the current moorland landscape) using a combination of text and a series of computer generated images. The location and area of the proposed forest (Affric or Strathspey) was shown on a map (Figures 1a and 1b).

Description of the payment method

Respondents were informed that the forest restoration plan would have to be part funded by the government and that every household would have to contribute through additional taxation. In order to identify the proportion of people who did not support the plan or were not willing to contribute financially to forest restoration, respondents were initially asked if they were prepared to pay anything, even a very small amount, in additional taxation. Those who agreed were then asked to answer the following question:

> The restoration of the Affric forest would cost a considerable amount of money, part of which would have to be raised from additional taxation of the general public. If the additional tax cost to your household was £*x* per year would you be willing to pay this amount?

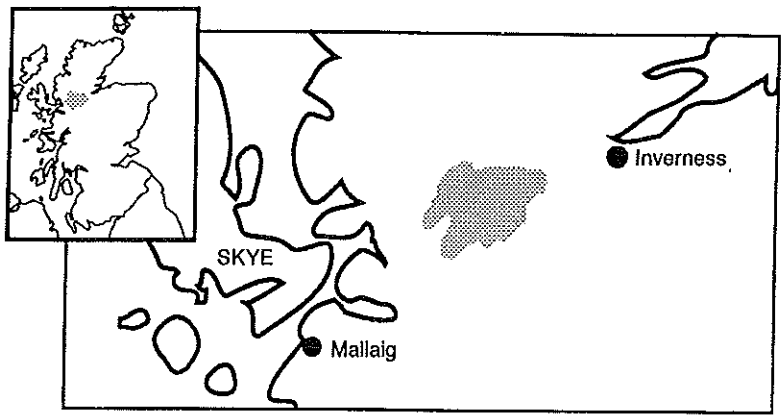

Figure 1a. Location of proposed forest: Affric questionnaire.

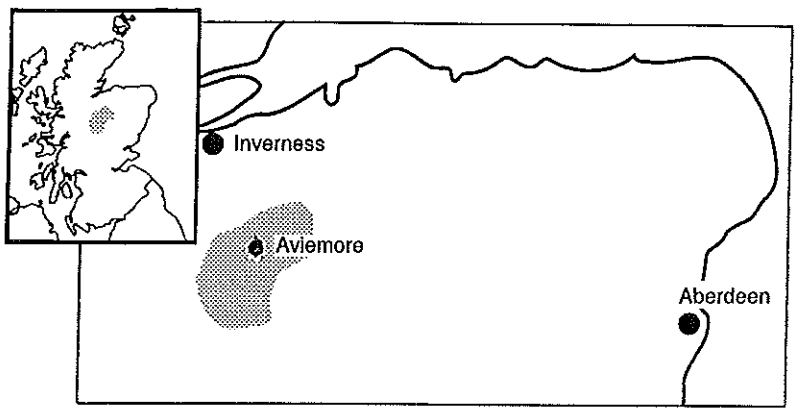

Figure 1b. Location of proposed forest: Strathspey questionnaire.

Respondents had the option to reply 'Yes', 'No' or 'Don't know' to the payment question. This discrete choice (DC) format is recommended for CV questionnaires because it presents the respondent with an easy and familiar purchase decision and is incentive compatible (NOAA, 1993). That is, it is in the individual's best interest to report their true WTP rather than act strategically (Randall, 1986). An individual will accept the offered bid level if:

$$V_1(b_1, y - x; s) + e_0 > V_0(b_0, y; s) + e_i$$

where:

- b_1 = level of environmental quality with restored pinewood
- b_0 = level of environmental quality with current moorland landscape
- y = income
- x = bid level offered
- s = vector of socio-economic variables
- e_0, e_i = random error variables with zero means
- V_1 = level of utility attained with restored pinewood
- V_0 = level of utility attained with current moorland landscape

Each respondent was offered a single bid level, but the bid level differed between respondents. The number and value of bid levels, and the sample size at each bid level, was identified from pilot data using the approach described by Cooper (1994).

Description of the contingent market

All market transactions take place in a social context. In the questionnaire respondents were informed that the forest restoration plan would be undertaken by forestry and conservation groups, with part of the costs (represented by the offered bid amount), for establishing and managing the forest, being met by the tax payer. This was regarded as fair in the sense that the additional tax would be in exchange for the public benefits of the new woodland.

Validation questions

Since there are no market data to compare with CV estimates of WTP, some form of internal validation is required to provide confidence that the 'answers correspond to some reality' (NOAA, 1993). This can be achieved through incorporating behavioural, attitudinal and other socio-economic questions which are considered relevant to WTP (Hoevenagel, 1993). Respondents were therefore asked about their household income, age, membership of environmental groups, outdoor activities, and familiarity with the area.

The questionnaire was tested using focus groups involving members of the general public and a small-scale pilot mailed to 50 households. The revised version was then sent out to approximately 700 Scottish households,[1] randomly selected from the telephone directory and allocated evenly between the two forest locations. The sample was implemented in two tranches so that further bid levels could be introduced if the initial responses to the WTP question suggested that the bid design was inappropriate (e.g. if a high proportion of respondents accepted the highest bid tranche, further (higher) bid levels could be introduced). Dillman's (1978) recommendations for mail surveys were followed and involved an initial mailing, a reminder postcard one week later and, for those respondents who had not replied by the end of the third week, a second questionnaire. The response rates for the Affric and Strathspey surveys are presented in Table 1.

Statistical modelling of WTP data for woodland restoration

The response to the discrete choice payment question was modelled using step-wise logistic regression of the form:

$$y = \frac{1}{1 + \exp[-b_0 - \sum_i b_i x_i]}$$

where

y is the probability of accepting the offered bid level

x_i is covariate i, $i \geq 1$ (x_1 = bid offered and is always in the model)

b_i are coefficients to be estimated, $i \geq 0$

Only respondents who replied either Yes or No to the payment question were included in the regression analysis. Protesters[2] and respon-

Table 1: Summary of responses to the WTP surveys for Affric and Strathspey

Response	Affric		Strathspey	
	Number	Percentage	Number	Percentage
Not willing to pay anything	77	23	64	21
Accepted offered bid	55	16	50	16
Rejected offered bid	57	17	53	17
Unsure	11	3	9	3
Protesters	3	1	6	2
Response rate	203	61	182	59
Unwilling to participate	25	7	27	9
No response	106	32	100	32
Total delivered	334	100	309	100
Undelivered	23		35	

dents who replied 'Don't Know' to the payment question were excluded from the analysis on the grounds that their preferences for the forest plan were not revealed. Because the logistic curve is continuous and there can be no discrete lump of probability attached to any particular bid level, the group of respondents who were unwilling to pay anything (even a very small amount), to restore the forest were also excluded.

Since negative bid levels were not included in the model, bid was restricted to a non-negative number by transforming to $bid - a/bid$, for some value of a. This transformation is more satisfactory than a logarithmic transformation as a way to cope with the absence of negative bids, because it does not alter the behaviour of the logistic curve at higher bid levels.[3] When carrying out the step-wise logistic regression bid was forced into the model with the reciprocal of bid level (*recipbid*) used as an additional covariate. Inclusion of both *bid* and *recipbid* in the model is equivalent to the transformation $bid - a/bid$. The advantage of this approach is *recipbid* is only selected if significant, i.e. bid is only transformed where necessary. Where *recipbid* was not selected in the step-wise regression procedure, bid level was truncated at zero.

The covariates which were found to significantly influence the response to the payment question (at the 95 per cent level) for Affric and Strathspey are shown in Table 2 (Model 1A).[4] All of the covariates selected in the step-wise procedure influenced the probability of accepting the bid in line with a priori expectations. In the case of the Affric forest, respondents who had participated in outdoor pursuits in the Affric area (*activities*), had heard of the original Caledonian forest (*aware*), and responded earlier (*days*) were more likely to accept the offered bid level. Respondents to the Strathspey survey were more likely to accept the offered amount if they had a higher income (*income*), were a member of one or more environmental charities (*member*), and were likely to visit the area if the forest was created (*encourage*). In both surveys, as one might expect, *bid* was negatively correlated with the probability of acceptance.[5]

Mean WTP from discrete choice data is estimated by integrating under the bid function (Hanemann, 1984). Since this procedure requires the logistic curve to be a function of only one variable, average values for the other significant covariates in the model are conventionally used (Cameron, 1988). However, because the logistic model is non-linear this approach generates a biased estimate of WTP. A more satisfactory approach, is to predict the probability that each respondent would accept the bid using the fitted logistic regression model. These individual predicted responses can be averaged to obtain an estimate of the probability of a positive response by bid level in the population. A logistic curve is fitted to these probabilities with mean WTP then derived by integration (Macmillan *et al.*, 1996).[6] Figures 2a and 2b show a scatterplot of the observed proportion of respondents accepting the bid and the fitted logistic curve for Affric and Strathspey respectively.

Table 2: Estimates of regression coefficients for Model 1 (WTP only)

	Model 1A: WTP only						Model 1B: WTP only adjusted for part whole bias					
	Affric (n = 112)			Strathspey (n = 98)			Affric (n = 112)			Strathspey (n = 98)		
Covariate	b	s.e.	t	b	s.e.	t	b	s.e.	t	b	s.e.	t
bid	−0.0100	0.0073	−1.33	−0.0064	0.0062	−1.04	−0.0332	0.0080	−4.16	−0.0079	0.0092	−0.87
recipbid	52.4	32.1	1.63	62.0	29.4	2.11	—	—	—	62.8	32.2	1.95
income	—	—	—	0.366	0.155	2.36	—	—	—	0.456	0.175	2.60
membership	—	—	—	1.315	0.736	1.79	—	—	—	1.699	0.821	2.07
encourage	—	—	—	1.527	0.586	2.61	—	—	—	1.983	0.690	2.88
activities	1.186	0.628	1.89	—	—	—	2.352	0.620	3.79	—	—	—
aware	2.64	1.34	1.98	—	—	—	—	—	—	—	—	—
days	−0.0622	0.0294	−2.12	—	—	—	−0.0682	0.0297	−2.30	—	—	—

b, Regression coefficient; s.e., Standard error; t, t-value

In order to take account of the respondents who were unwilling to pay anything, mean WTP estimated using the above procedure was weighted by the proportion of non-zero payers. The resulting estimates of mean WTP per household per year for Affric and Strathspey were £51 and £69 respectively.

Scope effects

A basic axiom of economic theory is that, unless the individual is satiated, he/she will prefer more of an environmental good (Diamond *et al.*, 1993). A major criticism of CV is that WTP estimates tend to be the same for a narrowly defined environmental good, as for a vastly

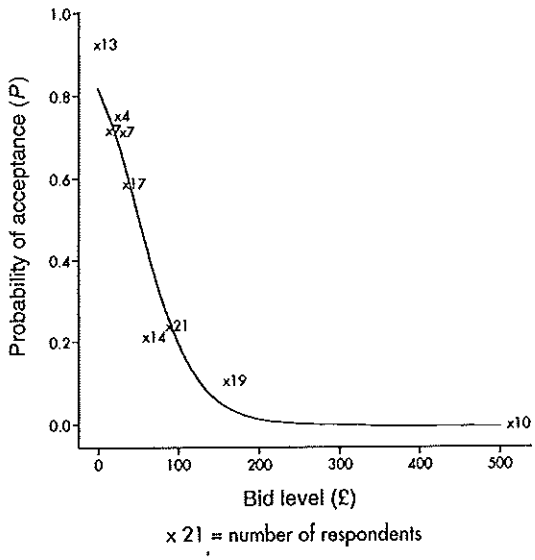

Figure 2a. Scatterplot of proportion of respondents accepting the bid, excluding non-payers and WTA bids, and fitted logistic curve: Affric Forest.

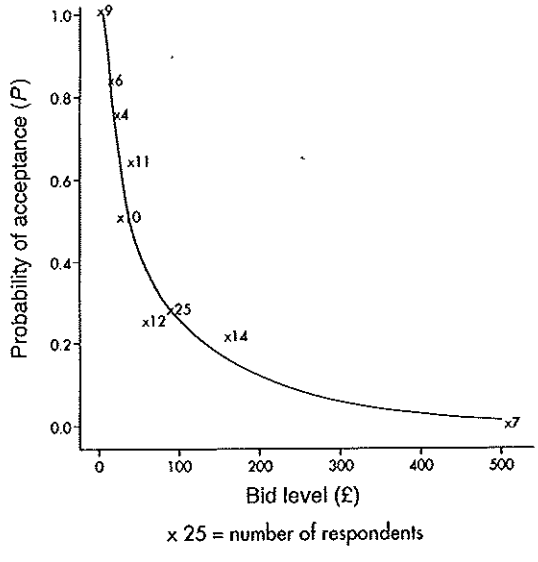

Figure 2b. Scatterplot of proportion of respondents accepting the bid, excluding non-payers and WTA bids, and fitted logistic curve: Strathspey Forest.

more inclusive category (Kahneman and Knetsch, 1992). For example, Hanley and Owen (1994) found that WTP for one Site of Special Scientific Interest (SSSI) in southern England was not significantly different from WTP for all sites in the region. The influential NOAA report (1993) stated that CV studies which exhibited 'inadequate responsiveness to the scope' of the environmental good should be judged unreliable.

Several reasons for lack of scope have been suggested. First, it is possible that respondents value a wider, more inclusive environmental good (e.g. restoration across the entire Highland area) than the more specific environmental change described in the questionnaire (e.g. restoration of the Affric forest). Termed *part-whole bias* it can arise from survey design flaws, or from the inability of respondents to answer contingent valuation questions (Boyle *et al.*, 1994). A second explanation, and of more fundamental concern to CV stems from the notion that WTP reflects only the private benefit (warm glow) a respondent gets from giving, rather than the satisfaction obtained from consuming more of an environmental good. A pure egoist, motivated entirely by warm-glow effects will therefore be insensitive to the scope of the environmental change (Kahneman and Knetsch, 1992).

In this study the issue of scope was tackled in two ways. The first approach attempted to address the problem of part-whole bias by reminding respondents that their payment would only go towards the specific forest plan described, and asking if they were still prepared to pay the specified amount. Respondents who changed their minds were coded as having rejected the bid and the data re-analysed (Model 1B, Table 2). In the case of Strathspey, the covariates which influenced the probability of acceptance were the same as in Model 1A, but *recipbid* and *aware* were not selected for Affric.[7] The estimates adjusted for part-whole bias (WTP_{adj}) were £35 and £53 per household per year for Affric and Strathspey respectively.

The second approach involved sending out a new version of the questionnaire to an additional 300 households to elicit WTP for a plan involving both forests. Assuming households are not satiated, but have diminishing marginal utility with respect to woodland restoration one would expect that:

1 $WTP_{A+S} > WTP_A$
Where WTP_{A+S} is mean WTP for the two-forest plan and WTP_A is mean WTP for Affric alone
2 $WTP_{A+S} > WTP_S$
where WTP_S is mean WTP for Strathspey alone
3 $WTP_{A+S} < WTP_A + WTP_S$

Table 3 gives the mean WTP estimates for all three plans. For both the unadjusted and adjusted WTP, the mean estimates are in agreement with theoretical expectations as set out above.

Non-market environmental costs of woodland restoration

So far in this analysis it has been assumed that respondents who were unwilling to pay anything had zero WTP. However, there was some evidence that a significant proportion of respondents preferred the status quo and hence would actually require compensation if the plan were to go ahead. For example, of the respondents who stated that they were not prepared to pay anything toward the forest plan, almost 20 per cent stated that they preferred the current landscape. This is not surprising given that afforestation is associated with negative impact on important game species, such as red grouse (*Lagopus lagopus* L.) and the loss of an open

Table 3: Mean estimates from WTP models for the individual forests and the combined plan

Option	Affric	Strathspey	Affric and Strathspey
WTP	£51	£69	£109
WTP_{adj}	£35	£53	£67

moorland landscape popular with walkers and other outdoor enthusiasts (Mackay, 1995). A survey to elicit WTA compensation was therefore undertaken for the Affric and Strathspey forest plans. The compensation context was tax savings due to reduced government subsidies to local farmers and landowners:

> If environmental groups were prepared to meet all the costs of restoring the Caledonian Forest in Affric it is likely that the tax-payer will save money. This is because the government would no longer have to pay agricultural grants to farmers. Imagine that the restoration of the Affric forest would save you £*xx* per year in tax, would you support the plan to restore the forest?

An initial compensation payment of £3 was selected (although higher amounts could be introduced if necessary), and the new version of the questionnaire was sent out to 70 randomly selected households divided evenly between the two forest locations. Over 40 useable responses were received and a logistic regression was performed on the combined WTP/WTA data set (Model 2).[8]

The observed and predicted proportion of respondents who accepted the bid level offered and the proportion predicted by Model 2 are shown in Figures 3a and 3b. Mean adjusted WTP was unchanged for Affric at £35, but fell from £53 to £24 per household per year for Strathspey. As in Model 1 the covariates selected by the step-wise procedure influenced the likelihood of accepting the bid in line with a priori expectations (Table 4).[9] The increase in magnitude of *t*-statistics is probably largely a function of sample size.

Discussion

This study has provided evidence that the restoration of native pinewoods on a large scale can generate substantial non-market benefits. When mean annual WTP per household is aggregated across the Scottish population the benefit estimates for Affric and Strathspey are £69 million and £47 million respectively, which is equivalent to £765 ha^{-1} and £432 ha^{-1}.[10] However, failure to incorporate the compensation required by respondents who preferred the current moorland landscape, would have produced seriously biased estimates for Strathspey and led to the wrong project being selected. If only WTP is considered the preferred location is Strathspey, but if compensation payments are also included, Affric is best.

The prospect that afforestation schemes will give rise to non-market costs as well as benefits was previously established by Hanley and Craig (1991), who found that the environmental costs of commercial afforestation in the *flow country*, an extensive blanket bog characterized by internationally rare breeding birds and a distinctive landscape, outweighed the use and non-use benefits of afforestation by over £300 ha^{-1}.[11] While it is likely that many other types of environmental project also have non-market costs and benefits, CV researchers are generally reluctant

Table 4: Estimates of regression coefficients for Model (WTP/WTA data)

	Affric (n = 210)			Strathspey (n = 181)		
Covariate	*b*	s.e.	*t*	*b*	s.e.	*t*
bid	−0.048	0.0076	−6.27	−0.029	0.0061	−4.72
income	0.197	0.086	2.29	—	—	—
membership	—	—	—	1.257	0.531	2.37
encourage	1.415	0.460	3.07	2.854	0.504	5.66
activities	1.130	0.478	2.36	—	—	—
aware	—	—	—	1.588	0.615	2.58
days	−0.057	0.0251	−2.28	—	—	—

b Regression coefficient; s.e. Standard error; *t*. *t*-value

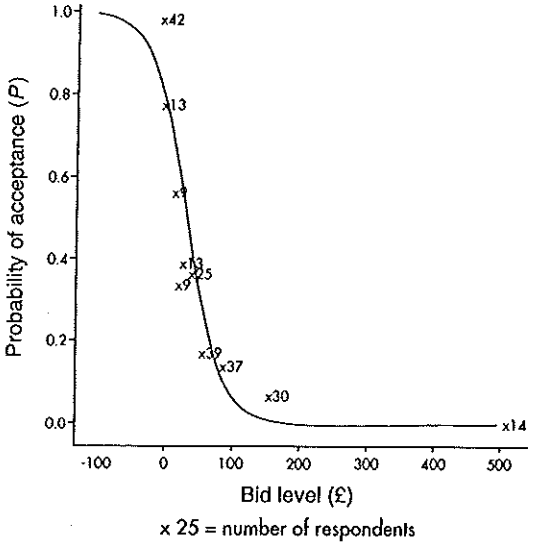

Figure 3a. Scatterplot of proportion of respondents accepting the bid, including WTA bids and non-payers, and fitted logistic curve: Affric Forest.

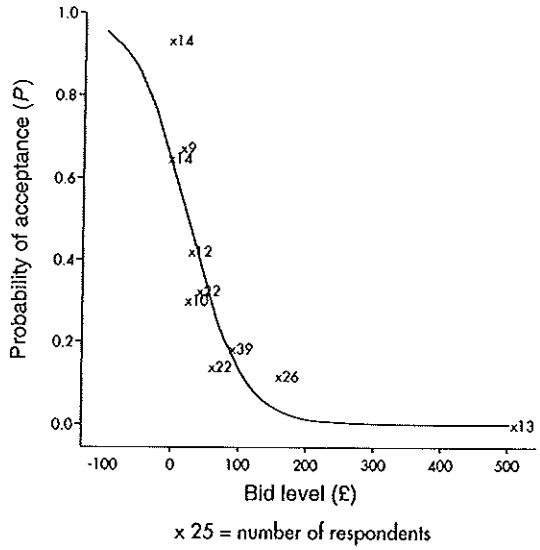

Figure 3b. Scatterplot of proportion of respondents accepting the bid, including WTA bids and non-payers, and fitted logistic curve: Strathspey Forest.

to ask WTA questions. In part this reflects an assumption that compensation is unrealistic for most environmental programmes and difficulties with protesting and strategic bidding with WTA questions (Kahneman and Knetsch, 1992). However, there is also the concern that WTA values are much higher than WTP for similar environmental goods (Fisher *et al.*, 1988). Although Hanemann (1991) has shown that differences between the two measures can arise from substitution and income effects, there is a possibility that many people are loss averse and will value losses more than equivalent gains (Knetsch, 1992). If loss aversion is prevalent, then the bias arising from ignoring losers even when they represent a relatively small proportion of the population, could be substantial.

The follow-up question to counteract any potential problem with part-whole bias substantially reduced the mean WTP for all three plans (Affric, Strathspey, and the two forests combined). However, it is not clear whether respondents changed their mind because they were reminded of the scope of the proposed change, or some other reason. For example, it may be that some respondents had initially accepted the offered bid in order to register their support for woodland restoration or the environment in general. Termed 'Yes-saying' this type of response is believed to be widely prevalent in discrete choice (DC) studies of WTP, and could be one of the principal reasons why DC estimates are often considerably higher than open-ended[12] estimates (Kanninen, 1995). As mean WTP is substantially altered when the reminder question is used it is important that further research is directed at understanding why some respondents change their mind.

The comparison of WTP and WTP_{adj} for the individual plans, and the two forests combined, found that WTP for both forests was greater than for either forest alone, but less than the sum of WTP for the individual plans. In other words, the value for an individual forest is reduced when it is valued as part of a wider, more inclusive good. Although consistent with theoretical expectations about income and substitution effects, Kahneman and Knetsch (1992) argue that this may be a fatal pathology of CV because 'no measuring instrument can be taken seriously if it yields drastically different estimates of economic value for the same object'. Termed 'embedding' this effect is particularly pronounced when respondents are asked to

value a good in sequence, with WTP much lower when a good is placed at the end of a sequence. Randall and Hoehn (1996) suggest that embedding is not a fatal defect of CV and have shown that 'embedding' also occurs in experiments involving market goods. However, the significance of embedding remains a contentious issue and as CV may exacerbate embedding as a result of poor survey design, caution should be exercised when interpreting CV estimates for specific goods when valued in sequence or as separate parts of a policy package.

Problems with double-counting and hypothetical bias also arise when using CV estimates in cost–benefit analysis (CBA). In the case of pinewood restoration, double-counting would occur if the estimates reported here, which include recreation, are added to benefit estimates derived for recreation (from a travel cost study). A second, and more problematic issue relates to the treatment of altruism in CBA. Some economists have argued that passive-use values which stem from the desire to preserve resources for the benefit of others should not be included in CBA because it represents double-counting. However, rejecting altruism would ignore the personal satisfaction people derive from helping others. As McConnell (1997) points out, the treatment of altruism in CBA depends on the underlying motivation. If the general public value the well-being of resource users, altruism has no impact on the benefit–cost outcome, but if the public cares about the use of the resource, not its value to the user, passive use value is relevant to CBA. Although the latter is more plausible in the case of passive use values for the natural environment (McConnell, 1997), more attention should be paid to identifying motives for altruistic payments in CV.

Hypothetical bias refers to the disparity between CV payments and actual cash payments. In general hypothetical payments have been found to over-estimate real payments by a factor of between 2 and 10 (e.g. Bishop and Heberlein, 1979; Sept and Strand, 1992; Navrud and Viesten, 1996) and is believed to be a result of strategic over-bidding. Although there are some doubts over the comparability of CV and real payment instruments in these studied (Hanemann, 1994), a consensus is emerging that CV estimates should be calibrated downward. For example, the NOAA report (1993) suggested that WTP derived from CV should be divided by two. Following this convention the 'best estimates' for pinewood restoration are £382 ha^{-1} a^{-1} and £216 ha^{-1} a^{-1} for Affric and Strathspey respectively. This arbitrary treatment of benefit estimates is unsatisfactory and further research should be directed at understanding the divergence of CV and actual WTP.

Concern has also been raised over the validity of asking the general public to value an environmental good with which they may be totally unfamiliar or is of low personal relevance (Ajzen *et al.*, 1996). For example, Whitehead *et al.* (1995), using theoretical tests based on relative prices and income, found that WTP was less reliable for respondents who had no information about the resource before the participation in the survey. Furthermore, Price (1997, unpublished) argues that if people have no knowledge of an environmental good it cannot have any value to them and benefit aggregation should be restricted to that proportion of the population who are aware of the resource. These concerns are less relevant to this study since there was evidence from the survey that awareness levels were high (e.g. over 90 per cent of respondents had heard of the Caledonian forest), and responses to the bid question were influenced by socio-economic variables which one might expect to influence WTP from economic theory. For example, respondents were more likely to accept the bid if they were on a high income, were members of an environmental charity, and participated in outdoor activities.

Convergent validity, whereby the extent to which WTP estimates converge on estimates generated by CV and other valuation techniques for comparable types of environmental change is a further test of validity. Willis and Benson (1989), using the travel cost model, report lower benefit estimates in the range of £12–213 ha^{-1} a^{-1} for commercial forests. Since the Willis and Benson study was concerned with commercial forests rather than native forests and did not measure non-use benefits this comparison is not very informative. A more comparable study, which involved passive use and use benefits of SSSIs in England (Willis, 1990) yielded benefit estimates in the range £440–2290 ha^{-1} a^{-1} which

is broadly consistent with the values obtained for pinewood restoration in this study.

Conclusions

This study has shown that the non-market benefits of restoring native pinewoods are substantial. However, the need to take account of the non-market benefits of the current landscape is also highlighted. If WTA compensation is excluded it is likely that the benefits of land use change will be overestimated and there is a possibility that the wrong project will be selected. There is a lot of uncertainty about values derived from CV, and concerns about hypothetical bias and the potential for double counting suggest that the mean WTP figures obtained in this study should be considered as upper bound estimates of the public's WTP for large-scale pinewood restoration in Affric and Strathspey.

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Notes

1 The Scottish population was chosen because the impact of forest restoration was likely to be greatest among this group (although it is also likely that people outwith Scotland could also value pinewood restoration).

2 Respondents were classified as protesters if they rejected the offered bid level because they objected to some aspect of the contingent market unrelated to the environmental change. For example, respondents who objected to taxation as the payment vehicle.

3 As a logarithmic transformation substantially lengthens the upper tail, the method can give absurdly high estimates of mean WTP if there are few bids that correspond to a mean probability of acceptance close to zero, or if the fit of the model is poor in the upper tail (Buckland *et al.*, 1996, unpublished).

4 Because this is a binomial regression model, the *t*-statistics in Table 2 do not match the significance tests for inclusion of model terms on the basis of deviance explained. Although *bid* is not always significant using a deviance test when the reciprocal of *bid* is included (due to their negative correlation: $c = -0.3$), taken as a pair, they are always highly significant and both are kept in the model whenever the reciprocal is accepted by the stepwise regression procedure.

5 *Bid* and *recipbid* are always negatively correlated. Therefore, if *bid* is negatively correlated with the probability of acceptance then *recipbid* will be positively correlated.

6 An alternative approach would be to take each respondent in turn and substitute his/her covariate values into the logistic equation to estimate an individual WTP. However, this approach assumes that just the location of the WTP curve changes when the covariates change, whereas a change in shape might occur, in which case bias should be anticipated (Buckland *et al.*, 1996, unpublished).

7 As *recipbid* was not selected, bid level was truncated at zero.

8 This dataset also included respondents from the original WTP survey who were unwilling to pay anything and who were excluded from Model 1. As non-positive bids were permitted in Model 2 this group could be included as having rejected the offered bid.

9 Since *bid* was not restricted to a non-negative number, *recipbid* was not included in the stepwise procedure.

10 Based on aggregation of mean WTP to the Scottish level (1.98 million households) and dividing by the area of each proposed forest: Affric—86 000 ha, Strathspey—100 000 ha.

11 However, it should be noted that this study asked for WTP to prevent afforestation, and did not elicit WTA compensation for individuals who might have been in favour of afforestation.

12 An open-ended CV payment question simply asks respondents to state their maximum WTP.

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