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Dealing with ignored attributes in choice experiments on valuation of Sweden's environmental quality objectives

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Abstract

Using a choice experiment, this paper investigates how Swedish citizens value three environmental quality objectives. In addition, a follow-up question is used to investigate whether respondents ignored any attributes when responding. The resulting information is used in the model estimation by restricting the individual parameters for the ignored attributes to zero. When taking the *shares* of respondents who considered both the environmental and the cost attributes (52-69 percent of the respondents) into account, then the WTPs for each attribute change if the respondents who ignored the attributes have a zero WTP. At the same time, we find evidence that not all respondents who claimed to have ignored an attribute really did. Instead, our results show that they put less weight on the attributes they claimed to have ignored. We also find that people with a university education were more likely to consider all the attributes than others did.

Key words: Choice experiment, WTP, ignoring attributes, follow-up question, environmental quality objectives.

JEL classification: D61, Q50, Q51.

1. Introduction

Stated preference surveys on environmental goods usually put a lot of faith in the cognitive abilities of respondents. Many choice experiments (CE) involve a trade-off among several attributes, where each attribute in itself can be quite complex.[1] Moreover, stated preference surveys concern decisions regarding issues that the respondents are not used to making decisions about. There is therefore a risk that respondents use simplifying strategies when responding (e.g., DeShazo and Fermo, 2002; DeShazo and Fermo, 2004). One example of a simplifying strategy is to ignore one or several attributes. There are of course other reasons why respondents ignore attributes as well; e.g., they may decide to not consider the cost attribute to communicate that the issue is very important to them or to protest against the trade-off between money and the environment (Stevens et al., 1991).[2] In addition, the design itself can result in lexicographic orderings, for example when one attribute is so much more important than the others or when the cost attribute is not high enough to result in a trade-off for the respondent (Rosenberger et al., 2003; Rizzi and de Dios Ortúzar, 2003). However, the act of ignoring certain attributes may also simply reflect that the respondent is not willing to pay anything for a change in the attribute, at least not within the range given in the experiment. In this case, the choices made are a reflection of the true underlying preferences. Whatever the reason that people ignore attributes, it is important to consider this behavior when estimating a stated preference model. Moreover, this knowledge becomes crucial when conducting a welfare analysis using the implied willingness to pay (WTP) measures. Studies that do not take into account whether respondents have considered some attributes may give biased welfare estimates and therefore result in potentially wrong policy implications.

[1] In a CE, respondents make repeated choices between alternatives. The alternatives are described by a number of attributes, and the levels of the attributes are varied among the choice sets. For overviews of the choice experiment method, see for example Alpizar et al. (2003) and Louviere et al. (2000).

[2] Stevens et al. (1991) discuss the problem of valuing the environment in monetary terms. According to them, people who are ”genuinely altruistic” do not make trade-offs between money and wildlife. The fact that 44 percent of their respondents agreed with the statement that ”preservation of wildlife should not be determined by how much money can be spent” and 67 percent agreed that ”as much wildlife as possible should be preserved no matter the cost” indicates that some people do not consider costs when answering surveys.

In this paper we investigate the effects of using a follow-up question after the choice situations in a CE. More precisely, we asked the respondents whether they ignored any of the attributes when responding in a valuation survey on three Swedish environmental quality objectives. We then compare the marginal WTPs of two different logit models. In the first model, we estimate the marginal WTP for the whole sample without making use of the follow-up question. In the second, we use the follow-up question and estimate the marginal WTP for the conditional sample of respondents who considered the attribute in question and who also considered the cost attribute; i.e., we restrict the individual parameters for the ignored attributes to zero.

A few previous studies used approaches similar to ours to model the issue of ignoring attributes, both in transportation applications (Hensher et al., 2005) and in environmental applications (DeShazo and Fermo, 2004; Campbell et al., 2006; Campbell et al., 2008). In all these papers, the conclusion is that restricting parameters using follow-up questions can have large effects on the parameter estimates and the implied WTP measures. For example, in Campbell et al. (2006 and 2008), WTP estimates decreased by more than 50 percent when lexicographic preferences were accounted for, and Hensher et al. (2005), find significantly lower WTP estimates for travel time savings in a model which assumes that certain attributes are ignored. Interestingly, DeShazo and Fermo (2004) find the opposite result: The average marginal WTP increases when controlling for those who do not consider all the attributes in a choice set. Thus, according to the empirical evidence so far, the estimates will be biased in some direction. In this paper, we extend the previous analysis by discussing how to treat respondents who ignore attributes in a welfare analysis. It is possible that respondents stated that they ignored an attribute, while they really only put less weight on it or ignored it only in

some of the choice sets. Therefore, we also test whether the coefficients of ignored attributes really are zero. We follow up the discussion with an empirical analysis where we look at two extreme cases: one where we assume that those who ignored nevertheless have a positive WTP and one where they have a zero WTP for the attribute in question. This way we obtain an upper and a lower limit on the WTP estimates. We also investigate the relative importance of the attributes of the environmental objectives and whether there is a correlation between the share of people who ignored a certain attribute and the ranking of that attribute based on the WTP estimates. The rest of the paper is organized as follows: Section 2 presents the CE, Section 3 the econometric model, and Section 4 the results. Section 5 concludes the paper.

2. The environmental quality objectives and the choice experiments

In Sweden, a number of so-called environmental quality objectives have been formulated, of which 16 have been adopted by the Swedish Parliament. The main purpose of these objectives is to provide a framework for obtaining a sustainable environment. Another purpose is to define the quality of the environment, natural resources, and cultural resources in Sweden, and to be able to measure the change in environmental quality over time. The objectives are designed to, among other things, promote human health, safeguard biodiversity and the natural environment, and preserve the cultural environment and the cultural heritage (SEPA, 2006). The Environmental Objectives Council has the overall responsibility for coordinating the implementation of the goals. It monitors the actions of and policies designed by different governmental bodies in different sectors, and publishes an annual progress report. However, past evaluations have made clear that many of the quality objectives are not going to be reached given current policy measures (SEPA, 2006). The government is therefore interested in obtaining more information about citizen preferences regarding the various quality objectives, and the different components of the objectives, in order to better prioritize the

objectives. Therefore, we conducted three CE studies that investigate how people living in Sweden evaluate three different environmental objectives: a Balanced Marine Environment, Flourishing Lakes and Streams, and Clean Air.[3] The overall goal of the Balanced Marine Environment objective is: "The North Sea and the Baltic Sea must have a sustainable productive capacity, and biological diversity must be preserved. Coasts and archipelagos must be characterized by a high degree of biological diversity and a wealth of recreational, natural and cultural assets. Industry, recreation and other utilization of the seas, coasts and archipelagos must be compatible with the promotion of sustainable development. Particularly valuable areas must be protected against encroachment and other disturbance" (SEPA, 2006). The overall goal of the Flourishing Lakes and Streams objective is: "Lakes and water courses must be ecologically sustainable and their variety of habitats must be preserved. Natural productive capacity, biological diversity, cultural heritage assets and the ecological and water-conserving functioning of the landscape must be preserved, at the same time as recreational assets are safeguarded" (SEPA, 2006). The overall goal of the Clean Air objective is: "The air must be clean enough not to represent a risk to human health or to animals, plants or cultural assets" (SEPA, 2006).

The survey was developed in collaboration with a group of Swedish EPA administrators. The questionnaire sent to the respondents consisted of three parts. The first part asked questions about the respondents' engagement in environmental issues, and the second contained the CE about one of the environmental quality objectives. Each respondent answered a CE on one of the environmental quality objectives. The random sample of 3,000 individuals was hence split into three groups of equal size. The third part of the questionnaire consisted of questions regarding the respondent's socio-economic status.

[3] The data for the citizens is part of a larger study on six environmental objectives (Kataria and Lampi, 2008).

All 16 environmental objectives have been described with different interim targets in an attempt to make them more tangible and to be of help in the progress toward reaching the objectives. We decided to use these interim targets when defining the attributes in the CE in order to concretize the objectives and make them easier to understand for the respondents. In the case of a Balanced Marine Environment, we used four different attributes. Table 1 presents the attributes and levels of the CE in the survey. The cost attribute was expressed as a tax to be collected over the next five years.

>> Insert Table 1 here

The CE included six choice sets, each with three different alternatives. The first alternative was always an opt-out alternative describing the current environmental quality. The first level of each of the attributes in Table 1 is the level for the opt-out alternative. Hence, the changes we evaluate are improvements compared to the current situation. See Appendix for an example of a choice set. Note again that each respondent answered only one CE. In order to reduce the risk of hypothetical bias we included a short cheap-talk script in each survey version. Although the results are somewhat mixed, cheap-talk scripts have been successfully used to reduce hypothetical bias in choice experiments (Carlsson et al., 2005; List et al., 2006).

The choice sets were created using a cyclical design, a so-called fold-over (Bunch et al, 1996; Carlsson and Martinsson, 2003). First, an orthogonal main effects design was generated,

consisting of 12 attribute level combinations.[4] Each combination in the main effects design is one alternative in one of the 12 choice sets. The levels of the attributes of the second alternative in a choice set are obtained by adding two levels to each attribute level of the first alternative, and when the highest level is reached, it starts over from the lowest level.[5] To these two alternatives, an opt-out alternative was added. The 12 sets were then randomly blocked into two survey versions. All respondents were asked to choose one of the three alternatives. The design procedure was used for each of the three experiments.

The follow-up question used to investigate whether the respondent had considered the attributes when making their choices in the questionnaire read: "Was (were) there any attribute(s) that you did not consider when you made your choices? (Several alternatives are possible)". They could then mark the attributes they did not consider. Those who considered all attributes could mark a "No" alternative. This question followed directly after the choice sets in all questionnaires.[6]

3. Econometric model and interpretation of WTP

In the analysis of the responses, we apply a random parameter logit model (Train, 2003). For simplicity, we only include the attributes, plus an alternative-specific constant for the opt-out alternative. We therefore specify the utility of alternative *i* for individual *j* as:

$$U_{ijt} = \beta_j' x_{it} + \varepsilon_{ij},$$

[4] Orthogonal main effects design means that we do not have correlations between the attributes, i.e., each attribute affects utility but the utility is not affected by the interaction between the attributes. Moreover, each attribute level is included equally often (level balance).

[5] So if an attribute has four levels (0, 1, 2, 3) and the level in the first alternative is 1, the level in the second alternative is 3.

[6] As a referee pointed out, a question like this, which collects information regarding ignored attributes after the decisions have been made, is of course vulnerable to potential biases. Unfortunately, this is an unavoidable restriction, at least in mail surveys.

where x_i is a vector of the attribute levels of alternative i, β_j is the corresponding individual parameter vector, and ε_{ij} is an error term. We let all the attribute parameters except the cost parameter be normally distributed, including the alternative specific constant for the opt-out alternative. Furthermore, we assume that the utility coefficients vary among individuals but are constant across the choice situations for each individual. This reflects an underlying assumption of stable preference structures for all individuals.

The information about which attributes a respondent ignores can be used to restrict attribute parameters to zero (Hensher et al., 2005). The probabilities in the likelihood function are then only a function of the attribute parameters that have been considered.[7] A particular group of respondents are those who ignored the cost attribute; we cannot estimate their marginal willingness to pay since we cannot estimate the marginal utility of money. One alternative is therefore to exclude these respondents from the estimation. However, we want to know whether they are different in their marginal trade-offs among the other attributes and we therefore still include them.

We estimate two models for each environmental objective: The first is a standard model where we do not put any restrictions on the parameters, while we in the second model restrict all ignored attribute parameters to zero.[8] Our main interest lies in the WTP estimates. Since we assume that utility is linear in the attributes, the marginal WTP is simply the ratio between the attribute parameter and the cost parameter. One problem with reporting marginal WTPs is that the attributes are measured in different units for the different environmental objectives, and it is thus difficult to compare the magnitudes between different attributes and objectives.

[7] In our setting this is exactly the same as setting the attribute levels to zero. Since a respondent ignored or considered an attribute for the whole choice set, it does not matter how we specify it.
[8] Since the cost parameter is fixed, we set the cost attribute levels to zero when the cost attribute is ignored.

Therefore, we will estimate the WTP for an improvement of the attribute from the current level (opt-out) to the best possible level (the highest level of the attribute) in the experiment.

However, one should be careful when comparing the WTPs in the models with and without restriction of ignored attribute parameters to zero. For the model without restrictions (where we do not use the follow-up question), the WTP is the average WTP for the whole sample. For the restricted model, where we restrict the parameters of ignored attributes, the WTP is the average WTP for the conditional sample of respondents who considered the cost attribute and the environmental attribute in question. Therefore, a direct comparison of the WTPs from the two models could be misleading. Actually, a direct comparison of the estimates implies an assumption that those who ignore a certain attribute generally have the same preferences as those who did not ignore the attribute, since the conditional and unconditional WTPs in the second model then are the same. If we instead assume that respondents only considered attributes for which they have a positive WTP, then those who did not consider the attributes have a zero WTP and the conditional and unconditional WTPs are not the same in the second, restricted, model.[9] The respondents who did not consider the cost attribute are a rather special case. Strictly speaking, we cannot infer their WTP since we cannot estimate their marginal utility of money. One interpretation of their behavior is that they protested against making a trade-off between money and the environment, and another is that there is extreme yea-saying, which should exclude them from the welfare analysis. An alternative way to deal with these respondents in the welfare analysis is to still include them, making some assumption about their marginal utility of money.

[9] In this case, the model is similar to one of Carlsson and Kataria (2008), although they only allow for two groups of responses: (i) positive WTP for all attributes and (ii) zero WTP for all attributes. What this means is that the distribution of the random parameter has a probability point mass at zero. For a single attribute, the model is also related to the so-called spike models in contingent valuation (Kriström, 1997; Haab, 1999; Clinch and Murphy, 2001).

Given the above discussion, we have three different scenarios for the restricted model: (i) All respondents have a positive WTP. We assume that those who ignored the cost attribute do not differ from those who did not. (ii) Only respondents who considered the environmental attribute have a positive WTP. Again, we assume that those who ignored the cost attribute have the same mean marginal utility of income as those who did not. (iii) Only respondents who considered the environmental attribute and the cost attribute have a positive WTP. In the analysis we will present and compare the results for all three scenarios. This allows us to put limits on the WTP associated with the uncertainty regarding different ways of treating those who ignored attributes.[10]

4. Results

We use survey responses from a mail questionnaire sent out in June 2007 to a random sample of 3,000 men and women aged 18-75, selected from the Swedish census registry. Focus groups and several small pilot studies were also conducted before the main survey (1,000 questionnaires) for each objective was sent out. A single reminder was sent out three weeks after the main survey. In total 955 individuals returned the questionnaire, of which 304 (Marine environment), 342 (Lakes), and 309 (Air) were available for analysis due to non-responses to various questions.[11] Not everybody answered all six choice sets. However, we still chose to include these individuals in the analysis. As explained, following the CE the respondents stated whether they had ignored one or more attributes for whatever reason. Table 2 presents the descriptive statistics for the whole sample.

>> Insert Table 2 here

[10] When using WTP estimates from the sample to infer benefits to the population as a whole, similar kinds of extreme assumptions are not unusual as it is generally difficult to elicit preferences for non-respondents; see Mitchell and Carson (1989) for a discussion.

[11] The total response rate is 32 % and is corrected for those who had moved and who for other reasons did not received the questionnaire.

Comparing the descriptive statistics of the respondents with the national statistics, we find that the share of respondents who are women and the share of respondents with a university education are significantly higher, although only slightly, in this study than in Sweden as a whole (Statistics Sweden, 2008). However, there is no significant difference between the mean age of the respondents and the mean age of this age group at the national level.[12] All these comparisons are tested with the bootstrapping method.[13]

Table 3 shows the shares of respondents who ignored the different attributes.

>> Insert Table 3 here

As seen in Table 3, the cost attribute and the cultural assets attribute are the most commonly ignored attributes. Compared with for example Hensher et al. (2005), the fraction of respondents who ignored an attribute is higher in our study. An exception is their attribute "uncertainty of time," which in their study was ignored by 37%. Campbell et al. (2006 and 2008) have similar results, although in total we have more respondents who ignored at least one attribute. This is reported in Table 4, which shows the fractions of respondents who ignored 1-5 attributes.

>> Insert Table 4 here

[12] About 17% of people aged 18-74 in Sweden have at least three years of university education, while the corresponding share in our sample is 21 % (Statistics Sweden, 2008). Furthermore, 53 % of the sample are women, while women represent 49 % of people aged 18-74 years in Sweden (Statistics Sweden, 2008).

[13] One thousand samples were bootstrapped by randomly drawing observations with replacement as many times as there are observations in the original sample. The differences between the means are calculated 1,000 times for each variable. By using the percentile method and the 95 % confidence interval, it can be shown whether the means significantly differ at the 5 % significance level. The advantage of the percentile method is that it makes no assumptions of the underlying distribution (Efron and Tibshirani, 1998).

Table 4 shows that a majority of the respondents ignored at least one attribute in the questionnaire on Balanced Marine Environment and Flourishing Lakes and Streams, while a little less than half did in the questionnaire on Clean Air. Moreover, it is quite uncommon that people ignored more than two attributes.

Willingness to pay estimates: Treatment of ignored attributes

We now turn to the results of the random parameter models. All models are estimated with simulated maximum likelihood using Halton draws with 500 replications with Nlogit 4.0; see Train (2003) for details on simulated maximum likelihood and Halton draws. All random attribute parameters are normally distributed. The full model results are presented in Appendix. Table 5 reports the WTP estimates for the three environmental objectives. Remember that this is the WTP for an improvement of the attribute from the current level (opt-out) to the best possible level (the highest level of the attribute). The first model is the standard model where we do not restrict the parameters. In the second model, all attribute parameters ignored by the respondent are restricted. The WTP reported in the table is for the groups of respondents who considered the environmental attribute in question and the cost attribute. The standard errors are calculated using the Delta method.

>> Insert Table 5 here

Table 5 reveals that there are no systematic differences in WTP between the two model specifications for any of the CEs. Using t-tests we cannot reject the hypothesis of equal WTP estimates between the two models for any of the attributes. This is in sharp contrast to previous studies comparing models with and without consideration of ignored attributes (DeShazo and Fermo, 2004; Hensher et al., 2005; Campbell et al., 2006 and 2008).

Furthermore, accounting for ignored attributes does not result in less test variation in the model. We calculate the coefficient of variation, the ratio of the standard deviation to the mean, for the six models in Table A1, and although there are differences between the models, there is no systematic pattern in the differences.

There are two aspects of ignored attributes that we now want to explore. The first is to what extent we can assume that the coefficients of ignored attributes are zero. The second is the implications of different assumptions about the preferences of those who ignored attributes. The first aspect is investigated by estimating random parameter logit model where we for each attribute estimate separate coefficients for those who did and those who did not ignore the attribute, but with a common alternative specific constant. This means that we estimate two coefficients for each attribute in the experiments.[14] All models are again estimated with simulated maximum likelihood using Halton draws with 500 replications. Table 6 presents the results.

>> Insert Table 6 here

Interestingly, far from all coefficients are insignificant for those respondents who stated that they ignored the corresponding attribute. In particular, the cost coefficient is never insignificant. For the other attributes, 5 out of 10 coefficients are insignificant. On a few occasions, the magnitude of a coefficient is even greater for respondents who stated that they ignored the corresponding attribute. This implies that it is not clear whether all respondents who claimed to have ignored the corresponding attribute really did so. One possibility is that they put less weight on the attribute, or that they ignored it in some choice sets. It also implies

[14] This approach was suggested to us by an anonymous referee.

that it is not straightforward to assume that the coefficient actually should be zero for the ignored attribute. In either case, it seems that the respondents adopted some kind of simplifying decision strategy that deviates from the traditional view of rational respondent behavior. This in turn has important implications for the welfare analysis. This leads us in to the second aspect that we wish to discuss.

In the cases when respondents really did ignore an attribute(s), we have to be careful when comparing the estimated WTPs in the two different models. For the model without restrictions, the WTP is the average marginal WTP for the whole sample. For the model where we restrict parameters of ignored attributes, the WTP is the average marginal WTP for the conditional sample of respondents who considered the cost attribute and the environmental attribute in question. The difference between the conditional and unconditional WTP depends on the assumptions we make and the share of respondents who ignored an attribute. Table 5 also reports the shares of respondents who considered the environmental attribute in question and the cost attribute. The shares vary from 52 to 69 percent. We also report the shares of respondents who considered the environmental attribute in question, irrespective of whether they ignored the cost attribute. These shares are of course larger (in some instances very much so), which may have important implications.

Table 7 presents the estimated unconditional WTP for the restricted models, using the three different ways of treating those who ignored attributes as mentioned in Section 3: (i) all respondents have a positive WTP, (ii) only respondents who considered the environmental attribute have a positive WTP,[15] and (iii) only respondents who considered the environmental attribute and the cost attribute have a positive WTP.

[15] In (i) and (ii) we assume that those who ignored the cost attribute do not differ from those who did not. We tested whether the respondents who ignored the cost attribute made different trade-offs among the non-monetary

>> Insert Table 7 here

Obviously, the unconditional WTP is substantially lower in the restricted model when we assume that those who ignored the attributes have a zero WTP. For example, if we assume that also those who ignored the environmental and the cost attribute have a positive WTP, then the unconditional WTP is 608 SEK for animals and plants for a Balanced Marine Environment. If only those who considered the attribute have a positive WTP, then the unconditional WTP is 529 SEK.[16] If we instead assume that those who ignored the cost attribute and the environmental attribute have a zero WTP, then the unconditional WTP is even smaller: 395 SEK. This pattern is similar for all attributes, and the effect depends entirely on the share of respondents who considered the attributes. For the Balanced Marine Environment objective, the difference in WTP between (i) and (iii) is significant (using a t-test) for all attributes except one. For the Flourishing Lakes and Streams objective, the difference in WTP is not significant for any of the attributes, not even if we compare (i) and (iii). For the Clean Air objective, there is only a significant difference between (i) and (iii) for one attribute: animals and plants. Thus, the differences between WTPs are significant for half of the attributes and only when we compare the two extreme cases: that all respondents have a positive WTP and that only those who considered both the environmental and the cost attributes have a positive WTP. Thus, in our study, the welfare estimates will not be

attributes than other respondents, but found no significant differences. This was done by interacting the non-monetary attribute parameters with the dummy variable equal to one if they ignored the cost attribute. All the interaction terms were insignificant. Interestingly, this result differs from that of a somewhat similar experiment in Carlsson et al. (2007) where half of the respondents answered a standard CE while the other half answered a CE in which the cost attribute was held constant. The marginal rates of substitution among the attributes were significantly different between the two experiments. One explanation, according to the authors, is that the cognitive burden increases when the cost attribute varies. Another possible explanation is that the preferences between the cost attribute and the other attributes are not weakly separable.

[16] The calculations are made by multiplying the conditional mean WTP of 607.5 SEK for endangered species with the share of respondents who considered the attribute (87 percent). The other estimates in Table 5 are calculated in a corresponding way.

significantly different unless the share of respondents who ignored the attributes is sufficiently large.

Hence, how we interpret the answer to the follow-up question is going to be crucial for the welfare analysis. The problem with our approach is that we do not know why respondents ignored certain attributes. However, it is safe to say that those who ignored the cost attribute do not have zero marginal utility of money, although the survey provides us with no information about the actual value. This is also confirmed in the logit models with separate cost coefficients for the two groups of respondents. The result still allows us to put limits on the WTP associated with the uncertainty regarding different ways of treating those who ignored attributes. Hence, different respondents can ignore attributes for different reasons, and the minimum and maximum value for each attribute in Table 5 reflects the lower and upper limit of the WTP.

Willingness to pay estimates: Implications for the environmental quality objectives

Despite the uncertainty considering the welfare estimates and reasons why people ignore attributes, it is possible to compare and in general terms trace patterns of how Swedish citizens value the different aspects of the environmental quality objectives. Firstly, comparing the interim targets across and within the objectives, people generally seem to be most willing to pay for the attribute animals and plants. In comparison, the WTP for cultural assets-attributes is the lowest across all objectives, and the WTPs are insignificant for both Clean Air and Flourishing Lakes and Streams. Thus, people seem to put a relatively low weight on cultural assets compared to human health and animals and plants. As shown in Table 5, cultural assets is the most commonly ignored non-monetary attribute for all three

environmental objectives. Thus, our results clearly show that there is a negative correlation between the share of people who ignored an attribute and the ranking of the attribute based on the WTP estimates. The WTP for health and recreation is relatively high for the environmental objective Clean Air but not for Flourishing Lakes and Streams. The difference is perhaps not surprising. For Clean Air we look at improvements that affect human health while for Lakes and Streams we look at recreational improvements.

The trade-off between the interim targets animal and plants, human health and recreation, and cultural assets is important since it is a recurrent theme for the 16 environmental quality objectives adopted by the Swedish Parliament. Thus, it provides information about what targets should be prioritized. Sixteen percent of the marine objective responses were opt-outs, while the corresponding shares for the air and lake objectives were 11 and 19 percent respectively. Thus, the respondents opted for the current environmental situation more often in the case of the Flourishing Lakes and Streams objective compared to the other two objectives. One way to make additional use of our results would be to combine the obtained WTP estimates with estimations of the costs. However, in this study we provide basic and necessary input on the benefit side and leave a more detailed cost-benefit analysis for future analysis.

Can we explain why some people ignored attributes?

One interesting question is whether there are systematic differences between respondents who ignored and those who did not ignore attributes when making choices. In order to investigate this, we estimate two binary probit models. In the first model, the dependent variable is equal to one if a respondent ignored at least one attribute, but not the cost attribute. In the second,

the dependent variable is equal to one if the respondent ignored the cost attribute. Table 8 presents the results.[17]

>> Insert Table 8 here

The results in Table 8 show that people with a university education were less likely to ignore a non-monetary attribute than those with lower levels of education. The marginal effect of the variable University education is one of the largest among the socio-economic effects, indicating that educational level affects whether people ignore an environmental attribute. That people with a university education considered more of the attributes might indicate that the choice situations in our questionnaire and perhaps in CE studies in general, are cognitively demanding. This finding is in line with the results of Sælensminde (2001, 2002), who finds that people with less education make more inconsistent choices than people with more education, even in an experiment with only three attributes.[18] In fact, he finds that education is the only one of the included socio-economic variables that is significant, indicating that inconsistent choices seem to be difficult to explain in general.[19] On the other hand, Johnson and Desvousges (1997) find no attitudinal or socio-economic differences that could explain why some of their respondents gave inconsistent or invariable responses. Moreover, we find that respondents who live in rural areas are less likely to ignore a non-monetary attribute than others.

Respondents in general are more likely to ignore non-monetary attributes in the environmental objective Clean Air survey than in the surveys on Flourishing Lakes and

[17] We also ran both probit regressions with age and income dummies and age in a quadratic form to see whether there are some categorical or nonlinear effects, but found this to not be the case.
[18] However, ignoring a non-monetary attribute does not necessary imply an inconsistent choice in our case.
[19] Age, income, gender, or being a pensioner has no significant effect on whether people make inconsistent choices.

Streams and on a Marine Environment. It is possible that people are more or less likely to ignore attributes in a survey depending on how familiar the topic of the survey is to them. If people do not personally care about a topic, it is possible that they may give less attention to and more often ignore related attributes in a CE. Unfortunately, we have no data on whether the respondents live close to a lake or a marine environment and cannot therefore further investigate the objectives a Marine Environment and Flourishing Lakes and Streams.[20] However, we are able to investigate whether those who live in big cities, i.e., those who might suffer from bad air quality, ignored attributes in the experiment on Clean Air to a different extent than those who live in smaller towns or in rural areas. Interestingly, we find that people living in one of the three biggest cities in Sweden were clearly less likely to ignore attributes in the survey on Clean Air. Thus, even if people in general were more likely to ignore attributes in the experiment on Clean Air than in the other two experiments, those who live in big cities were not.

We find only two significant effects on the probability of ignoring the cost attribute: Older persons and those who have at least one child were more likely to ignore it. Interestingly, we find no significant effects of income or of being a member of an environmental organization on the probability of ignoring an attribute.

5. Conclusions

People for various reasons often ignore certain attributes when participating in stated preference studies. When investigating individuals' WTP in a CE it is important to be aware of which attributes a respondent has considered and which ones he or she has ignored. For example, if a respondent ignores the cost attribute, it is not possible to estimate his or her

[20] In Sweden it is quite common that people have summer houses close a lake or along the coast. Knowing whether the respondents have their permanent homes close to a lake or along the coast is therefore not enough to get a picture of how familiar they are with the topics of lakes and marine environment.

marginal WTP for the other attributes in a experiment. This implies that studies that do not take into account whether respondents considered the cost attribute are likely to give biased welfare estimates and therefore potentially lead to wrong policy implications.

Using the respondents' own statements about whether an attribute was ignored in order to restrict parameters to zero, we find no significant differences in mean marginal WTP between the models for the whole sample and the models where we estimate WTP only for those who considered the attribute in question and the cost attribute. However, the shares of respondents who considered both the environmental attribute and the cost attribute are between 52 and 69 percent. Therefore, what assumption we make about the WTP for those who ignored environmental attribute is crucial. If we assume that the marginal WTP is zero, the unconditional marginal WTPs are found to be substantially lower than if we assume that these respondents generally have the same preferences as those who did not ignore the corresponding attribute; i.e. if we assume that the respondents have positive WTPs. These findings can be interpreted in the light of different behavioral assumptions; our analysis shows that it becomes crucial to distinguish between the case when respondents ignore attributes for simplicity reasons and the case when respondents ignore attributes due to a zero WTP. This way we obtain an upper and a lower limit on the WTP estimates, depending on how we treat the respondents who ignored attributes.

We also find that the most commonly ignored attributes always have the lowest rankings in terms of WTP across all three environmental objectives. We therefore conclude that even if the coefficients of the attributes are not zero for the groups of subjects who claimed to have ignored the attribute, they seem to put less weight on those attributes than on others. Finally, we find that people with a university education and people who live in rural areas are less

likely to ignore an environmental attribute than those with lower levels of education and those living in towns and cities, and that those who live in a big city, and who therefore are more likely to suffer from bad air quality, are less likely to ignore environmental attributes in the survey version concerning the Clean Air objective.

As shown in this paper, it is potentially important to account for how individuals treat each attribute when responding to CE questions. This is consistent with previous findings by, e.g., Hensher et al. (2005) and Campbell et al. (2006). What we also show in this paper is that the reason why an attribute is ignored is equally important. This points to a number of important and difficult areas for future research. First of all, it is important to be able to find ways to discriminate among different reasons for ignoring attributes, since this is of relevance for welfare analysis. This is not as straightforward as it seems, since there are many reasons why respondents ignore attributes. Second, it is of interest to investigate how the share of respondents who ignore attributes is related to the number of attributes and the general complexity of the CE.

Considering the Swedish environmental objectives, our results suggest that people have the highest willingness to pay for improvements concerning conservation of animals and plants, and for a direct impact on human well-being in terms of for example health. Recreational aspects seem to have lower priority, and cultural assets seem to be the least important when comparing people's WTP for the interim targets, both across and within the environmental objectives.

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Table 1. Attributes and levels in the CE. The first level for each attribute is the opt-out level.

	Attributes	**Levels**	
	Survey 1 Marine Environment	*Opt out*	*Improvement*
Animals and plants	Number of endangered species	35	5, 15, 30
Discharge of oil and chemicals	Increase in surveillance of oil and chemical discharges	0%	10, 40%
Catch and growth of fish stock	Measure to increase the fish (cod) stock	0%	10, 40, 70%
Cultural assets	Number of fishermen at risk of losing their jobs	800	200, 600
	Survey 2 Lakes and Streams	*Opt out*	*Improvement*
Animals and plants	Number of endangered species	40	10, 20, 30
Human health and recreation	Share of lakes suitable for swimming	86%	90, 98%
Cultural assets	Share of unprotected ancient remains in water/ at coast	30%	40, 60, 80%
	Survey 3 Clean Air	*Opt out*	*Improvement*
Animals and plants	Number of acidified waters (due to bad air quality)	17000	3000, 8000, 14000
Human health and recreation	Number of premature deaths (due to bad air quality)	5000	1000, 2500, 4000
Cultural assets	Reduction, in percent, of number of damaged buildings (due to bad air quality)	0	10, 40, 60%
	All surveys	*Opt out*	*Improvement*
Cost[a]	Cost per year (SEK), same in all surveys	0	100, 300 600, 800, 1000

[a.] At the time of the survey 1 USD = 6.7 SEK.

Table 2. Descriptive statistics.

	Description	Mean	Standard deviation
Age	Age in years	48.86	15.78
Female	= 1 if female respondent	0.52	0.50
Have at least one child	= 1 if at least one child in the household	0.30	0.46
Household income per month	Income in SEK per month	24 742	13 070
Only primary education	= 1 if respondent only has primary education	0.20	0.40
University education	= 1 if respondent has university education	0.32	0.47
Lives in rural area	= 1 if respondent lives in a rural area	0.36	0.48
Lives in large city	= 1 if respondent lives in a large city	0.27	0.44
Member of environmental organization	= 1 if respondent is a member of an environmental organization	0.07	0.25

Table 3. Share of respondents who ignored a certain attribute.

	Balanced Marine Environment	**Flourishing Lakes and Streams**	**Clean Air**
Animals and plants	0.13	0.11	0.13
Health and recreation		0.13	0.18
Cultural assets	0.21	0.18	0.27
Oil and chemical spills	0.12		
Fish stock	0.11		
Cost	0.24	0.24	0.31

Table 4. Share of respondents who ignored attribute combinations.

	Balanced Marine Environment	**Flourishing Lakes and Streams**	**Clean Air**
Ignored at least one attribute	0.54	0.58	0.47
Ignored 1 attribute	0.38	0.35	0.33
Ignored 2 attributes	0.09	0.15	0.10
Ignored 3 attributes	0.05	0.07	0.03
Ignored 4 attributes	0.02	n.a.	n.a.
Ignored all attributes	0.00	0.01	0.01

Table 5. Average WTP (SEK) for attributes; standard errors in parentheses.

	Balanced Marine Environment		**Flourishing Lakes and Streams**		**Clean Air**	
	No restriction	Restricting ignored attributes	No restriction	Restricting ignored attributes	No restriction	Restricting ignored attributes
Animals and plants	510***	608***	378***	379***	980***	980***
	(99)	(118)	(96)	(95)	(140)	(140)
Share considered attribute		87%		89%		87%
Share considered attribute and cost		65%		67%		60%
Health and recreation			247***	239***	720***	960***
			(54)	(54)	(160)	(200)
Share considered attribute				87%		82%
Share considered attribute and cost				67%		57%
Cultural assets	438***	396***	92	132*	67	25
	(72)	(84)	(77)	(80)	(83)	(83)
Share considered attribute		79%		82%		73%
Share considered attribute and cost		57%		63%		52%
Oil and chemical spills	492***	455***				
	(67)	(77)				
Share considered attribute		88%				
Share considered attribute and cost		66%				
Fish stock	525***	499***				
	(83)	(97)				
Share considered attribute		89%				
Share considered attribute and cost		69%				

*, **, *** significantly different from zero at the 10%, 5%, and 1% level respectively.

Table 6. Estimated random parameter logit models; p-values in parentheses.

Parameters	Balanced Marine Environment		Flourishing Lakes and Streams		Clean Air	
	Considered attribute	Ignored attribute	Considered attribute	Ignored attribute	Considered attribute	Ignored attribute
Opt-out	-4.706 (0.000)		-3.105 (0.000)		-4.181 (0.000)	
Endangered species/ Acidified waters	-0.027 (0.000)	-0.009 (0.441)	-0.025 (0.000)	-0.045 (0.013)	0.0002 (0.000)	-0.0002 (0.000)
Health and recreation			0.045 (0.000)	0.019 (0.408)	0.0005 (0.000)	-0.0001 (0.477)
Cultural assets	-0.001 (0.000)	-0.001 (0.000)	0.007 (0.038)	-0.012 (0.131)	0.004 (0.154)	-0.003 (0.629)
Oil and chemical spills	0.018 (0.000)	0.020 (0.002)				
Fish stock	0.010 (0.000)	0.016 (0.002)				
Cost	-0.001 (0.000)	-0.001 (0.000)	-0.002 (0.000)	-0.002 (0.000)	-0.002 (0.000)	-0.002 (0.000)
Standard dev.						
Opt-out	6.690 (0.000)		3.789 (0.000)		4.364 (0.000)	
Endangered species	0.040 (0.000)	0.035 (0.041)	0.065 (0.000)	0.079 (0.000)	0.0002 (0.000)	0.0001 (0.021)
Health and recreation			0.066 (0.000)	0.066 (0.000)	0.001 (0.000)	0.001 (0.000)
Cultural assets	0.001 (0.351)	0.001 (0.200)	0.033 (0.000)	0.036 (0.000)	0.004 (0.598)	0.011 (0.376)
Oil and chemical spills	0.009 (0.246)	0.003 (0.932)				
Fish stock	0.118 (0.000)	0.011 (0.332)				
No. individuals	306		344		310	
McFadden pseudo R-squared (No coefficients)	0.34		0.29		0.42	

Table 7. Unconditional WTP for attributes (in SEK) under various assumptions of the WTP of those who ignored the attribute and cost; standard errors in parentheses.

	Balanced Marine Environment			**Flourishing Lakes and Streams**			**Clean Air**		
Model	(i)	(ii)	(iii)	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Assumption about those who ignored the attribute	Positive WTP	Zero WTP	Zero WTP	Positive WTP	Zero WTP	Zero WTP	Positive WTP	Zero WTP	Zero WTP
Assumption about those who ignored the cost	Positive WTP	Positive WTP	Zero WTP	Positive WTP	Positive WTP	Zero WTP	Positive WTP	Positive WTP	Zero WTP
Animals and plants	608	529	395	379	337	254	980	840	560
	(118)	(103)	(77)	(95)	(85)	(64)	(140)	(140)	(140)
Health and recreation				239	208	160	960	760	520
				(54)	(47)	(36)	(200)	(160)	(120)
Cultural assets	396	312	222	132	109	83	25	19	13
	(84)	(66)	(48)	(80)	(66)	(51)	(83)	(61)	(43)
Oil and chemical spills	455	400	300						
	(77)	(68)	(51)						
Fish stock	499	445	344						
	(97)	(84)	(67)						

Table 8. The marginal effects of the Probit model on the probability of ignoring attributes in the CE; p-values in parentheses.

	Ignored non-monetary attribute	**Ignored cost attribute**
	Marginal	Marginal
Constant	-0.068	-0.431
	(0.410)	(0.000)
Age in years/10	-0.003	0.029
	(0.789)	(0.009)
Female	-0.043	-0.012
	(0.187)	(0.699)
Have at least one child	-0.004	0.077
	(0.920)	(0.041)
Household income per month	-0.010	-0.010
in 10,000 SEK	(0.453)	(0.426)
Only primary education	0.009	-0.040
	(0.845)	(0.316)
University education	-0.071	0.010
	(0.057)	(0.780)
Lives in rural area	-0.088	0.042
	(0.052)	(0.330)
Lives in large city	0.021	-0.029
	(0.680)	(0.536)
Member; environmental	0.048	-0.004
organization	(0.477)	(0.945)
Environmental objective:	0.047	0.017
Balanced Marine Environment	(0.243)	(0.653)
Environmental objective:	0.181	0.070
Clean Air	(0.003)	(0.215)
Clean Air * Lives in rural area	-0.024	-0.023
	(0.763)	(0.743)
Clean Air * Lives in large city	-0.195	0.087
	(0.003)	(0.320)
No. of respondents		
Pseudo R^2	0.023	0.017

Appendix A

Table A1. Estimated random parameter logit models; p-values in parentheses.

	Balanced Marine Environment		**Flourishing Lakes and Streams**		**Clean Air**	
Parameters	No restriction	Restricting parameters	No restriction	Restricting parameters	No restriction	Restricting parameters
Opt-out	-4.910	-5.248	-3.008	-3.061	-3.510	-3.818
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Endangered species/	-0.025	-0.025	-0.026	-0.023	0.0002	-0.0001
Acidified waters	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Health and recreation			0.042	0.037	0.0004	-0.0004
			(0.000)	(0.000)	(0.000)	(0.000)
Cultural assets	-0.001	-0.001	0.004	0.005	0.003	0.0008
	(0.000)	(0.000)	(0.234)	(0.050)	(0.332)	(0.762)
Oil and chemical spills	0.018	0.014				
	(0.000)	(0.000)				
Fish stock	0.011	0.009				
	(0.000)	(0.000)				
Cost	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Standard dev.						
Opt-out	6.681	6.649	3.368	4.000	3.561	3.934
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Endangered species	0.040	0.034	0.069	0.054	0.0002	0.0002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Health and recreation			0.063	0.022	0.002	0.001
			(0.001)	(0.489)	(0.000)	(0.000)
Cultural assets	0.008	0.001	0.039	0.029	0.008	0.004
	(0.046)	(0.862)	(0.000)	(0.000)	(0.364)	(0.500)
Oil and chemical spills	0.007	0.006				
	(0.448)	(0.508)				
Fish stock	0.012	0.011				
	(0.000)	(0.001)				
No. individuals	306	306	344	344	310	310
McFadden pseudo R-squared (No coefficients)	0.34	0.32	0.29	0.28	0.42	0.38

Appendix B

Figure B1. An example of a choice set for the Clean Air objective experiment.

	Alternative 1 (Current situation)	**Alternative 2**	**Alternative 3**
Animals and plants	17,000 lakes are severely acidified because of air pollution	14,000 acidified lakes	3,000 acidified lakes
Human health and recreation	5,000 premature deaths per year due to air pollution	1,000 premature deaths per year	2,500 premature deaths per year
Cultural assets	Air pollution damages buildings	60 % fewer cultural buildings are damaged	40 % fewer cultural buildings are damaged
Increased tax per year and household, during next 5 years	0 SEK	+ 300 SEK	+ 800 SEK

If you could only choose among these three alternatives, which one would you choose?

□ Alternative 1 (current situation)

□ Alternative 2

□ Alternative 3