Respondent uncertainty in contingent valuation of preventing beach erosion: An analysis with a polychotomous choice question

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Abstract

Respondent uncertainty is often considered as one of the main limitations of stated preference methods, which are nowadays being widely used for valuing environmental goods and services. This article examines the effect of respondent uncertainty on welfare estimates by the contingent valuation method. This is done in the context of beach protection against erosion. Respondent certainty levels are elicited using a five-category polychotomous choice question. Two different uncertainty calibration techniques are tested, namely one that treats uncertain responses as missing and another in which uncertain 'yes' responses are recoded as 'no' responses. We found no evidence that the former technique offers any gains over the conventional model assuming certainty. The latter calibration technique systematically reduces welfare estimates. The reduction is statistically significant only when the most certain 'yes' responses are recoded as 'no' responses. The article further identifies determinants of respondent uncertainty. Finally, it explores how real market experience affects respondent uncertainty.

Keywords: contingent valuation method, preference uncertainty, environmental preservation, stated preferences, economic valuation, ecosystem services

1. Introduction

Economic valuation of environmental goods and services has become an important area of research in environmental sciences. As the awareness of the importance of services provided by ecosystems for humans grew, more attention was given to estimating their benefits and including them in cost-benefit analyses to enable better-informed environmental management. Stated preference methods are the main and sometimes the only tool for generating such information. Nevertheless, these methods and the reliability of their estimates have frequently been subject to criticism. One of the problematic issues concerns respondent uncertainty when answering the valuation questions. The contingent valuation method (CVM) is no exception. Because of its reliance upon stated or hypothetical rather than actual or revealed willingness to pay (WTP) values, the validity of the method and the reliability of its results have received much attention in the literature (Freeman, 1993; NOAA, 1993; Smith, 1993; Neill *et al*., 1994; Cummings *et al*., 1995). Several studies suggest that hypothetical values obtained by the CVM tend to overestimate the real values (List and Gallet, 2001; Little and Berrens, 2004; Harrison and Rutström, 2008). Such divergence between real and hypothetical payments is known as a hypothetical bias (Cummings *et al*., 1986).

Most existing CVM studies assume that respondents know their preferences with certainty. However, empirical evidence demonstrates that respondents are often uncertain when answering contingent valuation questions (Ready *et al*., 1995; Champ *et al*., 1997; Alberini *et al*., 2003). Moreover, it has been argued that respondent uncertainty affects the validity of CVM results. Several studies have shown that the higher the degree of uncertainty of a respondent about the stated hypothetical payment, the lower the probability that s/he would actually pay the stated amount in a real situation (Polasky *et al*., 1996; Champ *et al*., 1997; Johannesson *et al*., 1998). Incorporating information about respondent uncertainty might reduce the hypothetical bias and result in more efficient parameter and WTP estimates (Welsh and Bishop, 1993; Li and Mattsson, 1995;

Blumenschein *et al*., 1998; Champ and Bishop, 2001). However, there are also studies that report a lower efficiency of welfare estimations when CVM models are adjusted for respondent uncertainty (Ekstrand and Loomis, 1998; Samnaliev *et al*., 2006; Chang *et al*., 2007; Brouwer, 2009).

The current study estimates the WTP of beach visitors for beach protection against erosion at a beach where a beach user fee already exists and at the nearest open-access beach. A follow-up polychotomous choice (PC) question captures information on respondents' uncertainty regarding their responses to the contingent valuation questions. In a PC question format respondents have to choose from a set of uncertainty levels. These are included either directly into the WTP question or in a separate question following the WTP question. The latter approach was used in this study. The yes/no responses are then adjusted for uncertainty in two different ways, namely by recoding uncertain 'yes' responses into 'no' responses and by treating uncertain responses as missing.

This context enables us to perform a comparison between WTP estimates obtained for the two beaches with the standard CVM model (the model in which preference certainty is assumed) with estimates from CVM models adjusted for respondent uncertainty. Based on this comparison we assess whether and how incorporating information on uncertainty affects WTP estimates with respect to the standard CVM model. In addition, we identify factors which explain uncertainty reported by respondents when answering contingent valuation questions.

The study further examines the effect of having experience with a real beach market on respondent uncertainty. It does so by comparing degrees of uncertainty expressed by respondents who have and those who have not visited the paid beach. Market experience hence refers to the payment for beach access (i.e. the payment vehicle in this study). To our knowledge, this is the first study that examines uncertainty of respondents with and without prior experience in the context of a real market for a natural resource or a payment vehicle. Among the objectives of our research is to find out whether: (1) respondents having experience with a real beach market (i.e. a concrete payment vehicle)

are more certain when answering contingent valuation questions; (2) there are significant differences between respondents with and without experience in terms of the characteristics of their visit, preferences regarding beaches and socio-economic characteristics; (3) there is a statistically significant difference in welfare estimates for the beach visitors with and without experience. Finally, we examine determinants of a previous beach market experience.

The remainder of the article is organized as follows. Section 2 provides an overview of the existing literature on CVM dealing with respondent uncertainty. Section 3 describes the case study and survey design. Section 4 compares WTP estimates of CVM models corrected for uncertainty with the standard CVM models assuming certainty. Section 5 presents results of the econometric analysis of factors of influence on respondent uncertainty. Section 6 assesses the determinants of beach market experience and its effect on respondent uncertainty and WTP estimates. Section 7 concludes.

2. Previous studies on preference uncertainty in contingent valuation

Including information about uncertainty regarding individual preferences into the welfare model was first proposed by Hanemann *et al*. (1996). Since then, researchers have developed a variety of certainty measurement methods and calibration techniques for addressing preference uncertainty in contingent valuation studies.

The first group of methods can be referred to as numerical certainty scale (NCS) methods. Li and Mattsson (1995) were the first to develop an empirical framework for addressing the issue of preference uncertainty within the random utility maximization model. They used a post-valuation question to elicit a degree of respondent uncertainty on a scale ranging from 0% to 100% (with 5% intervals). These percentages were then used directly in the likelihood function as weights, representing the probability that an individual's WTP value is greater (for a 'yes' answer) or smaller (for a 'no' answer) than the bid amount. In their study the mean WTP estimate was reduced about six times after

the adjustment for preference uncertainty. Champ *et al*. (1997) developed a similar approach using a follow-up question measuring response certainty on a scale from 1 (very uncertain) to 10 (very certain). All 'yes' responses associated with a certainty rating below 10 were then recoded as 'no' responses. Estimates of the mean WTP from the model adjusted for uncertainty in this way and actual payments in the experiment were not statistically different. However, evidence on the appropriate cut-off point on the certainty scale is confounding (Champ *et al*., 1997; Ethier *et al*., 2000; Champ and Bishop, 2001; Poe *et al*., 2002). Loomis and Ekstrand (1998) developed a model which allows uncertainty for both 'yes' and 'no' responses. Their results show that incorporating degrees of uncertainty as probabilities only for 'yes' responses is superior in terms of goodness of fit and precision of the WTP estimates to the same approach using uncertainty information for both 'yes' and 'no' responses as well as to the approach suggested by Champ *et al*. (1997). Furthermore, Moore *et al*. (2010) developed a random utility model which assumes that respondents know the probability of actually paying the stated amount, but do not know the actual payment decision with certainty. In this case, the information from the uncertainty scale serves to identify the distribution of the individual probability of an actual payment.

Johannesson *et al*. (1993) and Ready *et al*. (1995) first introduced the PC method for eliciting respondent uncertainty. PC format can be applied as a post-valuation question or directly in the WTP question by providing response categories such as 'definitely yes', 'probably yes', 'maybe yes', 'maybe no', 'probably no', and 'definitely no'. Ready *et al*. (1995) found that the latter approach generates higher WTP estimates than in the case when preference certainty is assumed. They argued that it does not provide an incentive to respondents for thinking long and hard when answering the questions as it is too easy for them to say 'maybe yes'. However, Chang *et al*. (2007) report no difference between WTP estimates adjusted for uncertainty information derived in this way and those assuming preference certainty. Whitehead *et al*. (1998) found that sequential PC valuation questions are useful for obtaining

information about the certainty of respondent preferences. Welsh and Poe (1998) and Alberini *et al*. (2003) adopt a multiple-bounded discrete choice approach, which allows respondents to express their level of certainty for each of various bid amounts listed. Ready *et al*. (2001) obtained uncertainty information through a post-valuation PC question. Respondents who provided responses other than '95% sure yes' about paying the stated WTP values were further asked to select another value they would be willing to pay with 95% certainty. Johannesson *et al*. (1998) used only two response categories, 'fairly sure' and 'absolutely sure'. They found that treating only 'absolutely sure' yes responses as real 'yes' responses correctly predicts purchase decisions.

Wang (1997) developed a random valuation model, which departs from the idea that the value an individual attaches to an amenity is a random variable with an unspecified probability distribution. He includes a 'don't know' response option to valuation questions, arguing that 'don't know' (or 'not sure') answers represent the area where consumer surplus is neither sufficiently large nor sufficiently small relative to the offered bid. Hence, a respondent will answer 'yes' ('no') if the consumer surplus is sufficiently large (small) relative to the bid. Van Kooten *et al*. (2001) propose using a fuzzy approach, in which consumer surplus can be an element of both willingness to pay and willingness not to pay at the same time. Employing the same data as Li and Mattsson (1995), they obtained much lower WTP estimates. However, they conclude that it is not possible to say whether this approach is better than conventional contingent valuation.

There is no agreement in the literature on the standard or the most appropriate empirical approach to be used for integrating respondents' uncertainty into CVM surveys. Martínez-Espiñeira and Lyssenko (2012) compared six alternative calibration techniques of NCS. They found no statistically significant differences in mean WTP estimates derived from different techniques. Efficiency of the estimates was improved in comparison with the basic model in two out of six approaches. Shaikh *et al*. (2007) compared all proposed empirical methods for addressing uncertainty

and found little evidence that one method is generally superior to the others. They showed that the approach for uncertainty calibration suggested by Li and Mattsson (1995) outperforms other models on the basis of several goodness-of-fit criteria, but its welfare estimates are also the closest to those of the certainty model.

3. Case study and survey design

There are many cases in which public funds for natural resource management and preservation are insufficient. Taking into consideration that visiting such sites generates benefits (consumer surplus) to its users, it is not unreasonable to ask them to pay part of the costs associated with the specific resource management or conservation (the user-pays principle). Given the constant growth in visitor numbers in natural and protected areas, several authors suggest introducing (higher) entrance fees to visitors as a means of funding natural resource maintenance and preservation (Lindberg, 1998; Dharmaratne *et al*., 2000; Eagles *et al*., 2002; Baral *et al*., 2008). This article examines the willingness of beach visitors to pay for the costs associated with the prevention of beach loss due to erosion in the form of beach entrance fees.

For this purpose, a contingent valuation survey was carried out at two beaches in the town of Crikvenica in Croatia, namely at the beach where an entrance fee is already levied and at the nearest free beach. Crikvenica is located in the northern part of the Adriatic coast. It is one of the main tourist destinations in the country in terms of the number of tourist arrivals and overnight stays (CBSRC, 2009). The beaches under study are the principal and largest beaches in Crikvenica. The paid beach area is 29,700m^2, while that of the free beach equals 12,210m^2. Both beaches are public goods, but have been granted concessions. The reason for levying a beach entrance fee at one of them is dual. Firstly, it is the only sand beach in the town and the erosion effect is causing a need to nourish the beach each year, which makes its maintenance rather costly. Secondly, part of the funds raised by the

fee is invested into additional facilities, which do not exist at other beaches. These include toilettes, facilities for disabled, recycling facilities, bars and restaurants on the beach itself, equipment for additional sports activities and activities for children. The beach entrance fee amounts to €1.66 per person per day for adults, while children pay half of this price. The fee is charged only during the summer months and is being collected at four beach entrance points (the beach is enclosed by a fence). The texture of the free beach is pebble. This beach has some basic facilities, which also are available at the paid beach, such as showers, lifeguards, deckchairs and sun-umbrellas for rent, children playground and beach volleyball ground. Its advantage over the paid beach is that it is located closer to the town center.

The questionnaire consisted of the four main parts. The first one gathered information about the characteristics of respondents' town and beach visit. The second part obtained information about their preferences regarding various beach characteristics. The third part included the contingent valuation exercise. The last part of the survey gathered information about respondents' attitudes towards beach entrance fees in general and their socio-economic characteristics. At each beach, four different versions of the questionnaire were used, varying in bid amounts.

Before introducing the valuation questions, a careful description of the hypothetical scenario was presented to respondents. Because of distinct fee policies, the scenarios for the two beaches slightly differed. Visitors at the free (paid) beach were told that due to a (magnified) problem with beach erosion, and without any protection measures, the beach will withdraw over time until it will have completely disappeared in ten years. They were further explained that the costs of beach protection against erosion cannot be covered from the town budget, so that the town authorities have decided to ask people who actually use the beach to pay for these costs in the form of a (higher) beach entrance fee. Respondents were then asked whether they would be willing to pay a (higher) beach entrance fee if such policy were implemented. Contingent valuation scenarios for both beaches are

hypothetical and assume maintaining the status quo of beach quality and services offered. The paid beach indeed suffers from erosion, but there is no evidence of its deterioration or complete beach erosion in the coming 10 years. The erosion problem at the free beach is hypothetical, but nonetheless realistic. During pre-testing of the questionnaire the respondents stated that the presented scenarios are credible. Nevertheless, respondents who stated a zero WTP were offered an option to express their disbelief in an erosion problem. Such respondents were excluded from further analysis.

A double-bounded dichotomous choice format was used for eliciting WTP values. Respondents were not aware of the second WTP question prior to answering the first one. The question about uncertainty was asked to all respondents, regardless of the responses to the valuation questions. Respondents were asked to express their level of uncertainty about their stated responses by choosing from five response categories: 'very confident', 'confident', 'neutral', 'not so confident', and 'not confident at all'. The question was posed after the response to the second bid and it therefore captures the (un)certainty about stated maximum WTP associated with the second bid amount. Finally, respondents who did not provide a positive WTP value were asked about the motivation behind their response so as to identify protest bids. Those who stated that they are not the ones who should pay for the beach maintenance costs, who expressed disbelief in the erosion problem at the beach, or who said that beaches are public goods (i.e. disapproving the payment vehicle) were classified as protest responses.

In June 2008 a total of 80 face-to-face pilot surveys were conducted to test the questionnaire and ensure an appropriate bid design. Administration of the final surveys took place during July 2008. Using systematic sampling, three well-trained interviewers approached every tenth visitor at the beach. The number of visitors who agreed to participate in the survey amounts to 366 at the paid beach and 379 at the free beach. The response rates are equal to 79% and 69%, respectively. According to Bateman *et al*. (2002) high-quality face-to-face surveys achieve response rates of about 70% or higher,

which means that our surveys are in the acceptable range. Protest bids represent 8.5% of the paid and 12.7% of the free beach sample and were excluded from further analysis.

4. The effect of respondent uncertainty on welfare estimates

Besides assessing WTP values, this article studies how incorporating information on uncertainty affects the precision of welfare estimates and overall model performance. Models adjusted for preference uncertainty are theoretically expected to generate more efficient welfare estimates than the standard certainty model. However, Akter *et al*. (2008) found that according to the majority of existing empirical evidence welfare estimates derived from the models corrected for respondent uncertainty are less efficient than those obtained with the standard models assuming certainty.

There are several possible calibration techniques when using a follow-up PC format question for reporting a degree of respondent certainty. One of them is to recode only 'definitely' (or 'absolutely') certain responses as 'yes' and the rest as 'no' responses. A few studies have shown that such approach yields estimates that best match the actual purchase behavior (Johannesson *et al*., 1998; Blumenschein *et al*., 2008). Another possible calibration technique is to treat uncertain responses as missing (Vossler *et al*., 2003; Akter *et al*., 2008). We explore how these two calibration techniques perform in comparison with the standard CVM model.

The distribution of frequencies of respondent uncertainty levels for the two beaches, based on their response to the second WTP question, is shown in Table 1. The vast majority of respondents at both beaches reported that they are 'very confident' or 'confident' about their stated WTP, although the share of such visitors is somewhat higher at the free than at the paid beach (86% and 77%, respectively). As expected, the share of 'no' responses at the paid beach is larger than at the free beach due to higher bid amounts that respondents were facing in the questionnaire. It is likely that for the same reason respondents at the paid beach expressed slightly higher certainty levels for 'no' than for

‘yes’ responses. (Un)certainty levels between ‘yes’ and ‘no’ responses at the free beach are very balanced.

[INSERT TABLE 1 AROUND HERE]

An overview of welfare estimates, precision of the mean estimates and overall performance of different models for the two beaches obtained by the two calibration techniques is presented in Table 2. The results derived from the standard CVM model assuming certainty serve as baselines for assessing the performance of CVM models adjusted for respondent uncertainty, and the two calibration techniques. The double-bounded contingent valuation elicitation format is analyzed by a bivariate probit model. The model included only the intercept term and the bid amount as covariates (as in del Saz-Salazar and Garcia-Menendez, 2001; and Verbič and Slabe-Erker, 2009), while other marginal effects are reported in Logar and van den Bergh (2012). The mean WTP values reported in Table 2 are based on the follow-up bid amount because the levels of uncertainty stated by respondents referred to the second WTP question. Moreover, welfare estimates are expected to be more conservative than those derived from the first WTP question. The mean WTP is calculated as $WTP = \frac{-\beta_0}{\beta_1}$, where β_0 represents the intercept term and β_1 is the estimated parameter for the bid amount (Haab and McConnell, 2002). Precision of the mean WTP estimates are compared across the models based on the variability around the mean, which is measured by the 95% confidence intervals. The confidence intervals are calculated by employing Krinsky and Robb’s (1986) procedure based on 10,000 replications. The efficiency of the estimated mean value (EFWTP) is used as an additional precision indicator calculated as the confidence interval difference divided by the mean WTP (Loomis and Ekstrand, 1998). A lower EFWTP indicates a higher efficiency of the estimated mean value. Finally,

the performance of each model as a whole is confirmed in terms of pseudo R^2 and *p* values, which are based on the Wald chi-square test.

[INSERT TABLE 2 AROUND HERE]

The first calibration technique, in which models are adjusted for uncertainty by treating uncertain responses as missing, generates rather similar welfare estimates to those obtained from the standard CVM models in the case of both beaches. Nevertheless, the results for the two beaches differ. In the case of the paid beach, the estimates gradually decrease as more extreme recoding is applied (i.e. when only 'confident' and/or 'very confident' responses are taken into account), while the estimates for the free beach show no clear trend. One should note that in the case of the free beach no respondent selected 'not confident at all' category. For this reason, applying any calibration technique to this category has no effect on welfare estimates or model performance. A statistical test based on a resampling procedure showed that there is no statistically significant difference between the mean WTP values derived from the models adjusted for uncertainty and the standard CVM models when using this calibration technique. This finding applies to both the free and the paid beach. Given differing results for the two beaches, based on this study no conclusions can be drawn about the direction of the welfare estimates or the reduction of hypothetical bias when using this calibration technique. In general, efficiency of the estimates and performance of the models in terms of chi-square statistics and pseudo R^2 gradually deteriorate when more extreme recoding is used. This occurs because the number of observations diminishes while the number of estimated parameters remains constant in this calibration technique, which leads to a loss in the precision of parameter estimates and deteriorated joint significance of the variables in the model. Nevertheless, precision of the estimates is always equal to or better than when using the second calibration technique. Our results thus show no advantages of

including information on respondent uncertainty by using this calibration technique over the conventional CVM model.

In the second calibration technique (recoding uncertain 'yes' responses as 'no' responses) welfare estimates for both beaches descend gradually when using a more extreme recoding, as expected. In the case of the paid beach, the decline of welfare estimates is much more prominent than when using the first calibration technique. A resampling test indicates that only when 'very confident' responses are calibrated as 'yes' and the rest as 'no' are the mean WTP values derived from uncertainty-adjusted models in the case of both beaches significantly lower than those obtained from the standard CVM models. The precision of the estimates and overall model performance in terms of Wald statistic test and pseudo R^2, however, deteriorates substantially for both beaches when only 'very confident' responses are treated as real 'yes' responses and the rest of them are recoded as 'no' responses. The model for the paid beach becomes less significant, indicating that the null hypothesis that all the parameters in the model (i.e. the bid amount in this case) are equal to zero can be rejected at the 1% significance level and not at the 0.1% as in all other models. These findings are opposite to those of Ekstrand and Loomis (1998) and Brouwer (2009), who observed the highest statistical efficiency of the welfare estimates when only the most certain 'yes' responses are treated as real 'yes' responses. Nevertheless, these authors used a NCS method, which may generate different efficiency outcomes than when other approaches are applied (Samnaliev *et al*., 2006). Based on the review by Akter *et al*. (2008), NCS is more successful in generating efficient welfare estimates than PC, although none of the approaches systematically generates more efficient welfare estimates compared to the conventional CVM model. As for the expected differences between welfare estimates calibrated by the NCS and PC methods, they conclude that, under PC method, some empirical studies find lower and others higher welfare estimates, while the evidence that the NCS method reduces hypothetical bias is stronger. Results of the current study indicate that the PC method with a post-valuation question might

also be helpful in reducing hypothetical bias when uncertain 'yes' responses are recoded as 'no' responses.

5. Factors that determine respondent uncertainty

Empirical evidence for the underlying reasons for respondent uncertainty is still rather scarce (Akter *et al*., 2008). Besides, most of the studies that attempted to explain variation in self-reported levels of certainty by respondents used a NSC for eliciting respondent uncertainty (Loomis and Ekstrand, 1998; Champ and Bishop, 2001; Samnaliev *et al*., 2006; Brouwer, 2009; Lyssenko and Martínez-Espiñeira, 2012). Akter *et al*. (2009) is the only example that we are aware of in which the analysis is based on the PC responses.

Existing studies offer several explanations about the sources of uncertainty. The most common ones include unfamiliarity of respondents with the good under study and the lack of prior non-market valuation experience (Cummings *et al*., 1986; Alberini *et al*., 2003; Akter *et al*., 2009; Lyssenko and Martínez-Espiñeira, 2012). Other hypotheses are that respondent uncertainty stems from a lack of respondents' interest, from uncertainty about their income or benefits of the program, from the inability of individuals to make a quick decision, or from the questionnaire used in the study (Wang, 1997; Alberini *et al*., 2003; Champ *et al*., 2005; Shaikh *et al*., 2007; Akter *et al*., 2008; Brouwer, 2009).

In this study, ordinal polychotomous categories of uncertainty levels were regressed on the factors which could potentially explain variation in respondent uncertainty. Protest responses are included in this part of the analysis. The low number of observations for the 'not confident at all' category (six at the paid beach and one at the free beach) can affect the quality of the estimates (Long and Freese, 2006). Moreover, the parallel regression assumption, which implies that estimated coefficients are statistically the same for any two pairs of outcome groups, is violated when using a dependent variable with five categories ($\chi^2(42)=141.39$, $p<0.001$). For this reason, the 'not confident at

all' category was combined with the 'not confident' category, as recommended by Franses and Cramer (2010) and Lyssenko and Martínez-Espiñeira (2012). In this case, the parallel regression assumption holds ($\chi^2(30)=32.50$, $p=0.34$).

The results of an ordered probit model for two beaches jointly are presented in Table 3. Start bid amount variable is positive and significant at the 5% level and squared start bid amount is negative and significant at the 10% level. This indicates a U-shaped relationship between the amount respondents are asked to pay and the degree of certainty about their value statement, confirming the findings of Loomis and Ekstrand (1998) and Brouwer (2009). It means that respondents are more certain about their stated WTP at the lower and the higher bid amounts, while they are more uncertain around the middle-ranged bid amounts. This occurs because when the bid is substantially lower or higher than their maximum WTP, respondents are quite certain about whether they would pay the offered amount or not. However, when the bid is close to their maximum WTP, they are uncertain whether to answer 'yes' or 'no' (Loomis and Ekstrand, 1998).

[INSERT TABLE 3 AROUND HERE]

Respondents who are willing to pay a positive amount for protecting the beach from erosion are more uncertain about their stated WTP than respondents who have expressed zero willingness to pay, including protest responses. This result is in line with the studies of Loomis and Ekstrand (1998), Samnaliev *et al*. (2006)[1] and Brouwer (2009) and contrary to that of Lyssenko and Martínez-Espiñeira (2012), while Akter *et al*. (2009) found no significant effect of protest response on uncertainty levels. Respondents who stated that the main reason for visiting Crikvenica is having a second home in the

[1] Explanatory variables in their and our models are not directly comparable. They found a positive significant relationship between respondents who objected to user fees in principle and the highest uncertainty category to a 'no' response.

town expressed a significantly higher degree of uncertainty about their stated WTP than the rest of respondents. A possible explanation is that most of such respondents do not come only or mainly because of the beach, but they come to Crikvenica for many other reasons (e.g. visiting friends or family). They also stay in the town much longer than other respondents. Visitors who chose the beach primarily because of its proximity, beach texture, or free access are all significantly more uncertain about their WTP than those who chose the beach for other reasons. Choosing the beach mainly because of its facilities does not affect respondent uncertainty significantly. Uncertainty of respondents who stated proximity and free access as the main reasons for choosing the beach might reflect high substitutability of beaches, since in the case of a fee increase they can go to another free nearby beach.

On the other hand, visitors who stay at the beach shorter than other respondents are more certain and have on average a slightly lower stated WTP. A child in the travel group tends to increase uncertainty significantly. This is not surprising if we take into account that children pay half the access fee, so that total costs for these respondents are higher than for those without children. Respondents who think that beach maintenance costs should be paid by all stakeholders (local and national government, residents, tourists, and beach users) rather than only one of them expressed significantly higher certainty about their stated WTP.

The number of previous visits to Crikvenica, which might be considered as a proxy for respondents' familiarity with the beaches whose erosion protection is being valued, does not have a significant effect on respondent uncertainty. This result is in line with the findings of Akter *et al.* (2009) and Lyssenko and Martínez-Espiñeira (2012), but differs from those of Loomis and Ekstrand (1998) and Brouwer (2009). In addition, variables such as prior knowledge of respondents about the reasons for levying the entrance fee at the paid beach and their attitudes towards the beach entrance fee in general do not seem to affect respondent uncertainty significantly. Socio-economic characteristics of

respondents are also not significant explanatory variables of variation in the degree of respondent uncertainty.

6. Market experience as a determinant of respondent uncertainty and its effect on stated WTP

Respondent experience is in this study endogenous, i.e. it is determined by respondent's past behavior. Exogenous experience, on the other hand, involves information provided by the survey instrument. Previous studies in a setting of natural resource valuation that explored the effect of respondent experience on uncertainty regarding stated WTP and on welfare estimates distinguished between users and non-users of the natural resource (Whitehead *et al*., 1995; Cameron and Englin, 1997; Kniivilä, 2006; Garcia *et al*., 2009). The novelty of this study is that all respondents are users of the beaches and respondent experience in this context refers to having an experience with the real beach market (i.e. with payment for beach access, which represents the payment vehicle in this study).

In this section we test whether respondents with real beach market experience have a higher degree of certainty regarding their stated WTP responses. We do this by comparing two groups of beach visitors, namely with and without prior beach market experience. The first group embraces all paid beach visitors and those free beach visitors who have visited the paid beach at least once in the past, while the second group comprises free beach visitors who have never visited the paid beach. Table 4 shows the distribution of self-reported degrees of (un)certainty regarding stated WTP for the two visitor groups. In contrast to our expectations, visitors without previous beach market experience reported slightly higher levels of certainty about their stated WTP values than those with experience. However, a Wilcoxon-Mann-Whitney test suggest that the difference in the underlying distributions of the certainty levels between visitors with and without previous beach market experience is not statistically significant ($z=-1.154$, $p=0.2485$).

[INSERT TABLE 4 AROUND HERE]

Descriptive statistics of visitors with and without beach market experience are presented in Table 5. A two-tailed independent samples *t*-test showed that number of previous visits to the town, travel group size, number of children in the travel group, accommodation costs per night adult, household size, and income are all significantly higher for respondents who have at least once before paid a beach entrance fee. A higher number of previous visits to Crikvenica implies a higher probability of having visited the town's paid beach and hence having an experience with both a beach market and the payment vehicle. A higher income of visitors with experience might be a consequence of a greater proportion of foreign visitors, who mainly come from the EU countries, in which the average income is higher than in Croatia. As expected, there are more town residents among visitors with beach market experience as most of them have visited Crikvenica's paid beach at least once in life. Visitors without experience chose Crikvenica mainly because of its proximity, while those with experience came more frequently because of second homes and nice beaches. An obvious difference between visitors with and without experience is their preference regarding beach texture. A substantially higher share of respondents who have visited the paid beach prefer sand beaches, which is logical as it is the only sand beach in the town. However, an interesting finding is that the majority of respondents without beach market experience also expressed a preference for sand over other beach types. This may indicate that in such cases economic factors may play an important role when choosing a beach. Differences in accommodation costs per night adult, employment status, and income level between the two groups support this hypothesis. They show that visitors without experience have a lower purchasing power. As expected, a higher share of respondents with experience knows reasons for paying the beach entrance fee at the paid beach than those without experience. In the former group there are more respondents who think that beach users should mainly pay for the costs of beach

maintenance, while in the latter group more people think that the local government should mainly bear these costs.

[INSERT TABLE 5 AROUND HERE]

Our next aim was to examine whether previous experience with the real beach market and the payment vehicle has an effect on the stated WTP. This is done by testing whether there is a statistically significant difference in the mean WTP estimates between the visitors with and without beach market experience. The analysis covered only the free beach visitors because: (1) paid beach visitors have a substantially higher WTP than free beach visitors as their minimum WTP is the current fee price, while that of free beach visitors is zero (hence, testing for the difference in the mean WTP between respondents with and without experience is meaningful only for each beach separately); and (2) all paid beach visitors have prior beach market experience, so there is no variation for this variable within this subsample. The mean WTP estimates show that respondents with previous beach market experience are willing to pay less (€1.75) than those without the experience (€1.97). However, there is no statistically significant difference between these two values. Therefore, we conclude that in this case previous experience with the real beach market and the payment vehicle does not have a significant effect on respondents' stated WTP. Precision of the welfare estimates is nevertheless better for respondents with previous beach market experience. For a comparison, Cameron and Englin (1997) and Garcia *et al.* (2009) found higher welfare estimates for respondents who have experience with the valued resource, while Kniivilä (2006) found no effect of respondent experience on their stated WTP. Most of these studies also found that experience tends to reduce standard deviation of the WTP estimates.

We further apply a logit model to explore determinants of a previous beach market experience, i.e. of visiting the paid beach. The results are displayed in Table 6. They indicate that the most

significant factors in explaining why some visitors have and others have not visited the paid beach include number of previous visits to Crikvenica, beach texture as the main motivation for choosing the beach, and number of household members. The significant outcome of the first two explanatory variables is expected, while the logic behind the effect of the third variable is less straightforward. This variable has the strongest (positive) correlation with number of children in the travel group. An intuitive explanation is that respondents traveling with children are more inclined to go to the paid beach due to better facilities for children and sandy soil. Indeed, many visitors stated that sand is more convenient for children. Other factors which contribute to a visit of the paid beach include traveling by car or motorcycle (instead of bus, plane or train), beach facilities as the main motivation for choosing the beach, and income. Explanatory variables which diminish the probability of visiting the paid beach comprise proximity as the main reason for visiting the town or choosing the beach and the opinion that the local government should mainly pay for the costs of beach maintenance. Protest bids are excluded from the analysis. Around 76% of protest voters have previous beach market experience, which can be explained by a high share of town residents and second home owners among them. A sensitivity analysis showed that including protest bids in the model leads to subtle changes in results – choosing the beach because of its proximity is not significant anymore, while knowing reasons for levying the beach entrance fee has a positive effect at the 10% significance level.

[INSERT TABLE 6 AROUND HERE]

7. Conclusions

The main objectives of this article have been contributing to a better understanding of the effect of respondent uncertainty about stated WTP on welfare estimates in the contingent valuation method (CVM), the underlying drivers of their uncertainty, and the influence of previous experience with a real

market for a natural resource whose protection is being valued and with the payment vehicle on reported uncertainty. Standard CVM models were compared with CVM models incorporating information about respondent uncertainty in terms of welfare estimates generated, precision of the estimates and overall model performance. This has been done in the context of the willingness of beach visitors to pay a daily beach entrance fee with the purpose of preventing beach loss due to erosion. The study included a beach with an existing market (where the beach entrance fee is already levied) and a nearby open-access beach.

The article has compared two calibration techniques of polychotomous choice (PC) responses regarding uncertainty – one which treats uncertain responses as missing and another which recodes uncertain 'yes' responses into certain 'no' responses. The results obtained by the former technique differ for the two beaches. Welfare estimates for the paid beach gradually decline as more extreme recoding is applied, while those for the free beach do not show a clear trend. In the case of both beaches, however, there is no statistically significant difference between welfare estimates derived from the models adjusted for uncertainty compared to the standard CVM model. In this calibration approach estimate efficiency and model performance deteriorate with more extreme recoding. However, precision of the estimates always remains superior to the second calibration approach. We hence found no clear evidence that incorporating information about respondent uncertainty by recoding uncertain PC responses as missing offers any gains compared to a conventional CVM model assuming certainty. Recoding uncertain 'yes' as 'no' responses generates welfare estimates that are lower than those obtained from the standard model. However, welfare estimates for both beaches are significantly lower only when 'very confident' categories of the PC responses are considered as real 'yes' responses. Such results come at the expense of lower estimate precision and statistical significance of the model. As more extreme recoding is used, precision of the estimates decreases and model performance worsens. The results of this study indicate that this calibration technique might be useful for reducing

hypothetical bias, although more research would be needed to confirm these findings. In addition, we found no evidence that accounting for respondent uncertainty leads to gains in estimate efficiency.

This study has presented one of the first attempts to explore determinants of respondent uncertainty using PC responses. Results of an ordered probit model show that a positive stated WTP amount significantly and positively affects respondent uncertainty. A significant quadratic relationship between the start bid and respondent uncertainty was found, implying that respondents are more certain when asked about their WTP around high and low bid amounts, while they seem to be more uncertain around intermediate bids. Respondents who spend less time at the beach and those who think that beach maintenance costs should be paid by all stakeholders are significantly more certain about their stated WTP than other respondents. On the contrary, stating the ownership of a second home in the town as the main reason for visiting Crikvenica, choosing the particular beach because of its proximity, texture, or free access, and travelling with a child have a significant positive effect on respondent uncertainty.

The article has also examined the effects of prior experience with the real beach market (i.e. payment of the beach access fee, which is the payment vehicle used in this study) on respondent uncertainty and welfare estimates. It has found neither a statistically significant difference in the certainty levels nor in the mean WTP values between visitors with and without beach market experience. The most significant differences between the two visitor groups are their preferences regarding the good and their economic characteristics. Furthermore, determinants of previous beach market experience were analyzed. The number of previous visits to Crikvenica, travelling by private transport (car or motorcycle), choosing the beach because of its texture or facilities, the number of household members, and income all have a positive effect on the probability of having prior beach market experience. Factors that diminish this probability include proximity as the main reason for

visiting the town, choosing the beach because of its proximity, and the opinion that the local government should mainly carry the costs of beach maintenance.

We believe that more research is needed in particular on assessing the benefits of including information about respondent uncertainty in CVM models for the quality of estimates and on exploring the underlying reasons for respondent uncertainty.

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Table 1. Frequency distribution of respondent (un)certainty levels conditional on their response to the payment question

	Paid beach			**Free beach**		
Certainty level	'No' responses	'Yes' responses	Total	'No' responses	'Yes' responses	Total
Very confident	101	45	146	79	79	158
Confident	75	36	111	61	64	125
Neutral	29	21	50	12	14	26
Not so confident	11	10	21	12	7	19
Not confident at all	3	2	5	0	0	0
Number of observations	219	114	333	164	164	328

Table 2. Welfare estimates, estimate efficiency and overall performance of alternative bivariate probit models

	Mean WTP	95% confidence interval around the mean	EFWTP[b]	Wald chi2 (2df)	Pseudo R^2	Number of observations
PAID BEACH						
Standard CVM model assuming certainty	€ 2.89	€ 2.37 – 3.22	0.29	48.94***	0.068	333
Models adjusted for uncertainty – recoding uncertain responses as missing						
Uncertainty level 5[c] = missing	€ 2.88	€ 2.36 – 3.22	0.30	47.73***	0.067	328
Uncertainty level 4 & 5 = missing	€ 2.81	€ 2.21 – 3.18	0.34	40.82***	0.062	307
Uncertainty level 3, 4 & 5 = missing	€ 2.77	€ 2.02 – 3.16	0.41	32.48***	0.067	257
Uncertainty level 2, 3, 4 & 5 = missing	€ 2.55	€ 1.13 – 3.14	0.79	16.02***	0.054	146
Models adjusted for uncertainty – recoding uncertain 'yes' responses as 'no' responses						
Uncertainty level 5 = 'no'	€ 2.85	€ 2.33 – 3.19	0.30	47.55***	0.066	333
Uncertainty level 4 & 5 = 'no'	€ 2.68	€ 2.05 – 3.04	0.37	40.70***	0.061	333
Uncertainty level 3, 4 & 5 = 'no'	€ 2.23	€ 1.19 – 2.72	0.69	27.17***	0.057	333
Uncertainty level 2, 3, 4 & 5 = 'no'	€ 0.86	€ -2.43 – 1.90	5.03	13.54**	0.050	333
FREE BEACH						
Standard CVM model assuming certainty	€ 1.83	€ 1.61 – 2.04	0.24	97.12***	0.092	328
Models adjusted for uncertainty – recoding uncertain responses as missing						
Uncertainty level 5 = missing	€ 1.83	€ 1.61 – 2.04	0.24	97.12***	0.092	328
Uncertainty level 4 & 5 = missing	€ 1.86	€ 1.64 – 2.08	0.24	100.56***	0.096	309
Uncertainty level 3, 4 & 5 = missing	€ 1.86	€ 1.63 – 2.10	0.25	91.31***	0.091	283
Uncertainty level 2, 3, 4 & 5 = missing	€ 1.77	€ 1.11 – 2.37	0.71	29.64***	0.069	158
Models adjusted for uncertainty – recoding uncertain 'yes' responses as 'no' responses						
Uncertainty level 5 = 'no'	€ 1.83	€ 1.61 – 2.04	0.24	97.12***	0.092	328
Uncertainty level 4 & 5 = 'no'	€ 1.75	€ 1.53 – 1.97	0.25	112.52***	0.088	328
Uncertainty level 3, 4 & 5 = 'no'	€ 1.58	€ 1.34 – 1.81	0.30	106.20***	0.075	328
Uncertainty level 2, 3, 4 & 5 = 'no'	€ 0.32	€ -0.42 – 0.74	3.67	54.24***	0.065	328

Note: ** denotes $p<0.01$ and *** $p<0.001$

[b] Efficiency of the estimated mean WTP is calculated as $EFWTP = \left(WTP_{CIu} - WTP_{CIl}\right)/WTP_{mean}$, where WTP_{CIu} and WTP_{CIl} represent upper and lower bounds of the 95% confidence interval, respectively.

[c] Uncertainty level 5='not confident at all'; uncertainty level 4='not so confident'; uncertainty level 3='neutral'; uncertainty level 2='confident'; uncertainty level 1='very confident'.

Table 3. Ordered probit model results for respondent uncertainty levels

Variable	Parameter estimate	Standard error
Start bid	0.2944**	0.1497
Start bid squared	-0.0499*	0.0262
Positive WTP	0.6452***	0.1378
Number of previous visits to Crikvenica	-0.0037	0.0025
Reason for the town visit: have a second home	0.3797**	0.1628
Motivation for choosing the beach: proximity	0.2115*	0.1141
Motivation for choosing the beach: beach texture	0.3041**	0.1243
Motivation for choosing the beach: facilities	-0.0060	0.1580
Motivation for choosing the beach: free access	0.6627**	0.2561
Time spent on the beach: a few hours	-0.2958*	0.1553
Presence of child(ren) in the travel group	0.1492*	0.0892
Know reasons for levying the beach entrance fee	0.1205	0.0916
Agree with introducing the fee to other beaches	0.1190	0.1007
All stakeholders should pay for the costs	-0.3752**	0.1260
Income	<-0.0001	<0.0001
Log likelihood	-751.1771	
Pseudo R^2	0.0389	
Likelihood-ratio stat. (15df)	60.78***	
Number of observations	688	

Notes: Calculations are performed with STATA 11

***Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

Table 4. Frequency distribution of (un)certainty levels reported by visitors with and without beach previous market experience

Certainty level	Visitors with beach market experience (%)	Visitors without beach market experience (%)
Very confident	45.38	48.23
Confident	35.00	38.30
Neutral	12.12	9.22
Not so confident	6.54	4.26
Not confident at all	0.96	0.00
Number of observations	520	141

Table 5. Descriptive statistics for visitors with and without prior beach market experience

		Experience	
		No	**Yes**
Composition of visitors			
Town residents	(%)	0.7	2.1
Foreigners	Domestic visitors (%)	52.5	42.6
	Foreign visitors (%)	14.9	27.1
	Croatian, Bosnian and Serbian visitors who live abroad (%)	32.6	30.3
Town visit characteristics			
Number of previous visits		7.3***	14.9***
Days spent in the town		8.1	9.7
Main reason for visiting the town	Proximity of the destination (%)	36.5	22.4
	I was here before and liked it (%)	21.4	26.1
	I have a second home in the town (%)	3.6	9.2
	Visiting friends or relatives (%)	10.7	8.2
	Nice beaches (%)	7.1	15.7
	Other (%)	20.7	18.4
Beach visit characteristics and preferences			
Beach texture preference	Sand (%)	43.2	61.3
	Pebble (%)	36.9	20.1
	No preference (%)	19.9	18.6
Frequency of beach visit	Less than once a week (%)	0.0	1.3
	Once a week (%)	3.5	4.2
	Two to four days per week (%)	15.6	15.4
	Five to seven days per week (%)	80.9	79.1
Time spent on the beach	A few hours (%)	10.0	10.5
	Half a day - either morning or afternoon (%)	20.7	26.9
	The whole day (%)	69.3	62.6
Level of satisfaction with the beach	Unsatisfied or very unsatisfied (%)	2.1	1.5
	Neutral (%)	11.4	12.7
	Satisfied or very satisfied (%)	86.5	85.8
Travel costs and expenditure data			
Number of persons in the travel group		2.9*	3.1*
Number of children in the travel group		0.5***	0.7***
Number of other destinations visited		0.7	0.9
Travel costs per day (part corresponding to the beach)		€ 11.4	€ 12.2
Accommodation costs per night adult		€ 14.8**	€ 19.5**
Spending at the beach per day adult		€ 12.4	€ 13.7
Opinion on the beach entrance fee			
Knowing reasons for paying the fee	(%)	31.4	44.3
In favor of introducing a beach entrance fee to other beaches in Croatia and Europe (%)		66.0	71.0
Who should pay for beach maintenance	Local government (%)	49.3	38.8
	National government (%)	20.7	19.4
	Residents (%)	0.7	0.6
	Tourists (%)	4.3	4.1
	Beach users (%)	7.9	14.4

	All previous categories (%)	15.0	17.7
	Other (%)	2.1	5.0
Socio-economic characteristics of the visitors			
Gender	Male (%)	41.1	47.4
	Female (%)	58.9	52.6
Age		41.1	39.6
Employment	Employed in the public sector (%)	34.1	26.5
	Employed in the private sector (%)	32.6	43.0
	Self-employed (%)	5.0	7.5
	Retired (%)	14.9	7.9
	Student (%)	2.8	5.7
	Housewife (%)	1.4	4.4
	Unemployed (%)	9.2	4.0
	Other (%)	0.0	1.0
Number of household members		3.1***	3.5***
Income		€ 1693***	€ 2190***

Note: *, ** and *** denote $p<0.1$, $p<0.05$ and $p<0.01$

Table 6. Explanatory factors of beach market experience

Variable	Parameter estimate	Standard error
Intercept	-0.5888	0.3985
Owning a second home in the town	0.7539	0.4881
Number of previous visits to Crikvenica	0.0305***	0.0100
Mode of travel: private (car or motorcycle)	0.5012**	0.2458
Reason for the town visit: proximity	-0.5041**	0.2317
Motivation for choosing the beach: proximity	-0.4204*	0.2347
Motivation for choosing the beach: beach texture	2.000***	0.4290
Motivation for choosing the beach: facilities	1.1535**	0.4405
Motivation for choosing the beach: free access	-0.0476	0.5300
Level of satisfaction with the beach	-0.2028	0.1174
Know reasons for levying the beach entrance fee	0.3308	0.2257
Local government should pay for the costs	-0.4460**	0.2122
Number of household members	0.2617***	0.0865
Income	0.0002**	0.0001
Log likelihood	-264.8724	
Pseudo R^2	0.1807	
Likelihood-ratio stat. (13df)	116.83***	
Number of observations	624	

Notes: Calculations are performed with STATA 11

***Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level