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Does Uncertainty Matter?
An Application to the Willingness to Pay to Reduce Swimming Bans in Chicago

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I. INTRODUCTION

The treatment of "don't know" responses in referendum-style contingent valuation (CVM) continues to present both theoretical and empirical challenges for researchers. Carson, et al. (1998) made a NOAA panel recommendation to include a "would-not-vote" option in CVM questionnaires however, doing so is still often considered a methodological research treatment rather than a standard practice in applications. While earlier studies had explored the use of "don't' know" responses to willingness to pay (WTP) questions, the usual procedure was to drop them from the sample. More recent studies have followed the Carson, et al. approach of recoding all uncertain responses as "No" votes. However, due to data limitations and other constraints, the validity of this assumption is rarely tested empirically (Champ, et al. 1997, Ready, et al. 2001, Welsh and Poe 1998). In an analysis of old-growth forest preservation, Haener and Adamowicz (1998) found that an uncertain or "don't know" response does not necessarily imply the respondent would have been most likely to say "No", if he or she had been forced to be decisive.

Various survey designs have been used to incorporate uncertainty into the CVM response[1]. Several researchers have used a post-decisional certainty scale rating in which the respondent assesses how certain they were of their response (Champ, et al. 1997, Li and Mattson 2001, Loomis and Ekstrand 1998). While valuable in providing information on respondent level of comfort in their answers, the method is somewhat ad-hoc since the respondent was forced to do away with their uncertainty to make a decision before being allowed to express uncertainty.

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[1] Alberini, et al. (2003) state that uncertainty is not the correct interpretation of the NOAA panel's "would-not-vote" or "don't know" response. While we agree that preference uncertainty is not a valid interpretation in this context, we adopt the use of the word uncertainty to comprise all factors that may contribute to a respondent not being sure about accepting or rejecting a bid amount. This is discussed further in Section III.

This ordering effect may influence their perception of their degree of certainty.

Another approach used in recent literature utilizes a polychotomous set of responses including "Yes" and "No" and other responses with varying degrees of affirmative and negative certainty (Ready, et al 2001, Wang 1997). Several studies took this one step further by exploring the use of a multiple-bounded polychotomous choice approach (Alberini, et al. 2003, Welsh and Poe 1998).

The purpose of this paper is to investigate the reasons for uncertainty in CVM responses and its effect on the WTP to reduce swimming bans on Lake Michigan beaches in Chicago. Using data from two surveys collected on Chicago beaches in the Summer of 2004, this research will test the validity of recoding polychotomous choice responses. The approach of Carson, et al. (1998) comparing survey samples with and without "don't' know" response options will be implemented, as well as their recommendation of testing for convergent validity. Variants of Haener and Adamowicz (2001) approach of using additional responses from the survey to explore the reasons for uncertainty will also be explored in this research. A multinomial logit model will be estimated for polychotomous-choice responses and welfare estimates will be compared to models with a dichotomous-choice model based on assumed certainty, and recoded models using various assumptions about the uncertain responses.

The valuation questions for this study utilize both a dichotomous-choice WTP and a polychotomous-choice WTP for comparison. In addition, both formats use follow-up questions to elicit the reasons why respondents may either not be willing to pay or may be not be sure if they are willing to pay for the program. In addition, travel cost data was collected in both samples and the resulting value of lost beach recreation days due to swimming bans will be used to test the convergent validity of the CVM estimates.

Preliminary results will be presented here however econometric work is still underway in preparation for the conference presentation. The paper is organized as follows. Section II provides a description of the setting and swimming bans in Chicago, Section III discusses the theoretical and empirical models of uncertainty in CVM, Section IV describes the survey process and data, Section V gives preliminary econometric results and Section VI details the forthcoming work.

II. THE SETTING

There has been significant concern over deteriorating quality of Lake Michigan water and beaches. The reasons for increased levels of pollution are numerous, but the contribution of each cause is not well known. The reasons range from invasive species such as zebra mussels, increased commercial activity from transport and fishing, wastewater and sewage treatment overflows, stormwater management problems associated with roads and sewers, personal waste and litter, and seagull droppings. Consequently, the number of swimming bans due to high bacteria counts has been steadily increasing and is a source of constant concern for the City and its residents.

Figure 1 provides a summary of the number of advisories and closures for all Lake Michigan Beaches.

Figure 1: Lake Michigan Beach Advisories and Swim Bans: 1996-2003[2]

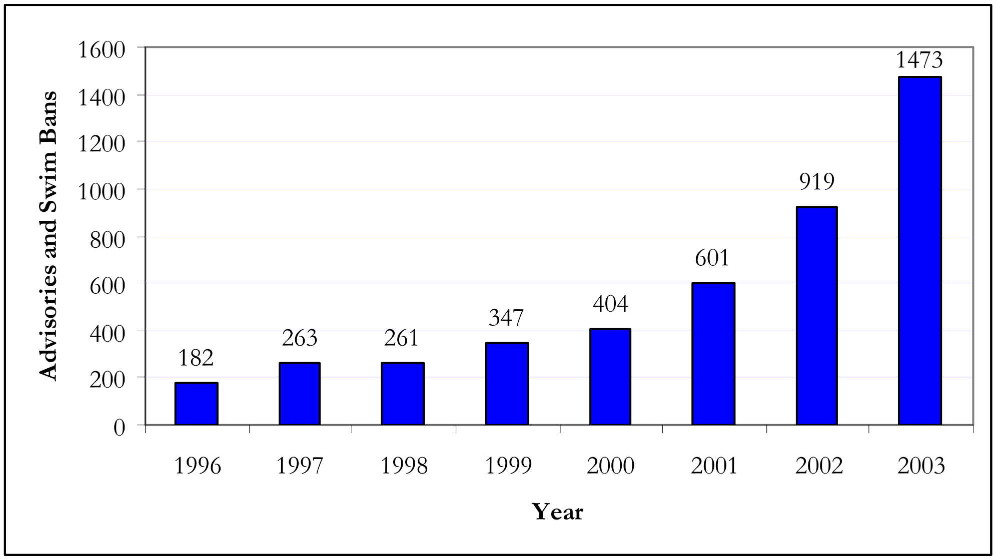
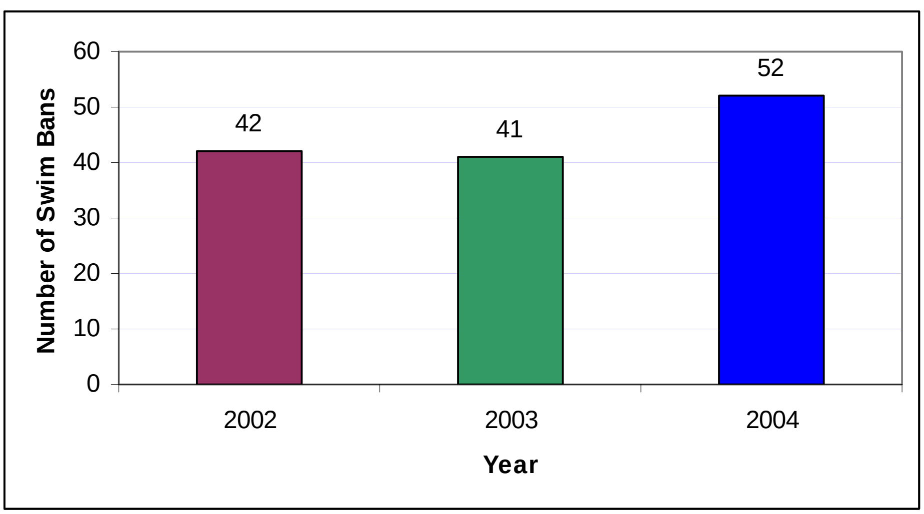


Figure 2 shows the recent number of swim ban days for the individual Chicago beaches used in this study.

Figure 2: Total Swim Ban Days for Nine Selected Chicago Beaches (2002-2004)



[2] It is important to point out that the number of swimming bans issued over time has increased due partly to increased monitoring programs. There were likely numerous occasions in the earlier years that bacteria counts exceeded standards even when the beaches were open for swimming.

There can be multiple swim ban days per calendar day since each beach represents one swim day. Our sample used a total of nine beaches and the overall beach season consists of approximately 100 days in Chicago. Table 1 shows the swim ban days on our sample beaches as a proportion of total swim days for those beaches during the season.

Table 1: Swim Ban Days on Survey Beaches

Year	Swim Ban Days	Swim Ban Days as a Percent of Potential Swim Days
2000	19	2.1%
2001	61	6.6%
2002	42	4.6%
2003	41	4.1%
2004	52	5.7%

Because the lakefront and beaches are among the most popular destinations in Chicago in the summer, there is significant concern about the lost value associated with increasing swimming bans. However, there are no entrance fees on Chicago beaches and there is little information on either the value of a day at the beach, or the recreational and existence value of reducing swimming bans in the City. A travel cost study by Sohngen, et al. (2001) found the value of single-day trip to Maumee Bay Beach on Lake Erie to be $25, and the overall value annual value of single day trips to of the beach to be $6.1 million. Using the same data, Murray, et al. (2001) found the average seasonal benefits of reducing one swim advisory to be approximately $28 per visitor, or $3.4 million per beach. Very preliminary findings from this study have found the value of a day at the beach to be in the range of $30-50 per person using the travel cost data, and the value of reducing swimming bans by 50% to be in the range of $50-130 per person using the CVM data. While these results are highly preliminary, they are not out of line from the Lake Erie values and indicate Chicago beaches to be a very valuable resource.

III. UNCERTAINTY IN CVM

The idea of uncertainty in CVM has been addressed in detail in the literature. It is not without ambiguity however, since there is little consensus on the type or source of uncertainty and little theoretical justification for many of the empirical treatments in the CVM literature. Many authors address the notion of preference uncertainty, but this may not an entirely accurate expression since the CVM model and resulting WTP equations are implicitly based on the assumption that respondents know there preferences with certainty. We use the term 'uncertainty' generally to refer to the respondents' inability to assign a definite yes or no to the WTP question without addressing the ultimately more complicated question of theoretical preference uncertainty.

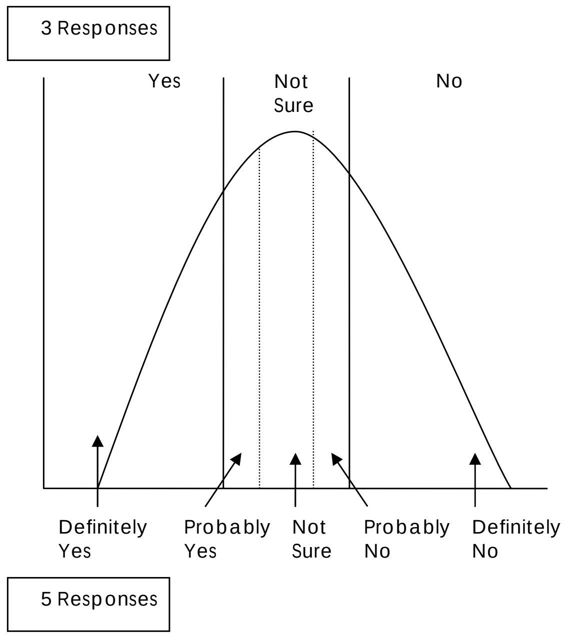
Uncertainty can arise from several different sources in CVM questionnaires. Respondents might not fully understand the program change and its effects. While the awareness of swimming bans is quite high in Chicago, there continues to be debate as to the sources of contamination and the effective solutions for reducing them. In addition, the hypothetical nature of the program may leave the respondent wanting more information before making a decision. They may question the appropriateness of the payment mechanism and may prefer an alternate method of payment[3]. Both Wang (1997) and van Kooten, et al. (2001) indicate that respondents know the range within they would definitely accept or reject a program and there exists a range of uncertainty as well. This is not unlikely if one considers something

[3] A third version of this survey was conducted to explore the option of allowing respondents to choose their own payment mechanism. This data will not be used specifically in this analysis however, several questions regarding the payment mechanism were included in all surveys and will be used to explain the WTP responses.

like an Ebay auction or the housing market. You may have an exact amount in mind entering into the bidding, yet your value changes depending on the amount and proximity of other bids, or your underestimation of the market. In this case, there may be an ex-ante range of values for which you are not entirely sure you will accept or reject the program. Further, a respondent may choose the “don’t know” or “not sure” option because they are simply indifferent between the two levels of provision.

The basic premise of the model with uncertainty utilizes some error in which the respondent’s valuation may be greater or less than the bid amount. For example, the respondent will definitely accept a program if their utility is greater than their utility without the program within a range of error (Alberini, et al 2003). The respondent will select the “don’t know” option if the utility change falls within the range of that error. The respondent may lean towards responding yes or no depending on where within that range the utility change lies. Consequently, it is not always the case that uncertain responses should be recoded as no responses. Figure 3 illustrates a possible valuation probability structure:

Figure 3: Valuation Distribution



Expressing this using the usual indirect utility comparison and suppressing the individual index, the respondent will definitely accept the environmental quality improvement (EQ_1) as long as:

$$V(Y-t, EQ_1, \mathbf{z}) + \eta > V(Y, EQ_0, z)$$

where V is the indirect utility function, Y is income, t is the bid amount, z is a vector of other factors specific to the respondent, and EQ_0 is the existing level of environmental quality[4]. The model is based on the theoretical constructs of Hanemann (1984) and Cameron (1988) and follows the logic of Wang's random valuation approach.

The model can be estimated several ways. The most common method of estimation involves recoding the uncertain responses as "No" responses and estimating a probit or logit

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[4] This is not a probability statement and the error η is not the same econometric error from the commonly-used random utility model.

(Champ, et al 1997, Ready, et al. 1998, Welsh and Poe 1998). However, as noted before, there are often no empirical tests of this assumption. Other approaches have tried to utilize the multiple responses as given by the respondents. Wang uses a maximum likelihood approach where the upper and lower bounds of the "not sure" range are estimated either as constants, or as functions of the individual's characteristics. Van Kooten, et al. express the values in the uncertain range to have fuzzy membership functions and estimate the bounds as fuzzy numbers. Alberini, et al. used the Welsh and Poe approach, plus a random-probit, and several variants of Wang's random valuation approach. Shaikh et al (2005) used five different empirical techniques from the literature, including the recoding approach of Champ, et al., the weighted maximum likelihood model of Li and Mattson, the symmetric uncertainty model of Loomis and Ekstrand, the random valuation of Wang, and the "fuzzy" approach of van Kooten, et al. While their questionnaire format used a certain-scale follow up question instead of a polychotomous choice, they found that the empirical method used produced varied results and cautioned against systematic judgments on the effect of uncertainty on welfare measures (Shaikh, et al 2005).

This research will use several of the aforementioned models. Several methods of recoding the responses as only 'yes' and 'no' responses will be tested against the dichotomous-choice model using a probit model. The random valuation approach, and a multinomial logit will be used to estimate the model with the five different response categories and results will be compared to the recoded models. The final comparison will be one of convergent validity by comparing the WTP to reduce swimming bans to the lost value associated with swimming bans from the travel cost model.

IV. THE CHICAGO BEACH SURVEY

The survey was implemented in three phases during the summer of 2005. Following extensive focus groups and survey pretesting, three different versions of the surveys were distributed to beachgoers over a period of three weeks in August and early September of 2004. A total of 2007 onsite surveys were collected on nine Lake Michigan beaches in Chicago.

1. The Survey Process

Three different surveys were conducted in order to test various methodologies and research questions. The surveys were offered in both English and Spanish, but very few chose to do the survey in Spanish. The response rate was between 80 and 90% depending on the survey type. The high response rate proved to be extremely important due to low attendance figures from an unusually cold and wet beach season. The average temperature for the time period was 14 degrees (22%) below normal, and consequently, the overall attendance at the beaches in our sample declined by nearly 30% from 2003 to 2004.

All surveys collected information about the respondent's beach trip, travel costs and alternate activities, perceptions about existing beach and water quality, knowledge of swimming bans, opinions on policy changes, and demographics. The surveys were basically the same except for the WTP question. The first survey (Survey 1 hereafter) was the most comprehensive and was collected for 1573 respondents on nine different beaches. The second survey (Survey 2 hereafter) was collected for 220 respondents on two of the most heavily-attended Chicago beaches. To compare across survey versions, a subset of the Survey 1 comprised of only observations from the two beaches sampled in Survey 2 will be used. In this case, the first survey data set consists of 575 observations, and the second survey dataset consists of 220 observations. A summary of the survey data is given in Table 1.

Table 1: Summary of Beach Survey Data

	Survey 1	Survey 2
Number of Observations to be used	575	220
Surveys Conducted on Weekend Days (including Fridays)		
Percentage of Days	33%	33%
Percentage of Surveys	39 %	55%
Average Air Temperature During Sample Period (Degrees)		
Mean	68	79
Std Dev	2.9	4.4
Min	61	73
Max	74	84
Average Historic High Temperature	*83*	*81*

Beachgoers were approached randomly with particular attention paid to the total number of respondents by age, gender, and potential household size. The sample was not as tailored as hoped due to the low-attendance days when all visitors were approached. Statistics for both samples of survey respondents are given in Table 2. Note that while average incomes and education levels are fairly high in Chicago, those living closest to the Lake have higher incomes and tend to visit more often.

Table 2: Summary Statistics for Survey Respondents

		SURVEY 1	SURVEY2
Household Income ($)	Mean	73,825	76,312
	Std Dev	53,514	57,226
	Min	16,200	20,356
	Max	157,200	175,001
Age (years)	Mean	30.30	32.14
	Std Dev	11.32	12.25
	Min	17	17
	Max	75	75
Percent with College Degree		75.65%	69.60%
Percent Female		58.22%	62.44%
Number of Trips in Season	Mean	12.25	13.04
	Std Dev	18.23	21.62
	Min	1.00	1
	Max	101.00	101

2. Swimming Bans

As noted earlier, there is significant awareness of swimming bans in Chicago. Several questions were posed regarding swimming and swimming bans. Table 3 shows the responses to some of the questions.

Table 3: Survey Responses to Swimming Bans

	SURVEY 1	SURVEY 2
Swim Regularly	48.70%	48.70%
Swam Today	19.69%	48.49%
Why Respondent Chose Not To Swim[a]		
“Don't enjoy”	4.73%	6.90%
“Not in the mood”	25.59%	35.34%
“Water too cold”	38.71%	51.72%
“Water not clean”	35.85%	38.26%
“Water not safe (waves, etc.)”	12.04%	0.86%
“Bad weather”	22.58%	18.97%
“Belongings unattended”	11.40%	21.55%
Knew of swim bans prior to survey	82.75%	81.33%

[a]Respondents could check more than one reason

The respondents were asked what type of activities they engage in on a regular basis (e.g. swimming) and if they swam on the day of the survey. If the respondent chose not to swim on the day of the survey, there were asked to identify the reason why. The weather had an obvious effect on respondents' decision to swim and a significant percentage of respondents indicated that they chose not to swim because the water was not clean.

Respondents were asked to rate their level of agreement with several opinion statements. For Survey 1, the options were "strongly disagree", "disagree", "no opinion", "agree" and "strongly agree". The options were the same for Survey 2 but the "no opinion" was changed to "not sure" in an attempt to see if the wording of uncertainty affected the response rates. The percentage of respondents choosing "no opinion" and "not sure" for a select group of statements is given in Table 4.

Table 4: "No Opinion" and "Not Sure" Responses to Select Statements

	Survey 1	Survey 2
	"No Opinion"	"Not Sure"
"The water is clean enough for swimming"	9.95%	11.45%
"I would visit more if beach were cleaner"	21.80%	14.80%
"I would visit even if swimming were banned"	4.04%	7.56%
"The City should replace bans with advisories"	7.58%	18.20%

There was some variation in the responses with the "not sure" percentage being higher in every case except for the statement about visiting more often if the water was cleaner.

3. Willingness to Pay

Following a series of swimming-related questions, and statements designed to remind the respondents of tradeoffs with respect to activities and budgetary spending, respondents were given a hypothetical scenario in which case an annual state income tax increase would allow better sewage treatment. The result would be 50% decrease in the number of swimming bans.

Survey 1 offered respondents a fairly-standard referendum-style dichotomous-choice WTP question. Survey 2 however, allowed the respondent to be uncertain of their WTP for a given tax amount and were offered a set of five response options. The question was followed by a set of statements asking the uncertain respondent to indicate why they were not sure if they were willing to pay. The survey instrument used in Survey 2 is given in Figure 3[5].

Figure 3: Willingness to Pay Question from Survey 2

1. Would you be willing to pay a $10.00 increase in your state income taxes **per year** for the program?

_____ 1. DEFINITELY YES → Go to Section V

_____ 2. PROBABLY YES
_____ 3. NOT SURE → Answer Question 2 below
_____ 4. PROBABLY NO

_____ 5. DEFINITELY NO → Go to Section V

If you checked 2, 3 or 4, please answer Question 2 below

2. If you are not entirely sure you would or would not pay, please indicate why:

_____ Not sure if reducing swimming is necessary
_____ Not sure the sewage expansion would reduce swim bans
_____ Not sure I want to pay that much
____ Not sure I want to pay for it through increased taxes
_____ Not sure the government would use the revenue accordingly
_____ Other, please explain_______________________________

The bid amounts for the tax ranged from $10 to $100 in both surveys. The final amounts were determined based on an extensive series of pretests and focus groups. Table 5 provides the WTP responses for both survey versions. The results are depicted in Figures 4 and 5.

[5] The entire survey is available at www.chicagobeachproject.org

Table 5: WTP Responses by Survey

Survey 1		Survey 2	
Response	**Percentage of Responses**	**Response**	**Percentage of Responses**
No	51.38%	Definitely No	13.18%
Yes	48.62%	Probably No	12.73%
		Not Sure	26.82%
		Probably Yes	21.82%
		Definitely Yes	25.45%

Figure 4: Distribution of WTP Responses for Survey 1

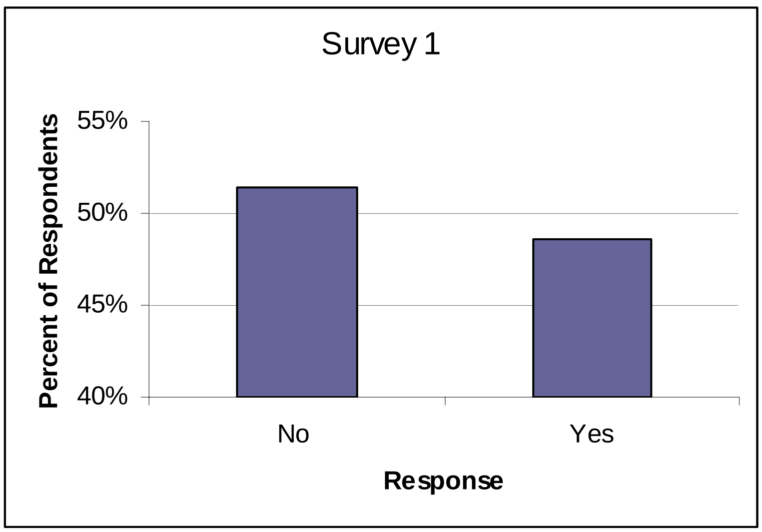
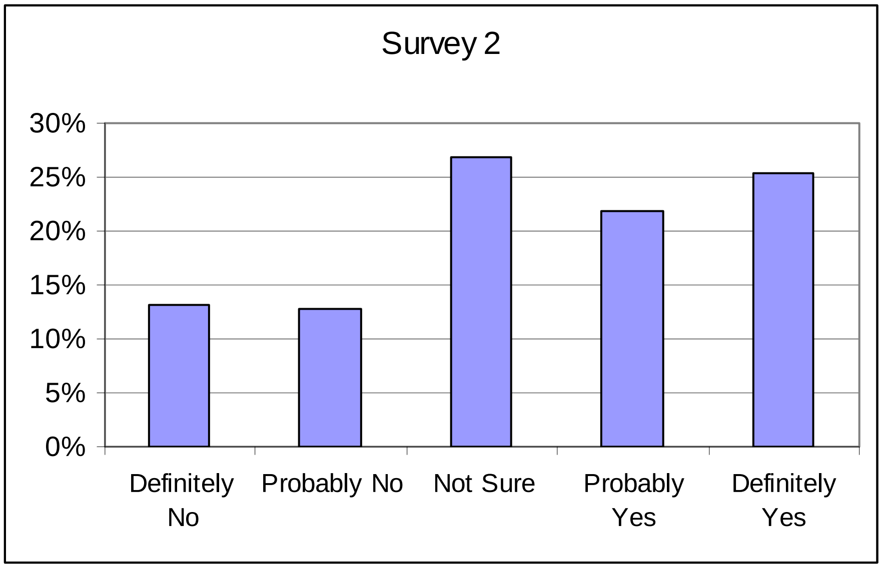


Figure 5: Distribution of WTP Responses for Survey 2



The polychotomous choice set resulted in 27% of respondents choosing "Not Sure". A casual comparison suggests that those choosing "Not Sure" may have been leaning towards saying "No" otherwise. Several options for recoding the responses in Survey 2 are discussed in the next section.

V. PRELIMINARY RESULTS

1. Recoding Survey 2 Data

The WTP responses in Survey 2 are recoded in several ways with "definitely no" and "definitely yes" always being treated as "no" and "yes", respectively. The methods are summarized in Table 6, followed by a summary of results in Table 7.

Table 6: Methods for Recoding Polychotomous-Choice Data

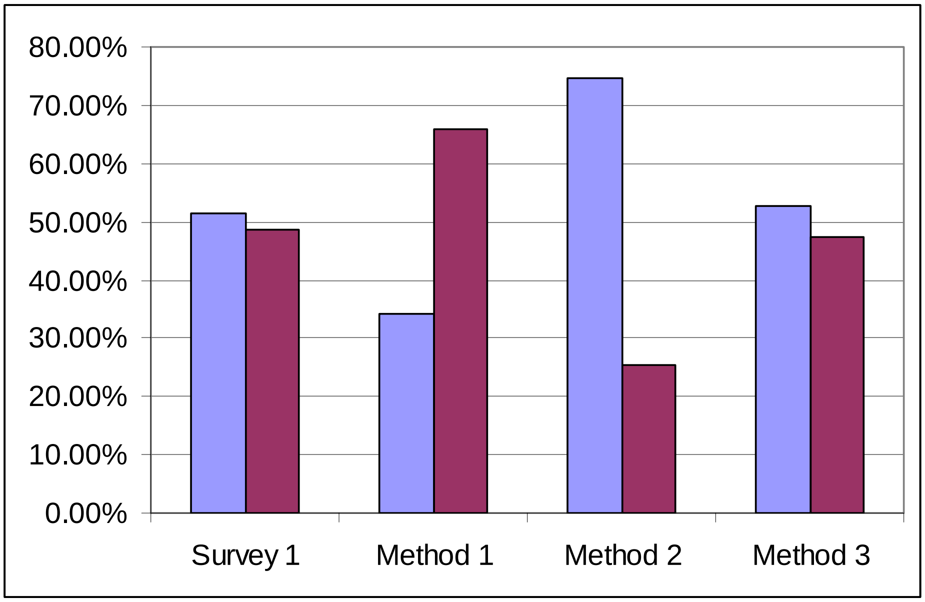
Original Response	New Recoded Response		
	Method 1	**Method 2**	**Method 3**
Definitely No	No	No	No
Probably No	Dropped	No	No
Not Sure	Dropped	No	No
Probably Yes	Dropped	No	Yes
Probably No	Yes	Yes	Yes

Table 7: Distribution of WTP for Survey 1 and Survey 2 Recoded Data

	Survey 1	Recoding Method for Survey 2		
New Response		**1**	**2**	**3**
No	51.38%	34.12%	74.55%	52.73%
Yes	48.62%	65.88%	25.45%	47.27%

The distribution of the recoded polychotomous-choice data using Method 3 shows a striking similarity to the data from Survey 1. Figure 6 shows the distribution of WTP by each method.

Figure 6: Distribution of WTP for Survey 1 and Survey 2 Recoded Data



This simple look at the recoded data suggests that the distribution of Survey 2 WTP most resembles the distribution of Survey 1 WTP under the assumption that those indicating there were "not sure" were most likely to say "no" if forced between acceptance or rejection. Further analysis of this outcome was tested using probit analyses of all the various methods.

2. Preliminary Probit Results

Several specifications for WTP estimation were used for Survey 1 and each of the recoded datasets from Survey 2. Initial results of the simplest specification show some significance in each model but a better of fit in Models 1 and 2. Results are given in Table 8.

Table 8: Marginal Effects for Probit Estimation

(Coefficients marked by * are significant at the 10% level)

	Survey 1	Survey 2		
		Method 1	Method 2	Method 3
Bid	-0.00318*	-0.0035*	-0.0028*	-0.0016
Income	1.20E-06*	3.48E-06*	9.1E-07*	1.33E-06*
Age	0.0014	0.0028	0.0073*	0.0039
Number of Visits in Season	-0.0005	0.0007	0.0026*	0.002
Dummy for Swim Regularly	0.0148	0.2242*	0.1242*	0.1185*
N	505	79	209	209
Pseudo R^2	0.0339	0.1863	0.1098	0.0436

This simple specification may not be the ideal model for estimation. Previous work using Survey 1 showed greater significance and better fit for an alternate specification. Results are shown in Table 9.

Table 9: Probit Results for Survey 1 WTP

Variable	Marginal Effect
Bid	-0.0026*
Income	1.14E-06*
Age	0.0316*
Age Squared	-0.0004*
College Dummy	0.1009*
Minutes spent on beach	-0.0007*
Travel minutes to beach	-0.0010*
Importance Rating of Reduce Swimming Bans (increasing)	0.0617*
N	494
Pseudo R^2	0.0758

Unfortunately, this specification proved to be problematic for the Survey 2 recoded data due to strong multicollinearity in the demographic variables. The beaches sampled do not have a great deal of variation in respondent demographics and its possible the fewer observations in Survey 2 provide less variation. Further analysis is required to find the best model for significance and comparison.

VI. FORTHCOMING WORK

The work done to date is preliminary and further econometric investigation is ongoing. Further exploration of the recoding methods will be based on responses to the reasons for uncertainty, as well as the uncertainty associated with the perception and opinion statements. The demographics and trip-taking behavior, as well as the preferences for those choosing each response category in Survey 2 will be compared to those who selected “yes” or “no” in Survey 1. This method of comparing individuals across response categories is based on Carson, et al (1998).

The initial probit estimates will be explored further to determine whether or not forcing the responses to fit into two categories causes poor econometric results. Wang’s random valuation model and a multinomial logit model will be estimated for Survey 2 in order to assess the responses as given by the individuals. Methods for the calculation of welfare effects will also be explored.

References

Alberini, A. K. Boyle, and M. Welsh, 2003. "Analysis of Contingent Valuation Data with Multiple Bids and Response Options Allowing Respondents to Express Uncertainty." *Journal of Environmental Economics and Management* 45: 40-62.

Cameron, T. A. 1998. "A New Paradigm for Valuing Non-Market Goods using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression." *Journal of Environmental Economics and Management* 15: 355-379.

Champ P. A., R. C. Bishop, T. C. Brown, and D. W. McCollum, 1997. "Using Donation Mechanisms to Value Nonuse Benefits from Public Goods." *Journal of Environmental Economics and Management* 33: 151-62.

Ekstrand, E. R. and J. Loomis, 1998. "Incorporating Respondent Uncertainty when Estimating Willingness to Pay for Protecting Critical Habitat for Threatened and Endangered Fish." *Water Resources Research* 34: 3149-3155.

Haener, M. K. and W. L. Adamowicz, 1998. "Analysis of "Don't Know" Responses to Referendum Contingent Valuation Questions" *Agricultural and Resource Economics Review* Oct: 218-230.

Hanemann, W.M., 1984. "Welfare Evaluation in Contingent Valuation Experiments with Discrete Responses," *American Journal of Agricultural Economics* 66: 332-41.

Li C. and L. Mattson, 1995. "Discrete Choice under Preference Uncertainty: An Improved Structural Model for Contingent Valuation." *Journal of Environmental Economics and bManagement* 28: 256-269.

Loomis, J. and E. Ekstrand, 1998. "Alternative Approaches for Incorporating Respondent Uncertainty When Estimating Willingness to Pay: the Case of the Mexican Spotted Owl." *Ecological Economics* 27: 29-41.

Murray, C, B. Sohngen and L. Pendleton, 2001. "Valuing Water Quality Advisories and Beach Amenities in the Great Lakes." *Water Resources Research* 37 (10): 2583-2590.

Ready, R., J. Whitehead and G. Blomquist, 1995. "Contingent Valuation when Respondents are Ambivalent." *Journal of Environmental Economics and Management* 29: 181-197.

Ready, R. C., S. Navrud and W. R. Dubourg, 2001. "How do Respondents with Uncertain Willingness to Pay Answer Contingent Valuation Questions?" *Land Economics* 77(August): 315-326.

Shaikh, S. L. 2005 "The Chicago Beach Project: An Interim Report" Working paper for the Chicago Beach Project, University of Chicago.

Shaikh, S., L. Sun and G.C. van Kooten, 2005 "Does Inclusion of Landowners' Non-Market Values Lower Costs of Creating Carbon Forest Sinks?" Working paper, University of Victoria.

Sohngen, B., F. Lichtkoppler, and M. Bielen, 1998. "The Value of Day Trips to Lake Erie Beaches." Technical Bulletin TB-039: Ohio Sea Grant Extension.

van Kooten, G.C., E. Krcmar and E.H. Bulte, 2001. "Preference Uncertainty in Non-market Valuation: A Fuzzy Approach." *American Journal of Agricultural Economics* 83(August): 487-500.

Wang, Hua, 1997. "Treatment of "Don't-Know" Responses in Contingent Valuation Surveys: A Random Valuation Model." *Journal of Environmental Economics and Management* 32: 219-232.

Welsh, M. P., and G. L. Poe, 1998. "Elicitation effects in contingent valuation: Comparisons to a Multiple Bounded Discrete Choice Approach." *Journal of Environmental Economics and Management* 36:170-85.