Temporal Reliability of Willingness to Pay from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation[1]

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Abstract

The U.S. Fish and Wildlife Service's National Survey of Fishing, Hunting, and Wildlife Associated Recreation has been a source of information on wildlife-related recreation since 1955. The contingent valuation method has been used to estimate willingness to pay for recreation trips in the 1980, 1985, 1991, 1996 and 2001 surveys. However, relatively little comparative analysis over time has been performed. Similar value elicitation formats were used in the 1991 and 1996 surveys for bass and trout fishing, deer hunting, and nonconsumptive wildlife recreation. We statistically analyze these data to assess the temporal reliability of the willingness to pay. We control for the effects of trip quality and socioeconomic variables and find that willingness to pay is significantly lower in 1996 for each activity. A subtle, but important, change in the 1996 question format may drive the result of lower willingness to pay.

Key Words: Contingent Valuation Method, Temporal Reliability, Wildlife-Associated Recreation, Willingness to Pay

Introduction

Benefit-cost analysis of fish and wildlife policy can be used to determine the efficiency of various policy alternatives. Since fish and wildlife resources are not provided in markets estimates of non-market benefits are important for fish and wildlife policy analysis. If the non-market benefits (i.e., economic value) of a policy exceed the costs then the policy is economically efficient. Information about changes in benefits is also important to fish and wildlife policy makers. Changes in non-market benefits may be due to changes in resource quality or some other underlying measure of policy choice. Changes in benefits provide signals that programs and policies could be adjusted to improve economic efficiency.

The contingent valuation method was developed to estimate the non-market benefits, or willingness to pay, of non-market goods (Mitchell and Carson, 1989). The accuracy (i.e., validity and reliability) of the contingent valuation method has been a source of considerable debate (Portney, 1994). One concern is temporal reliability. A contingent valuation survey is temporally reliable if willingness to pay is stable over time, assuming that the factors affecting willingness to pay have not changed. If willingness to pay is stable then estimates developed in previous time periods can be transferred to current policy applications. Two potential conclusions can be reached if willingness to pay is not stable over time. The first is that the particular contingent valuation survey is not reliable. This conclusion is only appropriate if the differences in willingness to pay cannot be explained adequately. If the differences in willingness to pay can be explained by changes in demand, supply, or other factors the second conclusion is that benefit estimates cannot be transferred across time. New benefit estimates must be developed in order to analyze current policy.

Numerous studies have found evidence of temporal reliability of the contingent valuation method. For example, Loomis (1990) employs the same survey instrument with the same sample of respondents in different time periods. Reiling, Boyle, Phillips, and Anderson (1990), Teisl, Boyle, McCollum, and Reiling (1995), Carson et al. (1997), and Downing and Ozuna (1996) employ the same survey instrument with different samples of respondents in different time periods. Each of these studies used relatively small differences in time between surveys (e.g., several months to two years) during which the factors affecting willingness to pay are not likely to undergo significant change. Whitehead and Hoban (1999) employ the same survey instrument with different samples and find that willingness to pay estimates are significantly different over a five year time period. But after controlling for factors that affect willingness to pay the differences in willingness to pay are not statistically significant.

Extensive data on the benefits of consumptive and nonconsumptive wildlife recreation is available from the U.S. Fish and Wildlife Service's (USFWS) National Surveys of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR). The FHWAR surveys have been a source of information on wildlife recreation since 1955. Estimates of net economic values (i.e., willingness to pay) for deer and waterfowl hunting and trout fishing based on contingent valuation questions were developed from the 1980 survey (Brown and Hay, 1987). Contingent valuation questions for elk hunting and wildlife observation, photography, and feeding (i.e., wildlife watching) were added and bass fishing questions replaced trout in the 1985 survey (Hay, 1988a, 1988b). Willingness to pay estimates for deer hunting, bass and trout fishing, and wildlife watching were developed from the 1991 survey (Waddington, Boyle, and Cooper, 1994). Elk and moose hunting and walleye fishing were added to the contingent valuation questions in the 1996 survey (Boyle, Roach, and Waddington, 1998).

The FHWAR surveys provide a unique opportunity for temporal reliability tests of the contingent valuation method using large national samples of respondents. In addition the surveys are relatively far apart allowing for potentially significant change in factors affecting willingness to pay. Nevertheless, little comparative analysis has been performed with the willingness to pay estimates from Brown and Hay (1987), Hay (1988a, 1988b), Waddington, Boyle, and Cooper (1994) and Boyle, Roach, and Waddington (1998). No comparative analysis has been performed with the primary data. One limitation is the change in contingent valuation methodology between the 1985 and 1991 surveys. The iterative bidding question format was used in 1980 and 1985, the dichotomous choice question format was used in 1991 and 1996, and the open-ended format was used in 2001. Therefore, tests for temporal reliability across each of the five surveys are confounded by the change in methodology. Separate tests for temporal reliability between the 1980 and 1985 surveys and 1991 and 1996 surveys are possible. However, these surveys were not designed for tests of temporal reliability. There are methodological changes in each of the survey that may confound the tests.

In this paper we test for temporal reliability using the bass and trout fishing, deer hunting, and wildlife watching contingent valuation data from the 1991 and 1996 FHWAR surveys. We first discuss the survey methods used in each of the surveys and review the willingness to pay estimates from the 1991 and 1996 surveys. We then develop samples of respondents that minimize differences in survey methodology and sample composition and statistically analyze the 1991 and 1996 contingent valuation data to assess change in survey responses. We conclude with a discussion of our results and suggestions for future research.

Survey Background and Methods

The U.S. Fish and Wildlife Service funds the FHWAR survey and the U.S. Bureau of the Census collects the data. Each FHWAR survey was conducted in two consecutive phases. First, screening interviews of a representative sample of the United States population were conducted in January and February in 1991 and in April through June in 1996. These interviews were by telephone or in-person, according to preference of the respondent. A household representative 18 years old or older was asked to provide estimates of the wildlife-associated recreation activity of all household members 6 years old and older. The screening interview information was used to construct a representative sample of wildlife-associated recreation participants for the detailed survey that followed. A sample of those household residents 16 years old and older who had participated recently and/or intended to participate in the upcoming year was selected for follow-up interviews.

The detailed interview phases of the 1991 and 1996 surveys asked respondents to recall their recreation activities and expenditures over a 4-month period. One exception is for respondents who reported participation in the first interview wave in 1996, who were then not given the second interview, but rather were interviewed in the last interview in January 1997, making their recall six to eight months for their second interview. Respondents were interviewed three times in 1991 and two or three times in 1996 to get information for their entire year's activity. Questions included what kinds of wildlife-associated recreation they participated in, how often they participated, and how much they spent for trip-related and equipment expenditures. In the last interview economic evaluation (i.e., contingent valuation) questions were presented to bass or trout anglers, deer, moose, or elk hunters and/or wildlife watchers.

An important difference in methodology between the 1991 and 1996 surveys was the determination of the state in which equipment was purchased and, in the economic evaluation section, in which state people participated. In 1991 all equipment purchases were reported by the state in which the respondent resided, not where the purchase was made. In 1996 a question was added for each expenditure item, asking for the state where the item was purchased. Expenditures could then be summed by state where the purchase took place. Similarly, in 1991 a respondent's valuation of recreation trips was reported by the state in which the respondent lived. The destination of the recreation trip was not asked. In 1996, respondents were asked where the recreation took place, and the valuation for the activity in a state was made up of two components: the in-state resident valuation and the out-of-state resident valuation.

The economic evaluation sections began with a question asking for the number of bass and trout fishing, deer hunting, and wildlife watching trips taken during the past year. Next, bass and trout anglers are asked for the number of fish caught and the average size of these fish on all of the trips. Deer hunters are asked whether they bagged a deer, the number of deer bagged and the sex of the deer. In the hunting and fishing section, respondents are reminded to include money spent on food and lodging during longer trips and asked about the average cost per trip. The average cost was multiplied by trips to arrive at the total cost of trips. Respondents are then asked if this total cost is about right (i.e., accurate) and, if not, asked for a total cost estimate. In the wildife watching section, respondents are presented with the total costs of their trips from answers to previous questions. Respondents are then asked if this total cost is about right and, if not, asked for a total cost estimate.

The contingent valuation question is then presented. Respondents could be asked up to three valuation questions in the 1991 survey depending on the recreation activities in which they participated. In the 1996 survey respondents could be asked up to seven valuation questions depending on their activities and states in which they participated. The question sequence is the same: bass, trout, or walleye fishing, deer, elk, or moose hunting, and then wildlife watching. In 1991, respondents were assigned fishing questions based on whether they lived in primarily bass or trout fishing states. A person who lived in a bass state and who fished for bass is asked a bass fishing valuation question and not asked a trout valuation question. In 1996, walleye fishing was added to the list. In 1991 all respondents were assigned the deer questions. In 1996, states were assigned hunting questions based on whether they lived in primarily deer, elk, or moose hunting states. All states were assigned the wildlife watching questions.

The payment vehicle for the contingent valuation questions is a lump sum increase in the total cost of all trips over the course of a year. In 1991 respondents are asked whether they would take any trips if the total costs were a specific dollar amount ($A) more than current costs. For bass and trout fishing the question was:

> Fishing expenses change over time. For example, gas prices rose dramatically during the 1970's, fell somewhat during the early 1980's, and rose again in the late 1980's. Would you have taken any trips to fish

> PRIMARILY for (bass/trout) during 1996 if your total fishing costs were $A more than the amount you just reported?

In 1996 the question was slightly different:

> Fishing expenses change over time. For example, gas prices rise and fall. Would you have taken any trips to fish PRIMARILY for (bass/trout) during 1996 in [state of residence] if your total costs were $A more than the amount you just reported?

Hunting and watching questions are similar. In 1996 additional contingent valuation questions were asked of respondents who participated in wildlife-associated recreation in states other than their state of residence.

An important change in the economic evaluation section from 1991 to 1996 is the site-specificity of the 1996 questions. In 1991 respondents consider all states at once. If the respondent answers “no” to the contingent valuation question this indicates that they would take zero trips to all sites when faced with the higher total cost. In 1996, respondents consider the sites in their state of residence and substitute sites separately. A “no” response indicates that they would take zero trips in their state of residence but does not preclude trips to substitute states. For this reason we expect that the propensity of “no” responses may increase in 1996. In both years a “yes” response suggests that the respondent will continue taking trips. However, it is not clear whether the number of trips would stay the same or decrease in response to the higher average cost per trip.

Another change in the contingent valuation question is the assignment of the dollar amounts ($A) in the valuation questions. In each survey the dollar amounts were developed from the previous survey results. In 1991, one of 10 amounts was randomly assigned to each respondent using the method developed by Duffield and Patterson (1991). The amounts ranged from $6 to $924 for bass fishing, $6 to $870 for trout fishing, $9 to $953 for deer hunting, and $3 to $823 for wildlife watching. In 1996 the methodology used to randomly assign dollar amounts to respondents was that developed by Cooper (1993). One of 96 amounts ranging from $6 to $1052 was assigned to bass anglers. One of 78 amounts from $122 to $1301 was assigned to trout anglers. Each deer hunter was assigned one of 219 amounts that ranged from $78 to $1048. One of 251 amounts that ranged from $22 to $1067 was assigned each wildlife watcher. Since bid design has been found to have significant effects on willingness to pay estimates (Cooper and Loomis, 1992), we may expect willingness to pay from the 1991 and 1996 FHWAR surveys to differ but the direction of the effect is unclear.

Previous Analyses of the FHWAR Survey

The willingness to pay analytical technique is similar in both Waddington, Boyle, and Cooper (1994) and Boyle, Roach, and Waddington (1998). Responses to the dichotomous choice contingent valuation questions are used to construct the discrete dependent variable. The probit model was used to analyze the yes/no responses. The models were weighted because the FHWAR is conducted with a probability sample where observations have unequal probabilities of being selected. Resident and nonresident valuation responses were pooled in 1996.

In 1991 probit models were estimated for each state. Reduced sample sizes and alterations in survey implementation procedures (e.g., the dollar amounts had to be provided to the Census Bureau before the survey was conducted and the final allocation of bids to respondents was different from the original bid designs) prevented Boyle, Roach, and Waddington (1998) from estimating state specific models in 1996. States were grouped into regions in order to develop statistically significant models.

In 1991 the independent variables chosen for the probit models for fishing were the dollar amount from the valuation question, the number of fish caught, and the average length of the fish. In 1996, some regions included both bass and trout states, so a species variable distinguishes between these states. Also, since the resident and non-resident responses were pooled, a variable for the residency status of the respondent was included. In 1991, the independent variables for deer hunting were the dollar amount, the number of deer bagged and whether the respondent hunted other big game. In 1996 the sex of the animal bagged and residence variables were added. In 1991, the independent variables for wildlife watching were the dollar amount, whether the respondent visited public or private land, whether the respondent photographed wildlife, and whether the respondent fished. In 1996 the residence variable was added.

The estimated probit models were used to derive estimates of annual willingness to pay. Willingness to pay per day was computed by dividing the annual willingness to pay by the number of trips the individual took. Willingness to pay for fish caught and deer bagged is also presented. The results from the 1991 analysis are not easily comparable to the 1996 analysis for several reasons: (1) the 1991 results are at the state level, while the 1996 results are at the regional level, and (2) the 1991 state results are the values of the state residents, no matter where they participated, while the 1996 results are the values of all people who participated in that region, no matter where they lived, and (3) the dollar amounts used in the contingent valuation questions are substantively different.

Even with these difficulties, a comparison of the results suggests there is a significant drop-off in the willingness to pay from 1991 to 1996. For example, 1991 bass fishing results show substantial variation at the state level in the estimates of annual willingness to pay. States with high value estimates include Arkansas at $921, Georgia at $913, Tennessee at $687, and South Carolina at $677. On the lower end, annual estimates for Iowa, Kansas, and West Virginia are $70, $220, and $331 respectively. The mean value across all states was $498. In 1996 there was no region that had a willingness to pay greater than the $381 value for the East North Central Census Region (Illinois and Indiana). In the USFWS's suggested regions values were negative in the southern and $262 in the northern bass region. All value estimates are in 1996 dollars.

Data

Since a comparison of willingness to pay estimates from the USFWS reports is problematic we estimate willingness to pay models after pooling the 1991 and 1996 FHWAR survey data. We discard cases for which respondents do not give complete information on key variables from the economic evaluation and demographic sections of the survey. For each recreation activity we only include states that appear in both the 1991 and 1996 surveys. For example, Massachusetts and Rhode Island were trout states in 1991 and bass states in 1996. Therefore, 1996 Massachusetts and Rhode Island respondents are not included in the bass data.

The 1991 and 1996 samples are made comparable by deleting those respondents who took trips outside the state of residence in 1991 and not including the contingent valuation questions presented to out-of-state recreation participants in 1996. In order to make the dollar amounts ($A) more comparable we inflate 1991 dollars to 1996 dollars using the consumer price index and randomly discard cases from the 1991 survey until the weighted mean dollar amounts are equal across survey year. Note that the empirical results below are robust to samples in which these two adjustments are not made. The sampling weights are normalized to account for the change in sample size.

In the bass fishing, trout fishing, and deer hunting models the average (inflation adjusted) bid amount in the 1991 survey is lower than in the 1996 survey. In the bass fishing model, 32% of 1264 responses with the bid amount less than $300 are deleted so that the average bid amounts are not statistically different across year of the survey. Forty nine percent of 1322 responses with the bid amount less than $305 are deleted in the trout fishing model. Twenty two percent of 2920 deer hunting responses with the bid amount less than $350 are deleted. The average bid amount in the 1991 survey is greater than that in the 1996 survey for the wildlife watching sample. Thirty percent of 3136 responses with bids greater than $300 are deleted.

Even after deleting a large number of 1991 cases, the number of cases in 1991 is much greater than in 1996. There are 2050 cases for bass fishing in 1991 and 965 in 1996. There are 1904 cases for trout fishing in 1991 and 1176 in 1996. In 1991 the number of deer hunting and wildlife watching cases are 4851 and 4590, respectively. In 1996, the number of cases is 1978 and 2077 for deer hunting and wildlife watching. These differences are due to the overall FHWAR sample size being lower in 1996 than 1991.

Descriptions of the variables used in the empirical models appear in Table 1. As in Boyle, Roach, and Waddington (1998), we include the annual catch of fish and the average length of the catch in the bass and trout fishing models. The annual bag of deer, whether the respondent bagged a buck, and whether the respondent hunted other big game are included for deer hunting. The wildlife watching model includes whether the respondent visited private or public land, with the omitted category being if they visited both private and public land, whether they photographed wildlife, and whether they took recreational fishing trips. In addition, we include six demographic variables: age, gender, race, education, marital status, and income. Regional dummy variables suggested by the USFWS and used in Boyle, Roach, and Waddington (1998) are also included in the models but not presented for brevity.

The household income question is different in the 1991 and 1996 surveys. In 1991 income is elicited with a discrete choice question that asked if income is greater or less than $25,000. This is followed by a question that asks respondents to place their income in one of seven categories. In 1996 respondents are asked one question in which they place their household income in one of ten categories. We initially combined income categories in the 1996 survey to be consistent with the 1991 survey and coded household income at the midpoints of the categories. After adjusting 1991 income to 1996 dollars using the consumer price index 1991 income is significantly greater than 1996 income. For example, the average income for bass anglers is $42,000 in 1991 and $32,000 in 1996. Since the FHWAR surveys are based on representative samples after weighting we speculate that the large differences are due to the change in the income elicitation question. To maintain as much consistency as possible between the surveys income is measured as a dummy variable equal to one if household income is greater than $30,000 and zero otherwise.

The weighted means for the bass and trout fishing, deer hunting, and wildlife watching data appear in Table 2. The percentage of "yes" responses to the contingent valuation question is larger in 1991 for each of the recreation activities. For example, 51% of bass anglers would pay the increase in total trip costs and continue taking trips in 1991 whereas only 39% would pay $A and continue taking trips in the state of residence in 1996. Few major differences across time appear in the independent variables. One exception is income where the percentage of respondents with income greater than $30,000 is higher in 1991 than in 1996.

Model

In order to specify theoretically consistent empirical models we develop expenditure difference models of survey respondent behavior. The expenditure function, $e(p,q,u^*)$, is derived when recreation participants minimize expenditures, $m = px + z$, subject to the utility constraint, $u^* = u(x,q,z)$; where m is income, p is the trip cost, x is trips, z is expenditures on all other goods ($p_z=1$), u is utility, and q is the quality (e.g., catch, bag) of each trip. When recreation participants maximize utility subject to the expenditure constraint the indirect utility function, $v(p,q,m)$, is derived.

Survey respondents are asked whether they would take any trips if their total trip costs were $A more than the total costs during the previous year (i.e., total cost = px). The respondent is faced with the following problem:

(1)
$$A \gtrless e(\bar{p},q,u^*) - e(p,q,u^*)$$
$$A + e(p,q,u^*) \gtrless e(\bar{p},q,u^*)$$

where $\bar{p}$ indicates that the respondent faces the choke price at which no trips are taken. If the expenditures to reach u^* with the increase in total trip costs is greater than the expenditures with the choke price the respondent will answer “no” to the valuation question. If the expenditures to reach $u*$ with the increase in total trip costs is less than the expenditures with the choke price the respondent will answer “yes” to the valuation question.

Willingness to pay is defined as the difference in expenditure functions when the respondent faces the choke price

(2) $$WTP = e(\bar{p}, q, u^*) - e(p, q, u^*)$$

Substitution of the indirect utility function into the expenditure functions in equation (2) yields

(3) $$\begin{aligned} WTP &= e(\bar{p}, q, v(p, q, m)) - m \\ &= s(\bar{p}, p, q, m) \end{aligned}$$

where $s(\cdot)$ is the willingness to pay function. Willingness to pay is decreasing in price, increasing in quality and increasing (decreasing) in income if recreation is a normal (inferior) good (McConnell, 1990). Including variables that measure these concepts in empirical models serves as internal validity tests of the contingent valuation data. However, only poor or inconsistent measures of trip cost can be obtained from the FHWAR surveys and this variable is not included in the empirical models.

In preliminary analyses the log normal functional form for the dollar amount fit the data best. Therefore we adopt this form in the rest of the paper. Researchers only observe the deterministic part of the willingness to pay function. Assuming error for the log normal form of the willingness to pay function, e, the probability of a “yes” response is

$$(4)\qquad \begin{aligned} p\,(yes) &= p\,(\log s(\cdot) + e \geq \log A) \\ &= p\,(\log s(\cdot) - \log A \geq -e) \\ &= p\left(\frac{\log s(\cdot) - \log A}{s} \geq \frac{-e}{s}\right) \end{aligned}$$

where *yes* is equal to one if $\log s(\cdot) + e \geq \log A$ and zero otherwise and $e \sim N(0, s)$. The following probit model is estimated

$$(5)\qquad p\,(yes) = \Phi\left(\frac{a}{s} + \frac{d}{s} YEAR91 + \frac{b'}{s} X - \frac{1}{s} \log A\right)$$

where Φ is the standard normal cumulative density, $YEAR91$ is equal to one for respondents to the 1991 survey and zero for respondents to the 1996 survey, X is a vector of independent variables, $\frac{a}{s}$ and $\frac{d}{s}$ are probit coefficients, $\frac{b}{s}$ is a probit coefficient vector and s is standard deviation of the regression measured as the negative inverse of the coefficient on the dollar amount variable (Cameron and James, 1987). The coefficients from the probit model, censored at $A, can be used to estimate the expected value of the log of willingness to pay

$$(6)\qquad E(\log WTP) = a + dYEAR91 + b'X$$

The null hypothesis for temporal reliability is $H_0 : d = 0$. The alternative hypothesis is $H_A : d \neq 0$. Cameron (1991) provides formulas for the calculation of the standard errors of the coefficients. The coefficients approximate the percentage change in willingness to pay as a result of a marginal change in the independent variable.

Results

The coefficient estimates from equation (6) where the log of willingness to pay is the dependent variable appear in Table 3. Each of the coefficient vectors are statistically significant at the .01 level according to the model χ^2 statistic. The probability of a "yes" response decreases with increases in the log of the change in the total cost, log*A*, since the standard deviation, σ, is positive and statistically significant at the .01 level. Note that our results are robust to the functional form of the dollar amount variable. These results are available upon request.

Each of the coefficients on the dummy variable for the 1991 survey is positive and statistically significant at the .01 level. These results indicate that willingness to pay is greater in 1991 relative to 1996. Willingness to pay is about 38%, 61%, 22%, and 54% lower in 1996 in the bass and trout fishing, deer hunting, and wildlife watching models. Since income is significantly higher in 1991 we interact the income variable and YEAR91 variables to determine if the difference in income is driving this result. We find no evidence that the difference in willingness to pay across the surveys is due to the income differences. These results are available upon request.

Most of the variables that measure resource quality are important determinants of willingness to pay. Bass and trout anglers are willing to pay .7% and .4% more for each additional fish caught. Trout anglers are willing to pay 9% more for an increase in one inch in the average length. Each of these results is statistically significant at the .01 level. Deer hunters are willing to pay 19% more for each additional deer bagged and 21% more to bag a buck. Each of these results is statistically significant at the .01 level.

Other results conform to expectations. Deer hunters who hunt other big game are willing to pay 61% more. This result is statistically significant at the .01 level. Those who participate in nonconsumptive recreation on only private or only public land are willing to pay 43% and 45% more than those who participate on private and public land. Those who photograph wildlife are willing to pay 14% more than others. These results are statistically significant at the .10 level. Those who fish are willing to pay 35% more. This result is statistically significant at the .01 level.

Several demographic variables help explain the variation in willingness to pay. Age has a positive effect on willingness to pay in the trout fishing and wildlife watching models and a negative effect in the deer hunting model. Men are willing to pay more for deer hunting and wildlife watching trips. Education has a negative effect on the willingness to pay for bass fishing trips and a positive effect on the willingness to pay for wildlife watching trips. Respondents who are married are willing to pay more for deer hunting and wildlife watching trips. Respondents with income above $30,000 are willing to pay more for bass fishing, deer hunting, and wildlife watching trips indicating that these activities are normal goods.

Conclusions

Willingness to pay estimates from the contingent valuation method are temporally reliable if willingness to pay is stable over time. Temporal reliability is an important methodological test because it is one of the indicators of the accuracy of a valuation method. Temporal reliability is also a practical test because it indicates whether benefit estimates can be transferred over time, reducing the cost of policy analysis. If willingness to pay is not stable over time then either true willingness to pay has changed due to changes in demand, supply, or other conditions or the particular contingent valuation survey is not a reliable tool for generating accurate benefit estimates.

In this paper we find that willingness to pay for wildlife recreation trips from the FHWAR surveys changes over a five year time period. Willingness to pay for bass and trout fishing, deer hunting and wildlife watching is significantly lower in the 1996 survey relative to the 1991 survey. In fact, this is the only result that is robust across the four empirical models. If there are no differences in the 1991 and 1996 contingent valuation questions, this result leads to one of two conclusions. The first is that the difference in willingness to pay indicates that the net economic value of wildlife-associated recreation has changed over the five-year period. However, none of the independent variables that we include are able to explain the change in willingness to pay. This conclusion would be appropriate only if significant change in omitted variables potentially explains the difference in willingness to pay.

A review of other results from the FHWAR surveys for potential omitted variables provides little hope. One significant finding of the 1991 and 1996 surveys was the increase in expenditures and days of participation for wildlife-related recreation. For example, there were 12.9 million black bass anglers (excluding the Great Lakes participants) fishing 158 million days in 1991. In 1996 12.7 million adult Americans fished for black bass on 191 million days. The freshwater fishing (excluding the Great Lakes) trip-related and equipment expenditures was $17.4 billion in 1991 and $24.2 billion in 1996. These differences suggest an increase in willingness to pay in 1996, not the decrease that we find. Given that we know of no obvious omitted variables from the FHWAR surveys that would lead to a decrease in willingness to pay, we reject this explanation.

The alternative conclusion is that the contingent valuation questions in the FHWAR survey are not temporally reliable measures of willingness to pay. Comparing the 1991 and 1996 surveys with the 1985 survey supports this conclusion. For example, bass fishing was included in the economic evaluation section of 1985. The average value per bass angler is $376 from 1985 (in 1991 dollars, using the CPI) (Hay, 1988a). The average value per bass angler is $433 in 1991 (Waddington, Boyle, and Cooper, 1994). For the 1985 and 1991 state by state comparison, one-half of the state estimates are not significantly different at the .05 level, and the other half are significantly different, with the 1991 numbers being about twice as large as the 1985 numbers. Willingness to pay in 1991 could be some kind of spike for these states, with 1985 and 1996 being similar in terms of economic values.

The second conclusion, that willingness to pay estimates from the FHWAR surveys are not temporally reliable, would be appropriate only if there were no other reasons to suggest that willingness to pay should differ in 1985, 1991, and 1996. However, the change from the iterative bidding to the dichotomous choice question format could explain the differences in the 1985 and 1991 values. One subtle, but important, change in the valuation questions between 1991 and 1996 is the state in which the recreation activity takes place. In 1996 respondents are asked about their activities in a single state. If respondents state that they would not take any trips in the state when faced with the higher cost they may still plan to take trips to substitutes states. In 1991, a "no" response indicates that the respondent would not take trips anywhere. This difference provides a plausible explanation for the finding that the probability of a "yes" response and willingness to pay is higher in 1991. There are other important methodological differences in survey administration and sampling also confounds these tests.

Furthur research could be conducted to test the temporal reliability of willingness to pay from the FHWAR surveys. Potential omitted variables such as changes in recreation demand and supply conditions (e.g., congestion, fish and wildlife stocks, habitat) could be incorporated in these models to determine if the decrease in value in 1996 can be explained. For example, an increase in congestion or a decrease in fish and wildlife stocks could feasibly lead to a decrease in willingness to pay.

Table 1. Variables and Descriptions

Variable	Description
YES	=1 if respondent is willing to pay $A, 0 otherwise
A	Increase in total cost of recreation trips (1996 dollars)
YEAR91	=1 if 1991 survey, 0 otherwise
CATCH	Total catch of fish
LENGTH	Average length of fish
DEER	Total bag of deer
BUCK	=1 if respondent bagged a buck, 0 otherwise
OTHERBG	=1 if respondent hunts other big game, 0 otherwise
PRIVATE	=1 if respondent takes nonconsumptive wildlife recreation trips to private land, 0 if takes trips to private and public land
PUBLIC	=1 if respondent takes nonconsumptive wildlife recreation trips to public land, 0 if takes trips to private and public land
PHOTO	=1 if respondent photographs wildlife, 0 otherwise
FISH	=1 if respondent takes recreational fishing trips
AGE	Age of respondent
GENDER	=1 if respondent is male, 0 otherwise
RACE	=1 if respondent is white, 0 otherwise
EDUC	Years of schooling
MARRIED	=1 if respondent is married, 0 otherwise
INCOME	=1 if household income is greater than $30,000, 0 otherwise

Table 2. Data Summary

	Bass Fishing				Trout Fishing			
	1991		1996		1991		1996	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
YES	0.51	0.50	0.39	0.49	0.49	0.50	0.37	0.48
A	481.17	318.16	481.73	155.36	495.40	312.19	495.18	304.24
CATCH	59.12	116.39	57.43	125.68	36.85	77.98	47.48	100.50
LENGTH	12.56	3.42	12.59	3.57	11.27	3.30	11.48	3.34
AGE	36.90	13.38	39.08	14.02	38.45	14.28	41.58	14.67
GENDER	0.83	0.37	0.85	0.36	0.82	0.38	0.80	0.40
RACE	0.95	0.23	0.94	0.24	0.94	0.23	0.93	0.26
EDUC	13.05	2.48	13.31	2.61	13.34	2.32	13.42	2.45
MARRIED	0.70	0.46	0.69	0.46	0.66	0.47	0.64	0.48
INCOME	0.56	0.50	0.50	0.50	0.61	0.49	0.50	0.50
Sample Size	2050		965		1904		1176	

	Deer Hunting				Wildlife Watching			
	1991		1996		1991		1996	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
YES	0.52	0.50	0.43	0.50	0.48	0.50	0.32	0.47
A	503.72	331.25	503.91	142.09	349.68	289.80	349.67	109.67
DEER	0.73	1.32	0.77	1.21				
BUCK	0.32	0.47	0.31	0.46				
OTHERBG	0.20	0.40	0.26	0.44				
PUBLIC					0.15	0.36	0.14	0.34
PRIVATE					0.82	0.38	0.83	0.38
PHOTO					0.32	0.46	0.34	0.47
FISH					0.20	0.40	0.15	0.36
AGE	37.44	13.50	39.44	13.77	38.61	13.87	41.57	14.13
GENDER	0.93	0.25	0.93	0.26	0.55	0.50	0.51	0.50
RACE	0.97	0.16	0.96	0.19	0.94	0.23	0.93	0.25
EDUC	12.66	2.35	12.93	2.51	13.52	2.53	13.99	2.58
MARRIED	0.71	0.45	0.70	0.46	0.70	0.46	0.65	0.48
INCOME	0.55	0.50	0.50	0.50	0.58	0.49	0.40	0.49
Sample Size	4851		1978		4590		2077	

Table 3. Empirical Results

	Dependent Variable = log(Willingness to Pay)							
	Bass Fishing		Trout Fishing		Deer Hunting		Wildlife Watching	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
Constant	5.20	11.76	3.30	7.94	5.17	18.93	2.82	7.47
YEAR91	0.38	3.19	0.61	5.76	0.22	3.32	0.54	6.12
CATCH	0.007	8.65	0.004	6.96				
LENGTH	0.01	0.76	0.09	5.67				
DEER					0.19	5.94		
BUCK					0.21	2.70		
OTHERBG					0.61	7.84		
PRIVATE							0.43	1.80
PUBLIC							0.45	1.99
PHOTO							0.14	1.80
FISH							0.35	3.70
AGE	-0.003	-0.61	0.01	3.21	-0.01	-3.62	0.01	3.38
GENDER	0.20	1.36	0.19	1.52	0.40	3.44	0.32	4.32
RACE	0.39	1.66	-0.06	-0.32	-0.07	-0.42	-0.10	-0.66
EDUC	-0.08	-3.67	0.02	0.78	0.02	1.25	0.03	2.13
MARRIED	-0.05	-0.38	0.06	0.52	0.21	3.04	0.19	2.38
INCOME	0.60	5.10	0.09	0.88	0.41	6.48	0.16	2.01
σ	2.16	14.54	1.94	14.84	1.79	23.52	2.24	22.41
χ^2(df)	482.17(11)		430.99(12)		1069.38(18)		820.31(18)	
Sample Size	3015		3080		6829		6667	

Note: Each model contains regional variables not shown.

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