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**TEMPORAL RELIABILITY IN CONTINGENT VALUATION
WITH A RESTRICTIVE RESEARCH BUDGET**

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WITH A RESTRICTIVE RESEARCH BUDGET

Paul M. Jakus, Becky Stephens, and J. Mark Fly

ABSTRACT

JEL Classification: Q26

TEMPORAL RELIABILITY IN CONTINGENT VALUATION

WITH A RESTRICTIVE RESEARCH BUDGET¹

Introduction

Information provided by contingent valuation (CV) surveys is becoming more commonly used as an input in the policy making process. Loomis (1999), for example, outlines the degree to which numerous federal and state agencies in the United States have used WTP estimates to formulate policy decisions and options. At the same time that demand for valid and reliable WTP estimates is growing, the criteria by which a CV survey can be evaluated as “good” have become very stringent. The NOAA Panel on Contingent Valuation (Arrow et al. 1993) set the bar very high, outlining a set of prescriptions they claimed were necessary to produce reliable and valid WTP estimates for *non-use* values to be used in natural resource damage litigation. These criteria make CV surveys very expensive, and also beg the question about “quality” criteria for CV surveys intended to estimate *use* values for environmental commodities whose services are well known to users. If valid and reliable WTP estimates can be done relatively inexpensively, this would allow trustees to make better informed policy and management decisions.

CV surveys have often been used to estimate use values for outdoor recreation activities such as hunting and fishing. Indeed, a seminal CV article focused on hunting permits and was sponsored by the Wisconsin fish and game agency (Bishop and Heberlein 1979). In recent years, state fish and game agencies have come under increasing pressure to incorporate “human dimensions” research into their management of wildlife and policy decisions affecting wildlife. Numerous state agencies now sponsor human dimensions research either within the agency itself

¹ We thank Kerry Smith for helpful comments on the initial draft of this manuscript. All errors, of course, remain with the authors.

(e.g., Oklahoma) or with university-affiliated research centers (e.g., Tennessee, Colorado, and New York). The purpose of most surveys is to monitor the activities and attitudes of hunters and anglers, and to evaluate proposed changes in species management (e.g., bag limits). However, oftentimes an agency may desire an estimate of WTP for a given management program. Whereas the agency may be willing and able to fund baseline human dimensions research, the allocated survey budget may not be adequate to fully implement and satisfy the criteria outlined by the NOAA Panel for WTP estimates to be used in litigation.¹

This paper reports on two survey efforts that labored under tight budget restrictions (“tight”, of course, by CV standards). The Tennessee Wildlife Resources Agency (TWRA) wished to have an estimate of hunters’ willingness to pay for a different form of access to lands owned by timber companies. Unfortunately, the agency could not increase the survey budget to allow for complete implementation of many recommended CV practices (focus groups, the use of visual aids, etc.). The budget constraint required survey design compromises that, *ex ante*, may or may not have been adequate to the task of providing valid and reliable WTP estimates.

The key research question of this paper is to determine the cumulative effect of these decisions on the quality of the WTP estimate, i.e., to what degree is confidence in the WTP estimate well-founded? Put another way, how far can one “push” the methodology? To answer this question, the temporal reliability of WTP estimates for access to Public Hunting Lands in Tennessee is evaluated. Data from two random digit dial surveys conducted at a four-year interval are used. After a brief review of the literature on temporal reliability, a discussion of the survey methodology focuses on the compromises made necessary by the survey budget. Results and implications for future research follow.

The WTP Function and Temporal Reliability

The WTP Function. A person's willingness to pay for a public good is dependent upon a variety of factors, and McConnell (1990) developed the variation function to show the functional relationship among those factors.² The compensating welfare measure associated with a change in the quantity of a public good is given by the difference in expenditure functions,

$$C_t = m(p_t, q_t^0, u_t^0) - m(p_t, q_t^1, u_t^0) \quad (1)$$

where C_t is the welfare measure as estimated at time t , $m(.)$ are the expenditure functions governing the income necessary to achieve utility u_t^0 at prices p_t given a change in public good level from q_t^0 (initial quantity) to q_t^1 (subsequent quantity). Substituting the indirect utility function $V(p_t, q_t^0, y_t)$ for the reference utility, McConnell denotes the difference on the right hand side of equation (1) as the variation function, $s(p_t, q_t^0, q_t^1, y_t)$, where y_t is income at time t . This function defines the compensation at time t needed to hold utility constant as we change the public good from q_t^0 to q_t^1 . In addition to prices, income and the public good q , $s(.)$ more generally will include other factors believed to influence willingness to pay such as demographics, D , so that $s(.) = s(p_t, q_t^0, q_t^1, y_t, D_t)$. Econometric estimation of the variation function yields parameters β that reflect the parameters of the originating preference structure.

Differences in WTP over time can be traced to the differences in the value of the variation function over time. Comparing time $t = 0$ to time $t = 1$, then,

$$\Delta WTP = s(p_0, q_0^0, q_0^1, y_0, D_0; \beta_0) - s(p_1, q_1^0, q_1^1, y_1, D_1; \beta_1) \quad (2)$$

Temporal differences in WTP can arise from changes in any of the arguments of the variation function across time, or changes in the parameters of the variation function over time. If preferences are stable ($\beta_0 = \beta_1$) but we observe changes in, say, prices or income, then WTP *should* differ over time and the left-hand side of (2) is non-zero. This is the essence of so-called

“test-retest” experiments in which the parameters of the WTP function are estimated using the same sample of people at two points in time. This approach allows one to capture all changes in the constraints under which people make choices (i.e., prices, income, other demographic factors, as well as changes in the availability of public goods) and focus on the stability of the preference parameters β . After controlling for changes in the explanatory factors, if one concludes that $\beta_0 \neq \beta_1$, the implications are (a) preferences have changed or, (b) contingent valuation is an unreliable methodology.

In the absence of test-retest samples, one must rely upon repeated cross-section samples to estimate relationships (1) and (2). This is more challenging in that the same people do not appear in each sample, so that one cannot fully control for possible changes in the explanatory variables. Whereas the test-re-test methodology give the analyst a better opportunity to “net out” the unobserved factors that may influence WTP but are not measured, the repeated cross-sectional approach does not permit this. For the sample collected at time $t = 1$, the analyst cannot “go back in time”, so to speak, to re-construct the set of prices, income, and the like that constrained consumption at time $t = 0$. Although the repeated sample approach is an incomplete strategy relative to the test-re-test approach, one may use a variety of statistical methods to test the hypothesis of preference stability, $\beta_0 = \beta_1$.

Temporal Reliability. Amongst the many recommendations made by the NOAA Panel was a recommendation that WTP estimates collected over a period of time be averaged in order to provide a stable estimate of WTP. As noted above, there are a number of reasons why WTP may change over time; for example, the true value of an environmental commodity may change as consumers gain more experience with the commodity or as they learn more about the services provided by an environmental commodity. Within the context of the Exxon Valdez oil spill, the

Panel was concerned about the timing of valuation surveys relative to the timing and publicity associated with the environmental damage incident, i.e., there might be a temporary increase in WTP in close temporal proximity to the event. This effect may fade with time as people learn more about the damage and have the chance to place it in perspective with consumption of other market and non-market goods. But concern about the reliability of CV WTP estimates over time did not originate with the NOAA Panel, and many researchers have investigated the temporal reliability of CV.

Loomis examined the temporal reliability of CV estimates in a pair of early studies (1989; 1990). Using a test-retest methodology in which the same respondents were sampled at a nine-month interval, he found that WTP to protect a hyper-saline lake were, in general, reliable over that time period. Reiling, et al. used two separate samples to estimate peoples' WTP for control of black flies (1990). Respondents interviewed during the peak of the black fly season were found to have the same WTP as respondents interviewed following the season. Since the publication of the NOAA Panel report, a small number of additional studies have examined the temporal reliability of CV (Teisel et al. 1995; Downing and Ozuna 1996; Carson et al. 1997; McConnell et al. 1998; Whitehead and Hoban 1999, and Berrens et al. 2000). The study by McConnell et al. uses the test-retest approach, while the remainder use repeated cross-section samples. (The study by Teisel et al. uses both methods, along with pre- and post-test control groups.) The time frame between measurements of WTP ranges from the very short—a few months in the McConnell et al. and Teisel et al. studies—to longer periods of time—one or two years in the Berrens et al., Downing and Ozuna, and Carson et al. studies. Only Whitehead and Hoban have let a “large” amount of time pass between WTP measurements. In their study of the WTP by a general population for cleaner air and water, the CV estimates of WTP were

significantly different over the five-year time period. However, after examining changes in environmental attitudes by the population, the authors conclude that the true WTP value had changed due to changes in explanatory variables. Any differences in WTP could be explained by the change in environmental attitudes by the population and the contingent valuation method had “correctly” measured the change in WTP.

Survey Design

Background and the Contingent Commodity. Concerns about the availability of land on which Tennessee sportsmen may hunt led the TWRA to enter into arrangements with a number of large timber companies to allow public hunting on timber company lands. These lands are called Public Hunting Areas (PHAs) and, at the time of the surveys, some 700,000 acres of timber company land was enrolled throughout the state. Timber companies were compensated for allowing access to PHAs by collecting a per acre payment from TWRA and also by collecting fees directly from hunters.³ Hunters who purchased a permit were given access only to PHA lands of the company from which they purchased the permit. The average permit cost was about \$20, allowing access to an average of 80,000 acres. Hunters were not granted access to lands held by another company unless an additional permit is purchased from that company. At the time of both surveys, approximately 12-15% of Tennessee’s hunters (about 40,000-50,000 hunters) used Public Hunting Areas during the course of the hunting season.

Beginning in the 1990s, timber companies informed TWRA that the administrative burden of collecting small fees from a large number of hunters was much greater than that of collecting a large fee from a single hunting group. Thus, companies had an incentive to move toward private leasing arrangements rather than allowing access to the general hunting public. Further, timber companies may have the perception that a single group would take greater care of

the land when that group holds an exclusive property right to hunt the land. These two forces caused TWRA officials to become concerned that public access to PHAs is threatened.

In response to these concerns, the agency considered an alternative method by which the administrative burden on timber companies could be lessened. Under a *single permit method*, TWRA would offer all hunters the opportunity to purchase a single permit that would allow the purchaser to gain access to all PHAs in the state. TWRA would be responsible for collecting the payments from hunters, and then distributing the proceeds to the timber companies. Receiving a lump sum from the TWRA relieves the companies of the need to collect small payments from a large number of hunters. The agency was interested in determining how much hunters were willing to pay for the single permit.

Key Survey Design Issues. The TWRA provided an adequate level of funding for analysis of most policy questions in the past, but this amount was not sufficient to fund a state-of-the-art CV study. Consequently some compromises were made. For example, the expense of conducting formal focus groups made their use impossible. Instead, CV questions were formulated using a combination of expert opinion (using TWRA personnel to help design the questions) and a series of pre-tests involving known hunters who were representative of the population. Second, the sample sizes for the various treatments in a CV study were small because the Random Digit Dial survey method (needed to achieve the primary goals of the survey) made it difficult to generate a large sample from the relatively small population of hunters in Tennessee (less than 10% of the adult population). To overcome small sample sizes, an estimation method that improves the statistical properties of the WTP estimate, the so-called double-bounded estimator, was used (Hanemann, Loomis, and Kanninen 1991; Alberini 1995).⁴ Finally, whereas telephone surveys provide a compromise between the expense of in-person surveys and cheaper mail surveys that

can be subject to serious non-response problems, the policy question in this case would seem to require a map of PHA locations, something that could not be done over the phone. For example, one might wish to assure that the respondent was well-informed about the location of PHAs and have a measure of the respondent's perceived proximity to Public Hunting Areas, but the survey budget precluded the use of multiple stage telephone-mail-telephone format. Instead, we were forced to rely upon a set of secondary measures to gauge knowledge of and proximity to PHAs. For example, hunters were asked if they had hunted a PHA in the past, and zip code information was used to determine if the hunter resided in or near a county in which a PHA was located.

Prior to asking hunters about the single permit system, some introductory text provided hunters with an overview of the PHA system as it was operated at the time of the surveys. It described the average permit price and the average size of a PHA, finishing with a statement that there were approximately 700,000 acres of land in state PHAs. This text was followed by the double-bounded CV question regarding the single PHA permit method.⁵

Response Rates. The analysis is based on two random digit dial surveys of the general population of Tennessee. The surveys were conducted in March and April of 1995 and 1999. For each survey, the RDD sampling frame began with 10,000 numbers. After removing ineligible numbers (businesses, disconnects, and fax machines), 7078 (1995) and 8529 (1999) eligible numbers remained. All phone numbers were attempted at least 5 times prior being placed in the "no contact" category. Excluding the no contact group yielded a response rate of 45.8% and 33.1% for 1995 and 1999, respectively. This study is concerned only with active hunters, of whom 255 were contacted in 1995 and 213 were contacted in 1999. Mean values for key variables from the two surveys are presented in Table 1.

Contingency Analysis

Contingency analysis was conducted using the raw survey response data without covariates (Table 2). The second and third columns of table 2 give the percentage of respondents who said they would be willing to purchase a single PHA permit at the stated price, for 1995 and 1999, respectively. The P-value reported in the fourth column is for the Pearson chi-square test that the proportions in 1995 and 1999 were identical. The P-value in the fifth column reports the Pearson chi-square test that the distributions of the four possible response combinations for any initial value (Yes-Yes, Yes-No, No-Yes, and No-No) were identical across the two years. In only one case—the \$20 value for the initial question—were the responses significantly different across the two years. This suggests that the implied CV values were temporally reliable across the two years.

Double-Bounded Responses, Using Covariates

Analysis of the double-bounded CV responses follows the restricted bivariate probit model (Alberini 1995). This model assumes that the underlying “true” WTP remains constant across the two questions, but allows the error correlation to differ from one (a restriction of the Hanemann, Loomis, and Kanninen approach). Models were estimated for the 1995 data only, the 1999 data only, and the combined dataset. The permit prices for 1999 were adjusted for inflation by the relative change in the consumer price index between March 1995 and March 1999 so that all models are based on 1995 prices.

Hunters’ willingness to pay for access to PHAs was hypothesized to be a function of a number of variables. In addition to the permit cost (*Price*) whose sign should be negative, whether or not the respondent hunted in PHAs was likely to influence WTP (*Hunt in PHA*). Although congestion effects may be present, one would anticipate that those who had already

paid for a PHA permit would be willing to pay more for access to a much larger acreage (presuming that the additional acreage is relatively proximate to the hunter's residence). Thus, a positive sign on this variable was expected. Hunters who reported experiencing problems gaining access to hunting lands were hypothesized to be more likely to support the single permit program because the proposed program increased the acreage available to hunters (*Access is a Problem*).

Finally, two additional factors were believed to condition hunters' responses to the program. All else equal, proximity to a PHA may influence WTP, although it is not clear that proximity to one PHA necessarily would make one WTP more for the expanded program (*Live Near PHA*). Hunter's willingness to pay for access to PHAs may be related to measures of a hunter's experience such as the number of years they had been hunting (*Years Hunted*), or the number of days hunted during the season (*Days Hunted*). It was not clear, a priori, what sign to anticipate on these variables, because those who have hunted for a long period of time, or very frequently during the season, may have better knowledge of alternative lands to hunt.

Parameter Estimates. Models were estimated for each individual year (columns two and three of Table 3) and for both years combined (columns four and five). All models reported in Table 3 hunters were responsive to the *Price* of the single permit. The two variables measuring the number of *Days Hunted* in the previous season were significant in all base models as well. The number of *Days Hunted* showed a quadratic relationship to the probability that a person would support the single permit system, all else equal. This suggests that those who hunt only a few days each season and those who hunt very often were less likely to support the single permit system than those who hunt a moderate number of days each year.

Whether or not a person lived in a metropolitan statistical area (*Live in MSA*) was significant in three of the four models. The log of number of years that a respondent had hunted (*ln Years Hunted*) was negatively related to the probability of support for the single permit system, but this was true in only the two models using the dataset that combined both years of data. It is possible that the larger sample size, relative to the models for each individual year, resulted in efficiency gains sufficient to make this variable statistically significant. None of the remaining variables were significant at conventional statistical levels. Finally, all specifications were also estimated using income as an explanatory variable—in no case was income statistically significant.

Temporal Reliability. Reliability is assessed by conducting likelihood ratio and Wald tests of the hypothesis that the parameters of the WTP function are identical across the two different years. The likelihood ratio test took the form $Q = -2 \times (\ln L_{\text{combined}} - (\ln L_{1995} + \ln L_{1999}))$, where Q is distributed chi-square, and the $\ln L$ are the values of the log likelihood function for the combined, 1995, and 1999 datasets, respectively. The Wald test is a bit different, looking at the difference between the two estimated parameter vectors and the relative precision of the estimates by using the estimated variance covariance matrices,

$$Q = (\beta_{95} - \beta_{99})' (\mathbf{VC}_{95} + \mathbf{VC}_{99}) (\beta_{95} - \beta_{99})$$

where the β and $\mathbf{VC}$ are the estimated parameter vectors and variance-covariance matrices for the 1995 and 1999 models, and Q is distributed chi-square. In addition to the likelihood ratio and Wald tests, the “Both Years Model #2” used a dummy variable to test for changes in the intercept between the two different years.

The combined model presented in column three of Table 3 restricted the coefficients of each variable to be identical across the two years. The likelihood ratio test of the null hypothesis

of parameter stability across the two years is not rejected ($Q=6.32$ with nine degrees of freedom). Similarly, the Wald test of differences in the coefficient vector also failed to reject the null hypothesis of $\beta_{95} = \beta_{99}$, with the test statistic value $Q=6.73$. This suggests temporal reliability of the parameters of the WTP function.

One may also compare the actual estimates of WTP across the two time periods. Changes in WTP over time can occur given changes in the parameters of the WTP function or changes in the arguments of the function. With $WTP = \beta X$, then $dWTP = (d\beta \times X) + (\beta \times dX)$. Given the finding above that $d\beta=0$, this is equivalent to testing whether the explanatory factors, both observed and unobserved, have changed sufficiently across the time periods to influence WTP. The WTP estimates for the 1995 and 1999 models are reported at the bottom of Table 3. The point estimates for each year appear to be different (\$12.92 and \$29.06 for 1995 and 1999, respectively), but the 95% confidence intervals for these estimates are relatively wide, especially for 1995. Given that each estimate is a random variable, one may use the method of convolutions to test the null hypothesis that $WTP_{95} - WTP_{99}=0$ (Poe et al., forthcoming). The convolutions test fails to reject the null hypothesis at conventional significance levels, with the two-sided P-value of 0.32.

Finally, an additional test of temporal reliability is to add a dummy variable that identifies the different years and allows a shift in the intercept or allows the slopes for each coefficient to differ across the years. The “intercept shift” model is presented in the column four of Table 3. The dummy variable $YEAR=1995$ was statistically insignificant, indicating that the two years do not differ with a simple change in intercept. An additional specification, not reported in Table 3, interacted a dummy variable for 1995 with every explanatory variable. None of the interaction terms was statistically significant, indicating temporal reliability of the estimating equation.

Conclusions

This paper examined the temporal reliability of WTP estimates generated by a restrictive research budget. A number of compromises were made in the design and implementation phases of the study. Specifically, the survey budget precluded the use of focus groups, it prevented the use of visual aids to communicate the location and size of PHAs relative to the hunter residence, and only relatively small samples of hunters could be gleaned from the random digit dial survey method. Still, it was decided to carry through with the experiment because (1) the contingent commodity was well-known to hunters and had a long established payment mechanism, (2) the WTP estimate would reflect only use values, and (3) estimates were needed for policy decisions.

The compromises in survey design and implementation appear to have had little impact on the temporal reliability of WTP estimates. In no case could one reject the null hypothesis that the parameter estimates were the same across both years in which the contingent valuation exercise was conducted, nor could one reject the null hypothesis that the WTP estimates were the same across both years. Some authors, however, have suggested that temporal reliability is a necessary condition for a quality CV WTP estimate, but is not sufficient to assure that the WTP estimate is valid (Desvousges et al. 1996).

Indeed, in reporting the results of these models to the sponsoring agency, a key concern was theoretical validity. The empirical results satisfied important economic criteria: namely, a negative price effect and zero income effects associated with the relatively small permit price. Where the validity of the models came into question was with respect to our “external” knowledge of the sample (Carson et al. 2001). A reasonable assumption was to expect WTP by those people who had hunted on PHAs to have a greater WTP than those who had not. A dummy variable capturing this effect was insignificant in all specifications. Further, the WTP

point estimates from a split sample test (PHA hunters versus those who did not hunt PHAs) did not allow one to conclude that a statistically significant difference was present. The results suggest that the contingent valuation methodology was pressed to its absolute limit in this study, with serious concerns about how well respondents understood the contingent commodity being offered.

Given these shortcomings, did the study still provide information to policy makers? The short answer is “yes”. Following discussions with agency personnel, a key conclusion of the modeling effort was that the expanded acreage provided by a single permit system would be unlikely attract additional hunters to PHAs, at least at permit costs that would fund program administration (roughly \$30 or more). The effort to design a single permit system was no longer seriously pursued. As a final postscript, the TWRA was never able to implement a fee collection system to allow access to all PHAs. In the 2000-2001 hunting season, a major timber company removed over 200,000 acres from the Public Hunting Area program, preferring to lease to a limited number of individuals or hunting clubs. Even more land was removed from the program over the next several seasons, such that by 2004 only 63,000 acres remained in Public Hunting Areas, less than 10% of the 1999 acreage (TWRA 2004).

Table 1: Mean Values for Key Variables

Variable	1995	1999
Live in metropolitan statistical area (% yes)	43.5%	39.0%
Hunted in public hunting area last season (% yes)	17.3%	15.5%
Live near a public hunting area (% yes)	50.2%	49.3%
Access to good hunting land is a Problem (% yes)	31.0%	35.7%
Years hunted (years)	21.4	25.7
Days hunted last season (days)	25.8	26.6
Observations	255	213

Table 2: Contingency Analysis for Responses to CV Questions

Initial value	First CV question only			Both CV questions
	% yes to the first question 1995	% yes to the first question 1999	P-value for difference	P-value for difference
\$20	45.2	76.5	0.01*	0.16
\$25	60.0	56.3	0.76	0.43
\$35	56.4	50.0	0.56	0.92
\$50	37.8	52.8	0.20	0.39
\$75	27.3	23.5	0.77	0.86
\$100	30.6	35.5	0.67	0.97

Table 3. Single Permit System: Double-Bounded Models

Variable	1995 only	1999 only	Both years model #1	Both years model #2
<i>Intercept</i>	0.130 (0.45) ^a	0.089 (0.27)	0.077 (0.36)	0.084 (0.38)
<i>Price</i>	-0.007 (-2.97)	-0.014 (-3.99)	-0.009 (-4.99)	-0.009 (-4.79)
<i>Hunt in PHA</i>	0.329 (1.58)	-0.061 (-0.25)	0.176 (1.16)	0.177 (1.17)
<i>Live Near PHA</i>	-0.083 (-0.48)	0.166 (0.87)	0.016 (0.13)	0.016 (0.13)
<i>Access is a Problem</i>	0.192 (1.24)	0.127 (0.70)	0.161 (1.38)	0.161 (1.37)
<i>Live in MSA</i>	0.092 (0.53)	0.412 (2.32)	0.220 (1.82)	0.221 (1.82)
<i>Ln (Years Hunted)</i>	-0.123 (-1.55)	-0.120 (-1.23)	-0.113 (-1.85)	-0.113 (-1.85)
<i>Days Hunted</i>	0.012 (1.93)	0.021 (2.95)	0.016 (3.38)	0.016 (3.37)
<i>Days Hunted Squared</i>	-8.9 × 10⁻⁵ (-1.68)	-1.2 × 10⁻⁴ (-2.15)	-1.0 × 10⁻⁴ (-2.61)	-1.0 × 10⁻⁴ (-2.60)
<i>Year = 1995</i>				-0.017 (-0.15)
<i>Rho</i>	0.318 (1.99)	0.517 (3.11)	0.400 (3.56)	0.397 (3.48)
Ln L	-260.96	-209.48	-473.90	-473.89
Observations	204	165	369	369
WTP	\$12.92	\$29.06	\$22.32	\$22.12
95% CI	-\$20.76 - \$46.59 ^b	\$15.17 - \$42.94	\$6.53 - \$38.11	\$6.00 - \$38.24

Coefficients in boldface are significant at $\alpha=0.10$.

^a Number in parentheses is ratio of the coefficient to its asymptotic standard error.

^b Confidence interval calculated using the delta method.

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Appendix: Text of Contingent Valuation Questions

Introductory Text

Several different timber companies own lands that are currently designated as Public Hunting Areas. To gain access to these areas, a hunter must purchase a separate permit for each area, at approximately \$20 per permit. A hunter must purchase the permit in order to hunt on only one Public Hunting Area, which average about 80,000 acres each.

An alternative plan would use a single permit to gain access to all Public Hunting Areas in Tennessee - about 700,000 acres total. Only those hunters purchasing the permit would be able to hunt in Public Hunting Areas. If you were offered the opportunity to purchase a single permit for {\$20 \$25 \$35 \$50 \$75 \$100} would you do so?

- 1 Yes
- 0 No
- 98 Don't Know

(IF YES) It is possible that management expenses may be higher than expected, so the permit price may be higher. Would you be willing to pay {\$40 \$50 \$70 \$100 \$150 \$200} for the permit?

- 1 Yes
- 0 No
- 98 Don't Know

(IF NO) It is possible that management expenses may be lower than expected, so the permit price may be lower. Would you be willing to pay {\$10 \$12.50 \$17.50 \$25 \$37.50 \$50} for the permit?

- 1 Yes
- 0 No
- 98 Don't Know

(IF YES) People may say "yes" for a variety of reasons. Why did you say "yes"? **(DNT RD)**

- 1 Better quality hunting areas
- 2 Greater area to hunt
- 3 PHA are less crowded
- 98 Don't Know
- 97 Other **(SPF)**: _____

(IF NO) People may say "no" for a variety of reasons. Why did you say "no"? (DNT RD)

- 1 Too expensive
- 2 Not worth it
- 3 No PHA near me
- 4 PHA have poor quality hunting
- 5 Would rather hunt elsewhere/don't hunt PHA's
- 6 Don't believe this would work
- 7 Don't want to pay additional money for this
- 98 Don't Know
- 97 Other (SPF): _____

ENDNOTES

¹ Harrison and Lesley (1996) make the distinction between "...gold-plated 'litigation quality' surveys on the one hand and homely 'research quality' surveys on the other hand."

² Hanemann (1999) develops an income compensation function that is closely related to McConnell's variation function.

³ TWRA remains responsible for enforcement of hunting regulations on PHAs.

⁴ Relative to a single-bound estimator, the double-bounded estimator provides a minimum mean squared error.

⁵ The text for the contingent valuation question is in Appendix A. In the survey, a second CV question was also asked about license fee increases. The order of the two CV questions was randomized, with some hunters getting the single permit question first, and the remaining hunters getting the license fee question first. Analysis indicated that the order of the question was not a statistically significant factor in peoples' responses.