Tinkering with Valuation Estimates: Is There a Future for Willingness to Accept Measures?[©]

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The contingent valuation method (CVM), conceived in the 1940s and brought into wide use in the 1970s and 1980s, has been used by economists to value a wide variety of non-market goods and services, especially those with public good and non-use characteristics. Carson (2002) notes that over 5,000 contingent valuation studies have been performed. These studies have employed either willingness to pay (WTP) or willingness to accept (WTA) measures (in some cases, both) to elicit valuation measures.

The choice of WTP or WTA (and the compensating and equivalent variation measures which underlie them) is indicative of the implied property rights scheme for the good in question; for example, if a respondent has to pay to avoid pollution damages, the implication is that he or she does not have the right to the "cleaner" scenario, and must pay to retain it. However, while one measure may be preferred to the other in a given situation due to the "correct" specification of property rights, empirical estimates of WTA and WTP have tended to differ considerably. This begs the question as to which yields the "truer" valuation estimates.

In this paper, we derive both WTP and WTA contingent value estimates for a public good, visibility in the Great Gulf Wilderness in New Hampshire. Our estimates were obtained from a mail survey of a random sample of 1,000 residents of New Hampshire, Vermont, and Maine and on- and off-site personal surveys in New Hampshire and Massachusetts.   Visibility at the study area, which is about one quarter mile northeast of the Mt. Washington summit, is commonly impaired by regional haze that is largely a product of fossil fuel energy production. We review the WTP/WTA debate in the next section, followed by a description of the surveys and the data.   The final section discusses the outcomes of these experiments and speculates on

when, if ever, WTA measures should be used in CVM studies.

Background

As Adamowicz, Bhardwaj, and Macnab (1993) note, WTP and WTA for the same good can (and generally are) vastly different. Others have noted that the WTA measure is subject to a much higher degree of inaccuracy as compared to WTP measures (see e.g. Goldar and Misra, 2001; Coursey, Hovis, and Schulze, 1987; Brookshire and Coursey, 1987; Bishop and Heberlein, 1990). A recent review of 45 studies which contrasted WTA and WTP by Horowitz and McConnell (2000) found that WTA was often an order of magnitude or more greater than WTP. One study found that WTA was nearly 3,000 times WTP; on average (dropping this outlier), the ratio WTA/WTP was about seven. Due to the volatility of these estimates, WTP has generally been the method of choice in CVM studies; for these and other reasons, the NOAA panel (Arrow et al. 1993) reviewing CVM strongly recommended against the use of the WTA measure.

Why the disparity between the measures? Strict theory based on compensating and equivalent variation measures notes that the income effect will cause some difference, though this should be minimal (see Willig's seminal 1976 paper). Hanemann (1991: 635) has theorized that a lack of substitutes for the good in question can lead to disparities between measures, noting that "the difference between WTP and WTA depends not only on an income effect but also on a substitution effect." Empirical support for this position has been mixed (see e.g. Adamowicz, Bhardwaj, and Macnab, 1993; Shogren et al. 1994; Mantymaa, 1996).

A second suspected source of the difference is survey construction, interviewing technique, and other issues related to data collection (e.g. Brookshire et al. 1982; Dwyer and Bowes, 1978). However, the empirical evidence does not strongly support this reasoning (Horowitz and McConnell, 2000).

Goldar and Misra (2001) attribute much of the disparity to the familiar hypothetical bias problem, and propose methods for reducing this bias. Kahneman and Tversky (1979) and others note that individuals may value gains and losses differently. In this case, respondent behavior is logical given loss aversion.

Zhao and Kling (2001) expand on the notion of uncertainty's role in the difference. In essence, they argue that respondents forced to make a decision on the spot demand compensation for this loss of quasi-option value (Arrow and Fisher, 1974) in the case of WTA, and produce WTP bids less than their expected value of the good so as to insure not "overpaying." Thus, in this framework, WTA bids are inflated by risk aversion while WTP bids are deflated, thus increasing the WTA/WTP ratio. Zhao and Kling provide some mixed evidence of this effect examining past studies, although empirical work is still needed. If their hypothesis is true, efforts to collapse the WTA/WTP ratio would need to explicitly remove risk averting behavior from the experiment. In addition, if the difference in ratios is indeed related to risk managing behavior, acceptance of Zhao and Kling's reasoning may preclude a Goldar-Misra explanation, and vice versa.

Finally, Horowitz and McConnell (2000) provide evidence that the WTA/WTP ratio increases or decreases depending on the type of good valued, as well as the respondent's familiarity with the good. Specifically, "non-ordinary" goods have significantly higher ratios than ordinary (private) goods. Thus, one would expect a good such as police protection to have a lower ratio than biodiversity.

Willingness to Accept: Why Ask?

List and Shogren (2002: 219-220) note that "the recent hypothetical valuation literature has been driven by compensatory natural resource damage assessment, which is closely tied to

WTA measures of value." However, given the problems with WTA, many researchers have chosen to use the seemingly more reasonable WTP estimates. However, there are at least three reasons why a WTA format might be preferred. First, from a theoretical perspective, property rights to a clean environment are often assumed to belong to the public, and consequently environmental losses should be evaluated using a WTA measure (Harper, 2000). If as suggested by Kahneman et al. (1990), individuals value losses more highly than gains, willingness to pay estimates could severely understate value. Second, given certain goods, WTA may be a more realistic scenario; for example, with deregulation of electricity generation, acceptance of an increase in air pollution in exchange for cheaper electricity. Finally, as Horowitz and McConnell (2000: 4, citing Knetsch [1990]) point out, "one of the most economically consequential decisions will be the *initial* (authors' emphasis) establishment of property rights, especially for environmental and other public amenities for which property rights are unclear." Thus, the choice of WTA vs. WTP has major ramifications both from an empirical standpoint and from a property rights regime.

Study Background and Previous Visibility Studies

Deregulation of electricity markets, in spite of the events of recent years in California, has been moving forward on the policy agenda. As Burtraw, Krupnick, and Palmer (1996) note, the "natural monopoly" status of this utility is being eroded by technological changes. As they state:

> Because new, cleaner plants are not expected to dominate the industry for some time,
> there is concern about increased use of existing facilities....most often by states in the
> Northeast, who fear that more open access to electricity transmissions will increase coal-
> fired generation in the midwest.

Moves toward deregulation are also fueled by the notion that the current system does not serve to keep prices low enough (Ando and Palmer, 1998). Not surprisingly the states which have

some of the highest electricity costs in the country are those which are moving toward

deregulation, including New Hampshire. Simulations by Palmer and Burtraw (1996) confirm

that increased power generation in the Midwest and MidAtlantic states will contribute to

increased loading of certain pollutants over the northeast. These results are consistent with

prevailing weather patterns which tend to sweep pollutants toward and over New England

(NERA, 2001) , leading to the region's dubious moniker of "the tailpipe of the United States."

With these increased emissions will come decreased visibility, the subject matter for this study.

Most previous studies of the value of visibility in wilderness (or remote) areas have used

the contingent valuation method (CVM). One of the first studies was conducted by Rowe, et al.

(1980) who found that non-residents were willing to pay about $4 per day to preserve visual

range in southwestern Colorado. Schulze et. al. (1983) reported that residents of Los Angeles,

Denver, Albuquerque and Chicago were willing to pay $3.75 to $5.14 per month to preserve

visibility in the Grand Canyon. Crocker and Shogren (1991) estimated that residents were

willing to pay about $3.00 per day to preserve visibility in the Cascades of Washington State.

And, Chestnut and Rowe (1990) found that respondents were willing to pay $4.35 per month to

avoid a change in average levels of visibility in the Grand Canyon, Yosemite and Shenandoah

National Parks.[1]

With respect to wilderness areas in the northeast, the Appalachian Mountain Club (AMC)

administered a survey in the summer of 1996 to ascertain visitor's perceptions of visibility in the

White Mountain National Forest. This survey was administered to individuals at three sites: The

Pinkham Notch visitors' center at the base of Mt. Washington, the Cardigan lodge at the base of

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[1]Many of these studies were modeled after research and ideas developed or presented at a
1982 conference on visual values (Rowe and Chestnut, 1983).

Mt. Cardigan and the Mt Washington Observatory (at the top of Mt. Washington). This survey

asked respondents to rate photographs of Mt. Jefferson, a mountain in the Class 1 Presidential

Dry River airshed, at various visibility conditions. Each photograph was correlated with a

measurement of optical extinction measured by a nephelometer at the site where the photograph

was taken. Results of this survey show that individuals were able to consistently perceive

different levels of visibility. That is, respondents were clearly able to differentiate between

improvements and degradations to visibility (Hill, 2000).

The Model

The visibility study which provided the data for this paper was subject to considerable

analyses to examine relationships, test hypotheses, and examine functional forms (Harper, 2000;

Stevens et al. 2000; Porras, 1999). Based on these previous uses of the data, a parsimonious

form of the model to be tested was developed:

Pr(bid acceptance) = Pr(WTP>Bid) or Pr(WTA<Offer)

where   WTA/WTP = F(INCOME, FVISIT, BID, VISLOSS)

It is common to assume a linear function:

$$WTA/WTP = \alpha + \beta_1 \text{ INCOME} + \beta_2 \text{ FVISIT} + \beta_3 \text{ BID} + \beta_4 \text{ VISIBILITY} + \varepsilon$$

where variable descriptions are provided in Table 1. This basic formulation was the same for

both the WTP and the WTA models. It was expected that the BID and VISIBILITY[2] variables

would have opposite signs across the two models. For example, the BID variable was expected

to have a positive effect on the WTA model and a negative effect on the WTP model. Both log

and semi-log forms were examined in the current analysis.

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[2]It is worth noting that the changes in visibility from status quo depicted were quite large, so that care should be taken in interpretation of this variable.

Survey Design and Data Collection

A case study of visibility in the Great Gulf Wilderness in New Hampshire was undertaken during the winter, spring and summer, 1999, and during summer of 2000. Visibility at the study area, which is about one quarter mile northeast of the Mt. Washington summit, is commonly impaired by regional haze that is largely a product of fossil fuel energy production (Hill, et al., 2000).

Four surveys were used to measure the value of visibility in the Great Gulf Wilderness region. The first survey (WTA) was administered *onsite* by a trained interviewer who used a personal computer (laptop) to present respondents with computer modeled images derived from the WinHaze Visual Air Quality Program. This program allowed us to hold weather conditions constant (cloud cover) while changing visibility only. The second survey was identical in all respects except that it was administered *offsite* to individuals residing in the Northampton/ Amherst area in Western Massachusetts (about a 3 to 4 hour drive from the study site). The third survey (WTA) was conducted by mail and involved a random sample of 500 New England residents. The fourth survey (WTP) was conducted by mail of a random sample of 500 residents of New Hampshire, Vermont, and Maine.

The first section of the surveys asked respondents to rate several pictures according to the amount of haze in each. Each picture was a view taken from Camp Dodge, directly across from the Great Gulf Wilderness that had been altered by WinHaze to simulate different levels of atmospheric pollution, all else held constant (cloud cover, etc). Respondents to the personal survey were asked to rate 15 pictures while mail survey respondents rated 4 pictures.

The CVM question was then presented. Following an introductory statement about electricity deregulation and air quality in the White Mountains (see appendix), each respondent

viewed two pictures in this section: picture A represented the status quo visibility and electric bill while picture B represented reduced visibility and a lower electric bill. The CVM questions were asked as follows:

1. WTA: *Would you be willing to accept this new level of visibility (indicated by picture B) in the White Mountain National Forest if your monthly electric bill were reduced by $x?*

2. WTP: *Would you be willing to pay $x per month <u>more</u> for electricity to avoid this new level of visibility (indicated by picture B) in the White Mountain National Forest?*

In all cases, picture A, which represented the base scenario, or status quo, described the average visibility level at the site during the summer months. Picture B represented one of four visual range reductions. The electric bill reduction was 20 percent of the respondent's total monthly bill in the personal survey and one of 1/4th, 1/3rd, or ½ of the monthly bill for the first mail survey respondents,[3] while respondents to the second mail survey were confronted with bids ranging from $10 to $50 per month (these values were chosen based on the initial year surveys).

A series of follow up questions were asked to obtain information about each respondent's socio-economic characteristics, motives involved in answering the valuation question, and plans, if any, to visit the wilderness area in the future.

Double wave mailings with postcard follow ups were used in each mail survey. Response rates were approximately 36 percent for the WTA survey and 39 percent for the WTP survey.

The WTA and WTP CVM questions followed an introductory statement about electricity deregulation and air quality in the White Mountains. Each respondent viewed two pictures: picture A represented the status quo visibility and electric bill while picture B represented reduced visibility. In all cases, picture A, which represented the base scenario, or

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[3] Twenty percent is the average savings expected from deregulation.

status quo, described the average visibility level at the site during the summer months.

Results

WTP. Results from the analysis of the WTP survey data were consistent with prior expectations. Higher income and larger improvements in visibility increased the probability that the respondent would accept the bid offered, while higher bids in turn lowered this probability. Thirty three percent of respondents in the sample accepted the offered bid. The model correctly predicted 70.3 percent of responses.

In a linear model, estimated mean and median will be the same since both logistic and normal distributions are symmetrical. The general formula to compute the mean WTP/WTA estimate (and the median for the log-linear model) is $\beta'X/\gamma$. Estimates of the median economic value of visibility derived from the semi-log WTP logit models were calculated by the following formula:

$$\textbf{Pr(Accept)} = 1/(1 + e^{-(\alpha + \beta \textbf{ Ln Compensation})})$$

where α and β are estimated parameters.

WTA. Results from the WTA survey analysis are also shown in Table 2. Relatively few respondents were willing to make a tradeoff between electricity bills and reduced visibility (20.1 percent). The model correctly predicted 80.6 percent of responses. The probability of future visits (FVISIT) and the amount of visibility loss (VISLOSS) both reduced the probability of a "yes" response. A surprising result was that the amount of compensation offered did <u>not</u> have a statistically significant effect on respondents. This seemingly counterintuitive result will be discussed later.

That relatively few respondents were willing to accept a tradeoff between visibility and

electricity cost is not surprising. In this study average electricity bill reductions were only about $18 per month. However, it is important to stress that the scenarios presented are thought to be very realistic given projected conditions for electricity deregulation in New England (Harper, 2000).

Comparison and Discussion of WTA and WTP Results

That WTA and WTP would vary widely is no surprise, given past empirical studies. Table 3 illustrates that this finding was also the case in the current study. As noted, the ratio of WTA/WTP ranged from about 12 to 13. Different calculations were performed; WTP1 and WTA1 are derived using the mean variable values from the individual data sets, while WTP2 and WTA2 combine the data sets and use the joint sample means.[4]

The means ratio of 12-13 is within the range of previous studies, as found by McConnell and Horowitz (2000). The value of WTP1 of $11.06/month is comparable to previous studies of visibility valuation. What is more troubling is the problem in calculating median WTA. While median WTP of $11.07/month is quite similar to mean WTP, we were basically unable to calculate median WTA (in fact, the estimate "exploded," giving implausible estimates in the range of several million dollars). This was likely due to the inability of the BID variable to explain much of the variability in the WTA model, as the coefficient was statistically not significant. In effect, this means that the variance of the coefficient of the BID variable in the WTA model was quite high (relative to the coefficient size). It also brings into question the whether the means ratio WTA/WTP can be interpreted with any degree of confidence. The

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[4]Log results were essentially identical to linear results in terms of statistical significance of coefficients. As with the linear model, the coefficient of the BID variable was not statistically significant.

question begs, then, why would the amount of compensation offered to respondents have no influence on their decision to trade visibility for lower electric bills?

We propose three possible reasons, one an artifact of the survey design, two grounded in economic theory. First, it may simply be the case that the compensation levels offered in the survey were simply not high enough to move respondents to accept the program. The bids were of necessity bounded by the respondent's electric bill, and the percentage reductions in the bids were based on estimates of bill reductions due to deregulation. In effect, the study may have suffered from being "too realistic"; yet, as a tool to analyze the policy of deregulation, this realism in vehicle design is necessary. In this case, the results are far more interesting from a policy perspective than from a methodological perspective. As more states move toward deregulation, considerations of full costs of the policy will need to incorporate realistic features in terms of payment vehicles, reasonable reimbursement levels, and appropriate information on possible changes in air quality/visibility.

A second reason for the behavior of the BID variable coefficient is the uncertainty hypothesis advanced by Zhao and Kling. In this case, one would expect WTP to be an underestimate of "true" values while WTA would be an overestimate. This relates to the uncertainty of the respondent's value of the good in question or, by extension in this case, the probability that the policy/contribution would have the desired effect on air quality/visibility.

The third and final reason relates to the Hanemann hypothesis regarding goods with no good substitutes. In effect, this would be interpreted such that there would be no substitutes for visibility/air quality, and so respondents simply would not make the trade for money. Analysis of comments on survey forms indicated that, while we tried to focus attention strictly on visibility in

the immediate region, it was clear that respondents were valuing broader commodities such as health effects of air quality degradation.

In the first case, it is possible that a survey instrument could be designed which would allow a high enough "ceiling" to stabilize the BID coefficient. In the latter two cases, the model is not the problem; in fact, there is no "problem." Most respondents (80 percent) are simply not willing to part with a good which they "own", visibility/air quality. This position can be justified on theoretical grounds. The fact that the size of BID <u>does</u> influence WTP estimates is not at all contradictory in this case. Since property rights have been reassigned in the WTP scenario, respondents are left with no choice but to buy back the good. This also may partly explain that while bid offers were comparable across the two groups, the percentage of yes respondents in the WTP survey was substantially higher than that in the WTA survey (33 vs. 20 percent). It is entirely possible that the difference between WTA and WTP, rather than being an anomaly or an artifact of hypothetical bias, is consistent with theoretical models of consumer behavior, and certainly merits further examination. In the final analysis, trying to "deflate" WTA estimates to make them more "reasonable" may actually turn out to be data manipulation which contradicts theoretical expectations!

Table 1. Logit Model WTP/WTA Specifications: Socioeconomic Characteristics of Respondents (Sample Means).

Variable	Definition	WTP Model Mean (Std. Dev.)	WTA Model Mean (Std. Dev.)	Combined WTA/WTP Data Sets Mean (Std. Dev.)
Dependent	Yes to CVM	0.33139 (0.47209)	0.20161 (0.40202)	0.25476 (0.43625)
BID .	$ payment/compensation per month	29.82558 (14.28506)	17.28454 (19.64551)	22.42040 (18.67936)
VISLOSS	decrease in visual range (kilometers)	131.28605 (10.18201)	128.92540 (6.82247)	129.89214 (8.43209)
INCOME	$000	54.07070 (28.64586)	40.49194 (33.44982)	46.05276 (32.23616)
FVISIT	1 if planning future visit, 0 otherwise	0.66279 (0.47414)	0.71774 (0.45101)	0.69524 (0.46086)

Table 2. Results of Logit Models: WTP to Avoid Visibility Loss and WTA Compensation for Loss of Visibility

Variable	Model 1: Dependent Variable = WTP Coefficient (Standard Error)	Model 2: Dependent Variable = WTA Coefficient (Standard Error)
Constant	-7.38847*** (2.50592)	9.84487*** (3.61821)
INCOME	0.02213*** (0.00682)	0.00724 (0.00493)
FVISIT	0.34000 (0.40970)	-1.24826 (0.34831)
BID	-0.04604*** (0.1347)	-0.00988 (0.01135)
VISLOSS	0.04933** (0.01872)	-0.08221** (0.02808)
N	172	248
Chi-Squared	33.04469 (4 d.f.)	23.87060 (4 d.f.)
% of Correct Predictions	70.3	80.6

*** significant at .01 level
** significant at .05 level
* significant at .10 level

Table 3. Comparison of Mean WTP and Mean WTA Measures, Valuation of Degraded Visibility.

Mean WTP1[a]	Mean WTA1[b]	Mean WTP2[c]	Mean WTA2[c]
$11.06	$140.56	$24.29	$283.97

Ratio[e]: 12.7   **Ratio[e:]** 11.7

[a] Estimated mean WTP for 131 km of visibility, mean income, and fvisit of WTP data.

[b] Estimated mean WTA for 129 km of visibility, mean income, and fvisit of WTA data.
[c] Estimated mean WTP for 147 km of visibility, mean income, and fvisit of WTP/WTA combined data)
[d] Median WTA estimates could not be calculated, as described in text.
[e] Ratio of (Mean WTA)/(Mean WTP)

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Appendix
Sample WTP Question

Section 2. For the next question, consider the following: Currently, many states are debating the issue of deregulation of the electric utility industry. If deregulation occurs in your state, you may be able to choose your own power provider. Assume for the purposes of this question that cheaper power (that is, less than what you currently pay) is available through a mid-western power company. Further, this power company produces electricity by burning coal. Increased demand for this company's cheaper power will contribute to air pollution and poor visibility in <u>the White Mountains of New Hampshire</u>.

·Please enter your estimated average monthly electric bill US$_____
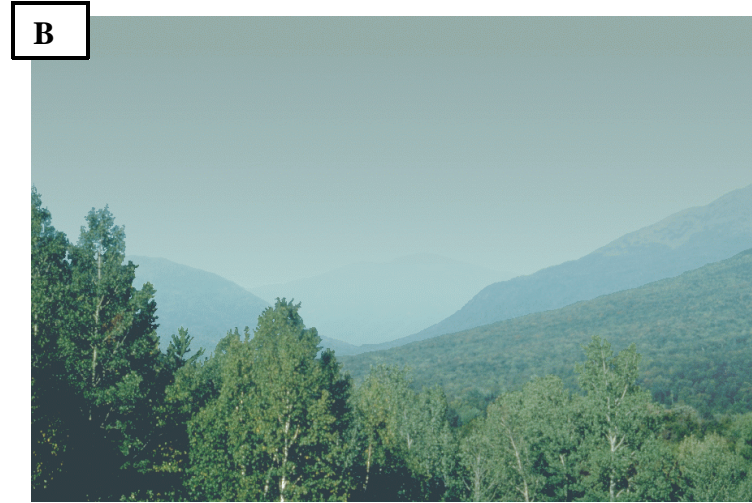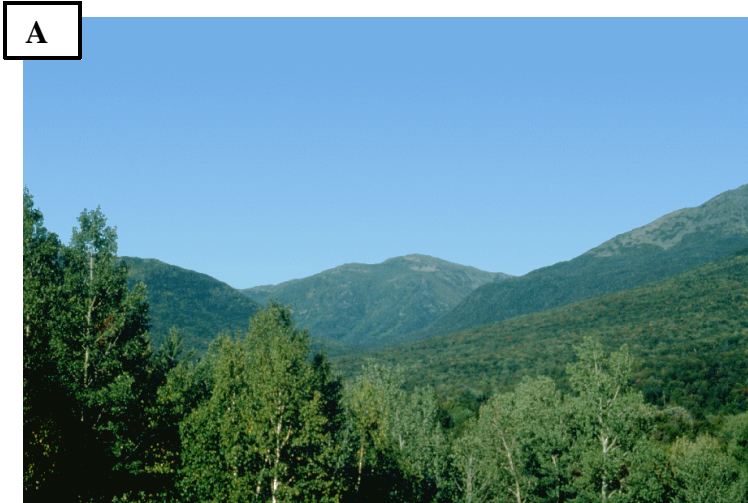
Now suppose picture A represents the level of visibility most often experienced in this region during the summer months. Further suppose that you are faced with a situation where the visibility level changes to that in picture B. For the purpose of this question, assume that visibility would change <u>ONLY in the White Mountain National Forest in New Hampshire</u>.

·Would you be willing to pay $_____ per month <u>more</u> for electricity to avoid this new level of visibility (indicated by picture B) in the White Mountain National Forest?

YES   NO