

# The Endowment Effect and WTA: A Quasi-Experimental Test

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## Abstract

This paper reports a test of the endowment effect in an economic analysis of localized air pollution. Regression techniques are used to test the significance of perceived property rights on household WTP for improved air quality versus WTA compensation to forgo an improvement in air quality. Our experiment contributes to the research into the WTP/WTA divergence by providing a new basis for supporting the existence of an endowment effect. Our results are in contrast to recent work by Shogren et al. which supports the substitution proposition of Hanemann while rejecting the endowment effect.

**Key Words:** contingent valuation, endowment effect, property rights, substitution effect

Examination of the potential welfare impacts of contemplated changes in the provision of public goods often plays a significant role in the evaluation of environmental management and policy changes and alternatives. Empirical estimation of welfare measures is often accomplished using survey methods. Perhaps the most popular of these is the contingent valuation methodology (*CVM*) - a survey based methodology that relies on individual responses to hypothetical market situations. *CVM* is predicated upon asking individuals the maximum they would be willing to pay (*WTP*) or minimum amount they would be willing to accept in compensation (*WTA*) for the proposed change.

Microeconomic theory suggests that differences between *WTP* and *WTA* should be negligible when income effects are small. However, contrary to theoretical constructs, empirical studies consistently report *WTA* values that are several times larger than those of *WTP* (Mitchell and Carson). Many hypotheses have been offered concerning this phenomenon. Some have targeted

problems with elicitation design as a possible contributor to the valuation divergence (Brookshire et al.; Shulze et al.), while others remain skeptical of the conventional presumption of valuation equivalence (Knetsch and Sinden; Knetsch, 1989 and 1990; Kahneman et al.; Hanemann).

It has been suggested that the seemingly inflated *WTA* values are due, in part, to an "endowment effect" - the supposition that individuals value losses more than commensurate gains (Thaler). If an endowment effect exists, then the conventional practice of eliciting *WTP* will understate welfare impacts when the consumer appears to have an inherent right to the good or change under consideration.

The major objective of this paper is to report on an empirical test for the presence of the endowment effect in an economic analysis of localized air pollution. Regression techniques are used to test the significance of perceived property rights on household *WTP* for improved air quality

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versus *WTA* compensation to forgo an improvement in air quality. In addition, theoretical issues surrounding the *WTP/WTA* divergence, with implications for benefit-cost analysis (*BCA*), are discussed.

### Equivalent and Compensating Measures of Welfare

Conventional welfare measurement is based on Hicksian surpluses derived from the utility maximization problem. These measures reflect lump sum income changes, paid or received, which are needed to achieve a specified utility level. The appropriate measures for price changes are compensating variation (*CV*) and equivalent variation (*EV*). The corresponding measures for quantity changes are compensating surplus (*CS*) and equivalent surplus (*ES*). Compensating measures assume the individual has rights to her *ex ante* (pre-policy) level of utility, whereas equivalent measures assume rights to the *ex post* (post-policy) level. For example, consider a policy which, if implemented, would provide improved air quality to households of a given area. Assuming the residents have rights to the post-policy level of air quality, *ES* represents the compensation required by an individual (*WTA*) to forgo the improvement which would leave her as well off as if the improvement actually occurred. Alternatively, assuming residents have rights to current (pre-policy) air quality, *CS* represents the amount an individual would be *WTP* to secure the improvement, which would leave the individual as well off as if the improvement did not occur.

The assertion in utility theory that individuals value commensurate gains and losses equivalently suggests that compensating and equivalent measures be equal in lieu of small income effects. Willig posited the theoretical foundations in support of this assertion for price changes. Randall and Stoll extended the work of Willig to surplus measures and showed a similar relationship between payment and compensation measures. Accumulating empirical evidence, however, is at odds with these theoretical developments. The significant disparity between *WTP* and *WTA* estimates typically observed in empirical applications has caused concern among economists and their clientele, and has effectuated

the development of a range of hypotheses regarding the disparity.

### Hypotheses

Advocates of traditional economic theory generally attribute the discrepancy between *WTP* and *WTA* to problems in *CVM* elicitation procedures. Respondents are usually asked to state their *WTP* for a hypothetical increase and/or *WTA* for a hypothetical decrease in (or in lieu of) the provision of a particular good or service. Among the plethora of criticisms of *CVM* (Mitchell and Carson), it has been suggested that respondents may intentionally misrepresent their "true" value if they feel their response can influence the outcome of the study, i.e., strategic bias. Macnab and Adamowicz suggest that, while such bias may explain some of the *WTP/WTA* divergence, empirical studies designed to test for these problems have reported mixed results. Hence, the extent to which such biases affect *WTP* and *WTA* is uncertain.

The hypothetical situation in which the goods are valued in *CVM* has also been suggested as a possible factor contributing to the valuation disparity. However, several experiments involving real exchanges have similarly shown *WTA* values that significantly exceed *WTP* measures (Knetsch and Sinden; Knetsch, 1990; Kahneman et al.). In some studies the magnitude of the difference tended to decrease as the respondent gained experience from repeated transactions, but the disparity nonetheless remained after the final round of exchanges (Coursey et al.; Knetsch, 1990). It should be noted however that the value convergence reported in these studies is for goods that are very private or "market friendly" and relatively inexpensive.

In addition to income effects and possible elicitation problems, Hanemann proposed that the divergence also depends on a substitution effect. He argues that the ease with which a private good can be substituted for the public good will have a significant effect on the magnitude of the disparity. Building on the theoretical framework of Randall and Stoll, Hanemann showed that the smaller the substitution effect (i.e., the less ease with which a private commodity can be substituted for the public

or rationed good), the greater the difference between *WTP* and *WTA*.

Recently, Shogren et al. conducted a series of laboratory studies which offer support for Hanemann's substitution proposition. They repeated Vickrey auctions for inexpensive private goods with abundant substitutes, e.g., name-brand candy bars and university mugs. For the low substitution case they use a nonmarket good represented by reduced risk from food-borne pathogens. They did not examine the case of a nonmarket good with many substitutes nor did they examine a market good with very limited substitution possibilities. Their findings showed that for the easily substituted market goods, *WTA* and *WTP* converged over repeated trials to a close proximity with the average market price. For the nonmarket good with low substitution, they found that the divergence between *WTA* and *WTP* persisted after repeated trials. They interpreted their results as fairly strong support for Hanemann's proposition.

Some more radical elements have advocated dismissing *WTA* results as being unreasonable. Proponents of this opinion generally cite two possible problems associated with *WTA* measures: the cautious consumer hypothesis and rejection of the property right implied by *WTA* (Mitchell and Carson, p.34). The cautious consumer hypothesis stems from the issue of consumers' unfamiliarity with the good being valued or the situation in which the good is being valued. The contention is that risk averse consumers will understate *WTP* and overstate *WTA* when time and knowledge limit the ability to make optimal value assessments. The rejection of the *WTA* property right occurs in situations where respondents often refuse to place a value on a good or service in question, or demand extremely large values in compensation for the loss of the good.

The focus of this study concerns the hypothesis that the valuation disparity is influenced by an endowment effect (Thaler; Kahneman et al.). The endowment effect is predicated on the assertion that individual value assessments are made with reference to initial entitlement. That is, individuals attach additional value to a good once it becomes a component of his or her resource or commodity base. Such a concept is contrary to a fundamental

assumption of utility theory, where indifference curves are drawn independent of current endowments (Knetsch, 1989). This implies that the direction of trade does not matter (i.e., individuals value equivalent losses and gains the same).

The potential existence of an endowment effect has serious ramifications for both traditional theory and applied work. If value assessments are dependent upon current endowments, gains from trade depicted by the standard utility model will be overstated (Knetsch, 1989). Consequently, attainment of the efficient allocation of resources predicted under the assumptions of the Coase theorem may not be possible (Kahneman et al.). From an applied standpoint, the existence of an endowment effect precludes the use of *WTP* measures for evaluating welfare changes when the consumer appears to have an inherent right to the good being valued. In such situations, the common practice of substituting *WTP* measures for *WTA* will understate welfare impacts, increasing the probability of rejecting a proposal that would provide a potential Pareto improvement.

As stated, one of the objectives of this paper is to test for the endowment effect using *WTA* and *WTP* data from a *CVM* study concerning the economics of localized air pollution. The following sections provide a brief description of the problem design and report the results of the quasi experimental test.

### Experimental Design

The study from which the data were taken involved a personal interview survey of households affected by noxious odor emissions from a nearby rendering plant (Bowker and McDonald). Two versions of the *CVM* questionnaire were developed (one eliciting *WTP* and the other *WTA*) and applied randomly to a sample of affected households. The *WTP* question was structured in such a way that residents would be responsible for paying into a fund to subsidize installation and upkeep of the necessary abatement technology. For the *WTA* question, respondents would be eligible to receive payments to tolerate persistence of the odor. Along with the valuation questions, a number of questions identifying household characteristics were included in the questionnaire (available from the authors).

Theoretically, the *WTP* and *WTA* constructs can be represented in a number of ways consistent with economic theory (Mitchell and Carson, p.26). Using an expenditure function framework, *WTP* or compensating surplus (*CS*) for this analysis may be represented as:

$$WTP = [e(p_0, q_0, U_0) = Y_{00}] - [e(p_0, q_1, U_0) = Y_{01}] \quad (1)$$

while *WTA* or equivalent surplus (*ES*) is:

$$WTA = [e(p_0, q_0, U_1) = Y_{10}] - [e(p_0, q_1, U_1) = Y_{11}] \quad (2)$$

where:  $q_0$  is a state of annual ambient air with the current odor level,  $q_1$  is a state with no odor level,  $U_0$  is the utility level for the current odor level,  $U_1$  is the utility level subsequent to an improvement in air quality,  $Y_{00}$  and  $Y_{01}$  are pre and post change incomes associated with  $U_0$ ,  $Y_{10}$  and  $Y_{11}$  are pre and post change incomes associated with  $U_1$ , and  $p_0$  is the ex ante price vector assumed constant.

The usual procedure when dealing with a given change in resource provision is to estimate a regression equation for mean *WTA* and/or *WTP* controlling for relevant covariates. As is the case typical with other studies which measure both *WTP* and *WTA*, a large difference was observed between the two values. Average annual household *WTP* was estimated at \$105.31, with that of *WTA* being \$735 at the sample means.

The basis for the endowment effect test involves specification of a quasi valuation function for *WTP* and *WTA* to examine the effect of given household characteristics on the two values. Of particular interest is the effect of entitlement on *WTP* and *WTA*. At the time the rendering plant study was conducted, property rights to air quality in the vicinity of the plant were disputed. Given the lack of mandated property rights, perceived entitlement becomes an important consideration. We assert that those who have been residents of the area since prior to the opening of the rendering plant (1968), are more inclined to feel that their rights to clean air have been violated, i.e. living there prior to the establishment of the plant established a de facto right to clean air. Those who moved to the area after the rendering plant began operating would have presumably known of the

odors before buying or renting and would not have the same "claim" to the clean air property right.

In order to test this assertion, the following quasi valuation functions are hypothesized for *WTP* and *WTA*:

$$WTP_i = a_{1i} + a_{2i}INC + a_{3i}HLT + a_{4i}PRIOR + u_i \quad (3)$$

$$WTA_j = b_{1j} + b_{2j}INC + b_{3j}HLT + b_{4j}PRIOR + v_j \quad (4)$$

where: *INC* is gross annual household income, *HLT* is a binary variable indicating perceived health risk (1 if respondents believe odors are a potential health risk, 0 otherwise), *PRIOR* is a binary variable indicating whether the respondent lived in the area prior to the opening of the rendering plant (1 if respondent lived in area before plant operation, 0 otherwise),  $i=1, \dots, 32$ ;  $j=1, \dots, 34$ ; and the respective errors  $u_i$  and  $v_j$  are each assumed identical independent normal.

Income was selected as an explanatory variable because, theoretically, as income increases the demand for a "good" increases (assuming that air quality is a normal good). Perception of health risk was included following the work of Roberts et al., who found that respondents' perception of health risk was a significant variable in explaining variations in *WTP* for ensuring relocation of a proposed landfill site.

The *PRIOR* variable is intended to capture possible endowment effects. The null hypothesis to be tested is  $H_0: b_4 \leq 0$  versus the alternative  $H_a: b_4 > 0$ . If the variable is significant in explaining variation in *WTA*, then it would appear that perceived property rights are an important factor in assessing damages from rendering emissions. Such a result would suggest that residents who predate the plant are, on average, providing significantly different values than those who postdate the plant. In essence, they are accepting compensation for the pollution as well as an inherent right which residents who postdate the plant would not have. Expectations with respect to *WTP* are less clear. One might argue that perception of property rights would have an effect opposite to that of *WTA* (i.e., a negative sign on the *PRIOR* variable in Equation 3). In other words, it is conceivable that those who believe their rights to clean air have been violated

may be inclined to pay less than those who do not have the same perception of rights.

### Results and Discussion

The results of the OLS regressions are presented in Table 1. The selected variables accounted for approximately forty percent of the variation in *WTP* and *WTA*. *R*-square values of this magnitude are relatively high compared to those of other *CVM* studies (Adamowicz). The coefficients on income were insignificant in both equations which is consistent with a number of previous studies that find little impact or significance of income on *WTP/WTA*. The health risk variable is significant at better than the 10 percent significance level in equation 1, and at the 1 percent level in equation 2. Respondents who perceived the rendering emissions as a health hazard had an estimated *WTP* of \$78.14 more than those who perceived no health risks. Similarly, individuals who perceived a health risk demanded, *ceteris paribus*, \$395.85 more in compensation than those who indicated otherwise.

The variable of primary interest is the binary variable, *PRIOR*, in equation 4. A one-tailed test of the hypothesis,  $H_0: b_4 \leq 0$  versus  $H_a: b_4 > 0$  is significant at the 5 percent level. For *WTP* in equation 3, the null hypothesis,  $H_0: a_4 = 0$  cannot be rejected. This agrees with a priori expectations. Those who lived in the area prior to the opening of the rendering plant demanded an estimated \$348.16 more in compensation than those who moved to the area after the plant. However, in the case of *WTP* there is no significant difference between those predating and postdating the plant.

Corroborating evidence can be obtained by testing the equivalence of the regression coefficients on the *PRIOR* variable between the two equations, i.e., the null hypothesis,  $H_0: b_4 \leq a_4$  versus the alternative,  $H_a: b_4 > a_4$ . The *t*-statistic for this test of the difference between two independent random variables (Snedecor and Cochran, p. 97) is 1.45 with 35 df, significant at better than the 10 percent level.

We contend that, because of the significance and direction of influence of the *PRIOR* variable in the *WTA* equation combined with that lack of significance in the *WTP* equation, we can

reject the null hypothesis that damage assessments are independent of perceived property rights. This result offers some support for the presence of an endowment effect in this study. Because property rights are not mandated in the area, those who resided in the vicinity before the opening of the plant would be inclined to feel that their rights to clean air had been violated, since they were giving up more, they would demand more in terms of compensation. Hence, it appears that "perceived" property rights may well be an important factor in contributing to the *WTP/WTA* divergence.

### Conclusions

Valuation symmetry predicated by theoretical aphorisms would imply indifference in the choice of measure used to estimate welfare changes. However, the consistently large disparity observed in empirical estimation casts doubt on the significance of the theoretical axioms when extended to "real world" applications. The findings of this study support the hypothesis that the disparity can be influenced by an endowment effect. If such is the case, then the *WTP/WTA* choice becomes a crucial factor in the process of estimating potential welfare impacts of a particular environmental management or policy alternative. The common practice of substituting payment measures for compensation measures will understate welfare impacts when the consumer has rights (or the perception thereof) to the good being valued.

Past studies concerning the *WTP/WTA* discrepancy have generally relied on privatized or "market friendly" goods suited to trading in constructed experimental markets. However, it is questionable as to how far deductions from such studies can be extended to public goods. Our simple experiment contributes to the research into the *WTP/WTA* divergence by providing a new basis for supporting the existence of an endowment effect. Our results are in contrast to those of Shogren et al. which lend support to the substitution proposition of Hanemann while rejecting an endowment effect.

Interestingly, controlling our results for the apparent endowment effect, i.e., calculating *WTP* and *WTA* with *PRIOR* set to zero, still leaves a considerable difference between *WTA* and *WTP* means. Acknowledging relatively low substitution

**Table 1.** OLS Parameter Estimates of the Quasi Valuation Functions<sup>a</sup>

Variable	WTP	WTA
<i>INC</i>	.30621 (0.35818)	-3.0634 (-0.80262)
<i>HLT</i>	78.14 (1.9129) <sup>b</sup>	395.85 (2.5736) <sup>c</sup>
<i>PRIOR</i>	61.05 (1.137)	348.16 (1.8234) <sup>c</sup>
Constant	71.684 (2.0413) <sup>c</sup>	715.90 (4.6820) <sup>c</sup>
<i>R</i> <sup>2</sup>	0.3988	0.3978
<i>R</i> <sup>2</sup> ADJ	0.3344	0.3376
OBS	32	34
AVE	105.31	735

<sup>a</sup>t-statistics in parentheses.<sup>b</sup>significant at the .10 level.<sup>c</sup>significant at the .05 level.

in housing, we speculate that the remaining discrepancy may well be attributed to the substitution effect.

Clearly, more empirical research is needed concerning the endowment and substitution effect hypotheses in relation to public goods valuation, both in laboratory and nonlaboratory settings. In addition, where possible, nonlaboratory studies should control for potential instrument and

experience effects not likely to be found in repeated Vickery auctions in a lab. Future lab experiments should also include treatments for nonmarket goods with many substitutes and market goods with limited substitutes. Admittedly, ours was a serendipitous situation. Nonetheless, it is likely that similar situations, where property rights are disputed, are not too uncommon and hence, researchers should keep an eye open for such opportunities.

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