A Method to Estimate the Magnitude of "Hypothetical Bias" in Stated Preference Surveys of Passive-use Value

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Abstract

This paper proposes a method by which estimates of hypothetical willingness to pay for public goods with passive-use value can be compared with actual willingness to pay inferred from aggregate voting and tax liability data.

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I. Introduction

Private preferences for goods that are provided collectively can be measured by economic valuation methods that are based on observed individual behavior. For instance, information about preferences for urban air quality improvements may at least partly be inferred from variations in the price of properties exposed to varying amounts of emissions. As another example, preferences for a recreational fishery resource may be estimated from time and money individuals actually spend fishing. Such studies can yield market-calibrated estimates of value thus providing important inputs to decision processes about the provision of public goods.

There are, however, important public goods the preferences for which do not leave any observable "trace" in individual behavior. Such goods include for instance the preservation of wilderness areas, from which individuals may benefit merely by knowing about their existence. The values of such goods have been termed "passive-use", "existence", or "non-use" values. The increasing importance of these values for public decision making and the difficulty in their measurement gained much attention in the process of damage assessment following the Exxon Valdez oil spill in 1989. According to present wisdom, the only economic valuation methods that are potentially able to estimate these values are stated preferences techniques, such as the contingent valuation method (CVM). These methods use surveys, in which respondents are asked about their willingness to pay for a proposed project concerned with the provision of a public good, or about their decision in a hypothetical referendum or other choice situation.

While stated preferences for many public goods can be compared with values derived from observed choices, there is little opportunity to test whether stated preferences for public goods with passive use values are reliable. This is a significant problem since

for a variety of reasons surveys of hypothetical choices may not always provide respondents with the necessary incentives to think hard and answer truthfully.[1] Researchers have thus started to examine potential bias of hypothetical values in situations involving private commodities where a direct comparison of stated and actual choices is feasible, or by comparing stated values with those inferred using revealed preferences techniques (Carson et al. 1996). Although such studies shed important light on the reliability of stated choices they are by their nature unable to externally test the validity of stated passive-use values of public goods.[2]

However, there appears to be a way to test the reliability and estimate potential biases of stated passive-use values. As Arrow et al. (1993) suggested, the problem may be approached by comparing hypothetical values for public goods with willingness to pay implied by closely similar real-world voting decisions. This would involve conducting a stated preference survey before an actual referendum is subjected to voters. Stated individual choices could then be compared with actual choices. However, to our knowledge no one has so far examined how exactly this should be done.

The aim of this paper is to present a method by which point estimates of stated willingness to pay (WTP) for public goods might be compared with WTP values inferred from aggregate voting outcomes. The presentation begins by positing the conditions under which the method is feasible. A theorem, based on these conditions, is then proposed. Next, the conditions for the theorem are examined, and its rationale is graphically illustrated. A final section concludes.

[1] Some encouraging results in this respect, however, are reported from a recent study that attempted to eliminate biases by directly confronting respondents with the hypothetical bias problem (Cummings and Taylor 1999).

II. The Model

In a rational voter context, consider the following conditions on a referendum decision about a proposed increase of a public good from provision level Q_0 to Q_1:

I. There is institutional congruence, i.e., the voters are consumers of the public goods as well as being taxpayers. All potential voters participate in the vote.

II. The sharing of costs for financing the public good is determined independently of the specific project at hand.

III. The budget is balanced (equal income and expenditures).

IV. Each issue is voted on separately. There is no tie with other projects.

V. Preference orderings are single-peaked.

VI. A project is considered accepted if it is approved of by at least a simple majority, that is, by 0.5 n + 1 of the n voters.

VII. Coalitions among voters are considered impossible due to high costs of bargaining.

Assumptions I–VII belong to the set of median voter assumptions (see e.g. Buchanan 1968). For the approach to CVM calibration presented here, the additional assumptions VIII–XI are required:

VIII. Individuals' WTP for the proposed public good increase, up to a random effect of taste, is monotone increasing in income.

IX. The individual's (perceived) tax increase in case of approval, up to a random term, is monotone increasing in income.

[2] An exeption to this are a few recent studies involving hypothetical and actual donations (see e.g., Cummings et al. 1997). However, these choices are quite different from those about public goods to be provided collectively.

X. The probability of individuals' approval, up to a random effect of taste, is monotone increasing in income.

XI. The random terms have zero expectation and equal variance for all income levels.

Finally, assumptions XII and XIII regard the process of surveying stated WTP:

XII. Stated WTP for the proposed public good increase is surveyed with no influence of the upcoming actual referendum on the survey process.

XIII. The survey sample is representative of the voter population.

We will return to these conditions further below. Based on these assumptions we state the following

THEOREM: *Given I–XIII, as sample size increases, the* p*th percentile individual on the distribution of individual approval probabilities can be identified asymptotically with the* p*th percentile individual on the income distribution, which in turn can be identified with the* p*th percentile individual on the distribution of stated WTP*.

Assuming that *p* percent of the individual reject the referendum, the *p*th percentile individual is roughly indifferent between accepting or approving the referendum. His or her additional tax payment due to the public good increase, ΔT_{p}, should therefore equal his or her actual WTP. This "indifferent voter's" actual WTP can be directly compared with the same percentile in the hypothetical WTP distribution, W_{p}. The appropriate "calibration factor" for hypothetical WTP is then simply the ratio $\Delta T_{\mathrm{p}}/W_{\mathrm{p}}$. In a concrete case this factor can be computed as

$$(1) \qquad C_p = \frac{f(I_p) r \Delta Q}{W_p B}$$

, where $f(I_p)$r, is the tax function, composed of the fixed tax schedule $f(I_p)$ (with I for income) and a variable tax rate r which is set annually in accordance with the planned budget (B), and ΔQ is the proposed public good provision increase, measured in money units.[3]

III. Examination of Assumptions

Rational voter assumptions and median voter assumptions are well discussed elsewhere in the literature (e.g., Mueller 1989). Assumptions XII and XIII concerning the process of surveying stated WTP are evident. Assumptions VIII–XI regarding identification of percentiles on distributions, however, warrant further attention. The conditions for these to be true are closely analogous to those derived and used by Bergstrom and Goodman (1973) in equating the median of public good quantities demanded with the quantity demanded by the citizen with median income. Let the actual WTP of a citizen i for the proposed public good increase be given by a function of income $WTP(I)$, the individual tax increase by a function $\Delta T(I)$, and let $NWTP$ (net WTP) denote the difference $WTP(I) - \Delta T(I)$. Then, assume that an individual's probability of approval y^*_i can be expressed by $y^*(NWTP_i)$. To examine the effects of differences in income on approval probability, compute the total derivative of approval probability with respect to income. This is

$$(2) \qquad dy^* / dI = \frac{\partial y^*}{\partial NWTP}\left(\frac{\partial WTP}{\partial I} - \frac{\partial \Delta T}{\partial I}\right).$$

[3] Referenda on the provision of regional or national public goods are often held at levels of government encompassing several or many voting districts. If sufficiently large samples of CVM responses are available for each of several voting districts the comparison of hypothetical and actual WTP can be made for each individual district. Theoretically, variations in income levels (and WTP) across voting districts could then be used to examine if calibration factors differ among different income groups.

Transforming this result into elasticity form, we have

$$(3) \qquad \frac{dy^* / y^*}{dI / I} = d(w - x).$$

where δ is the elasticity of approval probability with respect to net WTP, ω is the income elasticity of WTP, and ξ is the elasticity of the additional tax payment with respect to income. If for all values of I, $\delta>0$ and $\omega-\xi>0$, then the higher the citizen's income, the higher will be her probability of approval. Thus, the probability of approval is a monotone increasing function of income, and the median (or any other percentile) individual on the distribution of individual approval probabilities is equal to the respective percentile individual on the income distribution. If, however, $\omega-\xi$ is positive for some income levels and negative for others, y^* will not be monotone increasing in income. In this case the WTP of the median (or any other percentile) individual on the distribution of approval probabilities will not in general be the WTP of the consumer with median (or respective percentile) income.

IV. Illustration

The relationships between income, WTP, and additional tax payments underlying the required approval probability that is monotone increasing in income, are illustrated in figure 1. Apart from the special case where all individuals agree with or all reject the proposition (and thus no one's WTP can be estimated) WTP will exceed ΔT above some income level I_p. This is the income of the voter, who is indifferent regarding approval or rejection of the proposition or, in other words, whose oval probability y^* equals 0.5. Thus,

in contrast to the median voter case, where the individual with median demand can be identified on the income distribution, the identifiable individual is here the citizen with an approval probability of 0.5. The indifferent voter's WTP is illustrated in figure 2 as the area under the demand curve between the two public good provision levels Q_q and Q_2. This area is equal to the tax increase, which is defined by the same provision levels and the indifferent voter's marginal cost curve. As the graph assumes constant unit costs and Q is measured in money units, the indifferent voter's cost curve is simply his or her tax price τ_p.

V. Implications

The presented approach is to our knowledge the first detailed method so far proposed to externally validate and calibrate contingent values for collectively provided public goods with important passive use value. Given continuing debate over the degree of hypothetical bias in stated preference valuation methods, the presented validation method should be a useful tool to help resolve this debate. We acknowledge, however, that much theoretical and empirical[4] work remains to be done to evaluate how seriously various hardly avoidable violations of model assumptions may impair the accuracy of estimated hypothetical survey bias.

[4] A first empirical application of this "indifferent voter approach" is presented in Schläpfer and Hanley (2002), which however relies on CVM and referendum propositions that are not identical.

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Figure 1 Identification of the indifferent "*p*th percentile" voter with the *p*th percentile individual on the income distribution: illustration of the conditions on individual approval probabilities *y**, WTP, and tax increases.

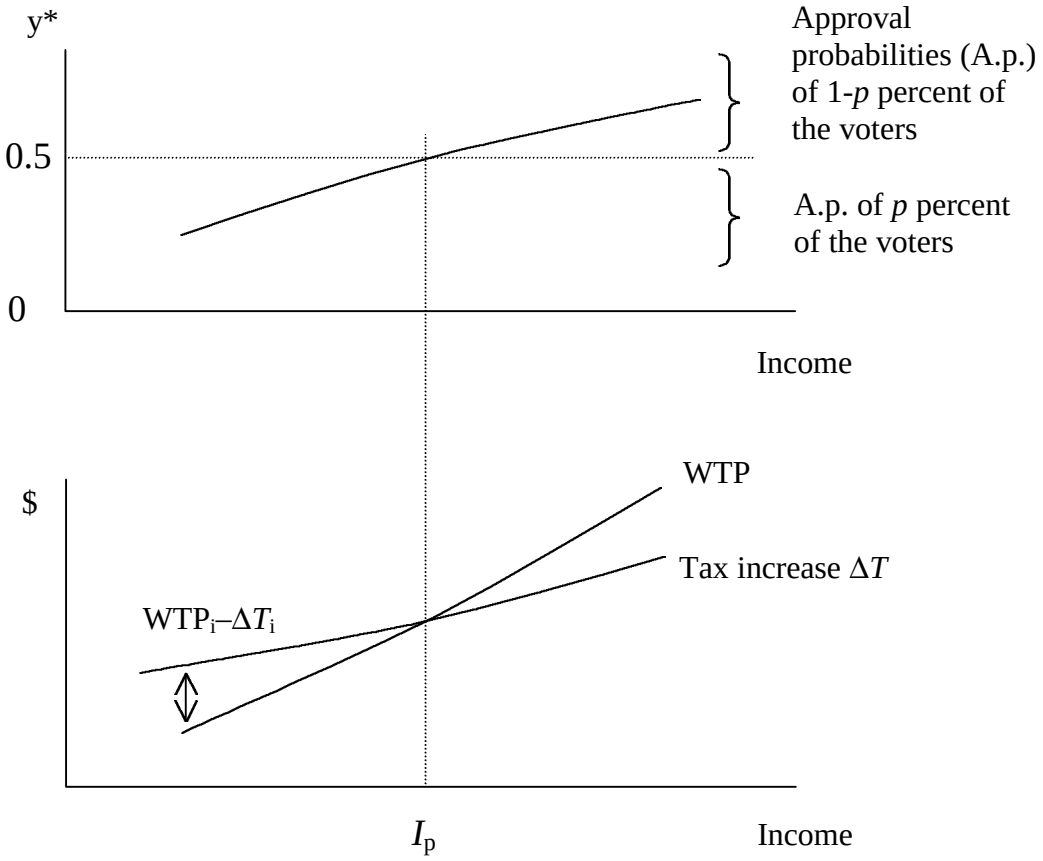

Figure 2. The indifferent (*p*th percentile) voter's WTP for an increase of a public good from Q_0 to Q_1.