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INDIVIDUAL AND HOUSEHOLD WILLINGNESS TO PAY FOR PUBLIC GOODS

JOHN QUIGGIN

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Abstract

In this paper, the issue of whether willingness to pay (WTP) for the benefits generated by a public good should be elicited on an individual or a household basis is addressed. Differences between individual and household WTP may arise when members of the household are mutually altruistic. It is shown that, for general specifications of altruism, household WTP is less than the sum of household members' individual WTP. Implications or the choice between household and individual measures of WTP are considered, and issues in the elicitation of household WTP are addressed.

Keywords: altruism, contingent valuation, household, public goods, willingness to pay

Individual and Household Willingness to Pay for Public Goods

Introduction

The issue of whether willingness to pay (WTP) for the benefits generated by a public good should be elicited on an individual or a household basis has long been recognised as a practical problem in applications of the contingent valuation method (Mitchell and Carson 1989). The choice between individuals and households as units of analysis presents difficulties in any study of consumer behavior. Standard welfare and demand theory is based on individual preferences, and modern theoretical analysis of household behavior is based on the rejection of the notion that households may be regarded as unitary decision-makers rather than groups of individuals. (Becker 1976). On the other hand, practical considerations of data collection normally encourage the use of households as the unit of analysis.

Further questions arise in the case when the contingent valuation method is used to elicit passive use or non-use values. Altruistic concern for others is an important element of passive use value, and altruism between family members is generally considered to be an important element of the analysis of household choices. The assumptions about altruism used in any implicit model of the household should be consistent with the assumptions used in the elicitation and aggregation of measures of WTP.

In this paper, the properties of individual and household measures of WTP for a public good are compared. It is shown that, for general specifications of altruism, household WTP is less than the sum of household members' individual WTP. Two polar cases are considered. If individuals display paternalistic altruism towards each other, and are concerned only with consumption of the public good, household WTP will be equal to the sum of household members' individual WTP. If individuals have well-defined personal utility functions but display nonpaternalistic altruism towards each other, it is possible to define a measure of private WTP which will be less than the individual WTP elicited by standard contingent valuation questions. It is shown that, in this case, household WTP will be equal to the sum of private WTP and therefore less than the sum of individual WTP. The implications of these results for the choice between household and individual measures of WTP are considered, and issues in the elicitation of household WTP are addressed.

Model

The formal analysis in this paper is separated into three subsections: notation and definitions; the formal derivation of the results; and discussion of the way in which the results may be interpreted.

Notation and definitions

We first consider a household of N individuals. Each individual i consumes an amount y_i of a Hicksian composite private good. The vector of all individual consumption levels is denoted $\boldsymbol{y}$, and the vector consisting of the consumption of all individuals other than i is denoted $\boldsymbol{y}_{-i}$. Total household consumption is $\sum_{i=1}^{n} y_i$. In addition, a vector $\boldsymbol{q}$ of nonrival goods is consumed by all members of the household. The goods described in $\boldsymbol{q}$ may be either public goods consumed by the entire community, club goods consumed by some subset of the community including all members of the household, or household goods such as central heating, which are public goods for members of the household but from which nonmembers are excluded.

Each individual has a utility function in the general form $u_i(y_i, \boldsymbol{y}_{-i}, \boldsymbol{q})$, nondecreasing in each of its arguments. We assume that, over the relevant range, there exist no Pareto-improving redistributions of the private good. That is, given $(\boldsymbol{y}, \boldsymbol{q})$, there exists no $\boldsymbol{y}^1$ with

$\sum_{i=1}^{N} y_i^1 \leq \sum_{i=1}^{N} y_i$ and $u_i(y^1_{\text{i}}, \boldsymbol{y}^1_{-i}, \boldsymbol{q}) \geq u_i(y_i, \boldsymbol{y}_{-i}, \boldsymbol{q})\ \forall\ i$, with strict inequality for at least one i. This assumption may be interpreted as saying that redistributions approved by all members of the household have been undertaken prior to the determination of the initial ($\boldsymbol{y}^0$, $\boldsymbol{q}^0$) and that subsequent changes in $\boldsymbol{q}$ and $\boldsymbol{y}$ do not create opportunities for Pareto-improving redistributions.

Given an initial ($\boldsymbol{y}^0$, $\boldsymbol{q}^0$), and $\boldsymbol{q}^1 \geq \boldsymbol{q}^0$, the compensating variation $WTP_i(\boldsymbol{q}^1)$ for individual i associated with a shift from $\boldsymbol{q}^0$ to $\boldsymbol{q}^1$ is implicitly defined by the equality

$$u_i(y^0_{\text{i}} - WTP_i, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^1) = u_i(y^0_{\text{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0). \tag{1}$$

This is the same as the standard formula for WTP presented by Mitchell and Carson (1989), except that the term $\boldsymbol{y}^0_{-i}$ implies that individuals may have altruistic concern about the consumption levels of other members of the household. WTP_i is the amount the individual would pay for an increase in $\boldsymbol{q}$, on the assumption that $\boldsymbol{y}_{-i}$ is unchanged.

Next, define a shift from ($\boldsymbol{y}^0$, $\boldsymbol{q}^0$) to ($\boldsymbol{y}^1$, $\boldsymbol{q}^1$) as potentially Pareto-improving if there exists $\boldsymbol{y}^2 \leq \boldsymbol{y}^0$ satisfying:

(i) $\sum_{i=1}^{N} y_i^2 \leq \sum_{i=1}^{N} y_i^1$; and

(ii) $u_i(y^2_{\text{i}}, \boldsymbol{y}^2_{-i}, \boldsymbol{q}^1) \geq u_i(y^0_{\text{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0)\ \forall\ i$.

For given $\boldsymbol{q}^0$, $\boldsymbol{q}^1$, condition (i), in conjunction with the assumption of a Pareto-optimal distribution within the household, implies that the question of whether a shift from ($\boldsymbol{y}^0$, $\boldsymbol{q}^0$) to ($\boldsymbol{y}^1$, $\boldsymbol{q}^1$) is potentially Pareto-improving depends only on $\sum_{i=1}^{N} y_i^0 - \sum_{i=1}^{N} y_i^1$. This justifies the definition of $WTP_{PPI}(\boldsymbol{q}^1)$, the (Pareto-optimal) household willingness to pay for a shift from $\boldsymbol{q}^0$ to $\boldsymbol{q}^1$, as

$$WTP_{PPI}(\boldsymbol{q}^1) = \sup\{ \sum_{i=1}^{N} y_i^0 - \sum_{i=1}^{N} y_i^1 : (\boldsymbol{y}^1, \boldsymbol{q}^1) \text{ is a potential Pareto-improvement on } (\boldsymbol{y}^0, \boldsymbol{q}^0)\}.$$

This is the maximum payment that members of the household could make, such that all of them would be better off, taking into account both the change in $\boldsymbol{q}$ and the changes in general consumption.

From this definition, it is easy to derive:

Lemma: Let $\boldsymbol{y}^1$ be such that $\sum_{i=1}^{N} y_i^0 - \sum_{i=1}^{N} y_i^1 = WTP_{PPI}(\boldsymbol{q}^1)$, and let $\boldsymbol{y}^2$ satisfy the conditions (i) and (ii) above. Then $u_i(y^2_{\mathrm{i}}, \boldsymbol{y}^2_{-i}, \boldsymbol{q}^1) = u_i(y^0_{\mathrm{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0)\ \forall\ i$.

Proof: Suppose that $u_i(y^2_{\mathrm{i}}, \boldsymbol{y}^2_{-i}, \boldsymbol{q}^1) > u_i(y^0_{\mathrm{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0)$ for some i. Then there exists $\boldsymbol{y}^3 < \boldsymbol{y}^2$ satisfying conditions (i) and (ii) contradicting the definition of $WTP_{PPI}(\boldsymbol{q}^1)$.

Household and individual WTP

The central result of this paper is that whenever some household member i displays altruism for some other member j, that is, whenever u_i is strictly increasing in y_j, aggregate individual WTP exceeds household WTP. The intuition behind the result is straightforward. In the individual WTP question, each individual is asked to state compensating variation for a situation in which the quantity of public goods $\boldsymbol{q}$ is increased and $\boldsymbol{y}_{-i}$, the consumption of private goods by all other household members, is left unchanged, implying that all other household members are better off.

By contrast, the definition of WTP_{PPI} involves a sum over compensating variations for each household member given that the every other household member incurs a loss of the private good sufficient to leave utility unchanged.

Result 1: Assume that for at least one pair (i, j), u_i is strictly increasing in y_j. Then for any $\boldsymbol{q}^1 > \boldsymbol{q}^0$, $\sum_{i=1}^{N} WTP_i(\boldsymbol{q}^1) > WTP_{PPI}(\boldsymbol{q}^1)$

Proof: Let $\boldsymbol{y}^2$ be such that $u_i(y^2_{\mathrm{i}}, \boldsymbol{y}^2_{-i}, \boldsymbol{q}^1) = u_i(y^0_{\mathrm{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0)\ \forall\ i$.

Since u is increasing in its arguments,

$u_i(y^2{}_i, \boldsymbol{y}^0{}_{-i}, \boldsymbol{q}^1) \geq u_i(y^2{}_i, \boldsymbol{y}^2{}_{-i}, \boldsymbol{q}^1) = u_i(y^0{}_i, \boldsymbol{y}^0{}_{-i}, \boldsymbol{q}^0)\ \forall\ i$, with strict inequality for at least one i.

Hence, $WTP_i \geq y^0{}_i - y^2{}_i\ \forall\ i$, with strict inequality for at least one i.

So,

$$\sum_{i=1}^{N} WTP_i(\boldsymbol{q}^1) > WTP_{PPI}(\boldsymbol{q}^1).$$

The necessary condition for Result 1 is that household members should care about the consumption of private goods by other household members. A partial converse to Result 1 may be obtained for the case where household members display paternalistic altruism[1] with respect to the nonrival good $\boldsymbol{q}$, but not with respect to general consumption. That is, household members gain utility from the fact that other members are consuming $\boldsymbol{q}$, but not from their general consumption. Then the converse of the argument used for Result 1 implies:

Result 2: If for all i, u_i is independent of all the y_j, $j \neq i$, then, for any $\boldsymbol{q}^1 \geq \boldsymbol{q}^0$, $\sum_{i=1}^{N} WTP_i(\boldsymbol{q}^1) = WTP_{PPI}(\boldsymbol{q}^1)$.

This result shows that paternalistic altruism with respect to the public good is fully reflected in both individual and household WTP measures.[2]

Paternalistic altruism with respect to the public good represents one polar case of the model. The opposite polar case arises when there exist functions $v_j(y, \boldsymbol{q})$ $j = 1, \ldots N$, and $W_i: \Re^N \rightarrow \Re$, such that $W_i(\boldsymbol{v}) = u_i(y_i, \mathbf{y}_{-i}, \boldsymbol{q})$, $\forall\ i$. This case may be interpreted as one of nonpaternalistic altruism in which each individual i has a 'private' utility function $v_i(y, \boldsymbol{q})$ but acts to maximize a 'household welfare function' W_i depending on the utility of all

[1] The term 'paternalistic altruism' is used here to refer to the idea that the person displaying altruistic cares about their own beliefs about what is good for the object of their concern, rather than about that person's own preferences.

[2] I am indebted to an anonymous referee for pointing this out.

household members. Individuals displaying nonpaternalistic altruism do not value the consumption of other household members directly, but only as it contributes to the utility of those household members.

We define WTP*$_i$, the 'private' WTP for individual i associated with a shift from $\boldsymbol{q}^0$ to $\boldsymbol{q}^1$ as the solution to the equality

$$v_i(y^0_{\mathrm{i}} - \mathrm{WTP}^*_i,\ \boldsymbol{q}^1) = v_i(y^0_{\mathrm{i}}, \boldsymbol{q}^0). \qquad (2)$$

Our next result shows that, in this case, household WTP is equal to the aggregate 'private' WTP. This result arises because the household can always redistribute income so as to make every member better off, provided that the cost to the household as a whole of an increase in q is less than the sum of private WTP.

Result 3: Assume that there exist functions $v_j(y, \boldsymbol{q})$ $j = 1, \ldots N$, and $W_i{:}\Re^N \rightarrow \Re$, such that $W_i(\boldsymbol{v}) = u_i(y_i, \mathbf{y}_{\text{-i}}, \boldsymbol{q})$, $\forall\ i$. Then for any $\boldsymbol{q}^1 \geq \boldsymbol{q}^0$, $\sum_{i=1}^{N}$ WTP*$_i(\boldsymbol{q}^1) = WTP_{PPI}(\boldsymbol{q}^1)$.

Proof: Define $\boldsymbol{y}^1$, $y^1_{\mathrm{i}} = y^0_{\mathrm{i}}$ - WTP*$_i$. Then, for all i ,

$$u_i(y^1_{\mathrm{i}}, \boldsymbol{y}^1_{-i}, \boldsymbol{q}) = W_i(v_1(y^0_1 - \mathrm{WTP}^*_1,\ \boldsymbol{q}^1), \ldots v_N(y^0_{\mathrm{N}} - \mathrm{WTP}^*_N,\ \boldsymbol{q}^1))$$

$$= W_i(v_1(y^0_1, \boldsymbol{q}^0) \ldots v_N(y^0_{\mathrm{N}}, \boldsymbol{q}^0)) = u_i(y^0_{\mathrm{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}).$$

Hence, by definition, $WTP_{PPI}(\boldsymbol{q}^1) \geq \sum_{i=1}^{N}$ WTP*$_i(\boldsymbol{q}^1)$.

Now suppose there exists $\boldsymbol{y}^2$ such that:

(i) $\sum_{i=1}^{N} y_i^2 < \sum_{i=1}^{N} y_i^1$; and

(ii) $u_i(y^2_{\mathrm{i}}, \boldsymbol{y}^2_{-i}, \boldsymbol{q}^1) \geq u_i(y^0_{\mathrm{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0) = u_i(y^1_{\mathrm{i}}, \boldsymbol{y}^1_{-i}, \boldsymbol{q})\ \forall\ i$.

Then there exists $\boldsymbol{y}^3 >> \boldsymbol{y}^2$ such that a shift from $(\boldsymbol{y}^1, \boldsymbol{q}^1)$ to $(\boldsymbol{y}^3, \boldsymbol{q}^1)$ constitutes a Pareto-improving redistribution of the private good, contrary to the assumption that no such redistribution is feasible.

Hence $WTP_{PPI}(\boldsymbol{q}^1) \leq \sum_{i=1}^{N}$ WTP*$_i(\boldsymbol{q}^1)$ and the result is proved.

Finally, observe that if all members of the household are perfectly altruistic, in the sense that they place an equal weight on the value of their own utility and that of any other member of the household, then $W_i(\boldsymbol{v}) = \sum_{i=1}^{N} v_j \; \forall \; i$. If personal utility v_i is linear in y_i, each individual will be willing to pay an amount equal to the WTP of the household as a whole. This yields:

Corollary 3.1 If all members of the household are perfectly altruistic, and personal utility v_i is linear in y_i,

$$\sum_{i=1}^{N} WTP_i(\boldsymbol{q}^1) = N \sum_{i=1}^{N} \text{WTP*}_i(\boldsymbol{q}^1).$$

The linearity condition of Corollary 3.1 will be approximately satisfied for small projects, provided preferences are smooth.

The analysis above is unchanged if willingness to accept (WTA) measures are used in place of WTP. The equivalent variation measure of individual WTA is implicitly defined by

$$u_i(y^0_{\text{i}}\, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^1) = u_i(y^0_{\text{i}} + WTA_i, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0), \tag{1*}$$

and household WTA is defined by

$$WTA_{PPI}(\boldsymbol{q}^1) = \inf\{ \sum_{i=1}^{N} y_i^0 - \sum_{i=1}^{N} y_i^1 : (\boldsymbol{y}^0, \boldsymbol{q}^0) \text{ is a potential Pareto-improvement on } (\boldsymbol{y}^1, \boldsymbol{q}^1)\}.$$

An argument similar to that used for Result 1 establishes:

Result 1*: Assume that for at least one pair (i, j), u_i is strictly increasing in y_j. Then for any $\boldsymbol{q}^1 \leq \boldsymbol{q}^0$, $\sum_{i=1}^{N} WTA_i(\boldsymbol{q}^1) \geq WTA_{PPI}(\boldsymbol{q}^1)$.

Analogous corollaries to Results 2 and 3 may be obtained similarly.

Interpretation

One way of interpreting Results 1 and 3, and particularly Corollary 3.1, is that the inclusion of altruistic WTP in measures of individual WTP involves a danger of 'double counting'. However, the core of the argument is not that benefits are overcounted when individual WTP is used as the basis for evaluation, but that costs are undercounted, in that the welfare loss to individual *i* associated with payments made by other household members is disregarded in the elicitation of individual WTP. In cases where differential degrees of altruism are expressed towards different household members, it may be argued that a form of overweighting is given to the utility of favoured members (Bernheim and Stark 1988), but this is a separate issue and is not addressed here.

We may also consider Result 3 in the light of the discussion by Brookshire, Eubanks and Sorg (1986) of 'preferential' and 'counterpreferential' WTP. Brookshire et al. use the term 'counterpreferential' to describe any WTP that arises from a feeling of moral duty rather than from the satisfaction of personal preferences. They argue that such counterpreferential WTP should be excluded from consideration in benefit–cost analysis. For example, if an adult with no children and no interest in education expressed WTP for schools on the ground that 'even though it does not benefit me, the community has an obligation to educate young people', Brookshire et al. would class this WTP as counterpreferential and would exclude it from consideration. If the altruistic component of individual WTP is regarded as counterpreferential, the approach advocated by Brookshire et al. would eliminate the disparity between household WTP and the sum of individual WTP.

The choice of benefit estimates

Having established that household WTP is, in general, less than or equal to the sum of individual WTP, it is necessary to consider which is a more appropriate estimate of the benefits generated by a public good. We begin by considering a number of arguments in favor of the use of household WTP. In each case, the argument shows that, under appropriate conditions, provision of a public good will be Pareto-optimal if and only if the cost of provision of the good is less than household WTP. Hence, under the stated conditions, household WTP is the most appropriate measure for use in benefit–cost analysis.

First, if the household chooses to redistribute income so as to achieve a Pareto-improvement on the original allocation whenever this is possible, an increase in the supply of the public good from $\boldsymbol{q}^0$ to $\boldsymbol{q}^1$ will be beneficial to the household if and only if the increase in the cost of provision of the public good is less than household WTP. By contrast, an increase from $\boldsymbol{q}^0$ to $\boldsymbol{q}^1$ at a cost greater than household WTP but less than aggregate individual WTP can never be associated with a Pareto-improvement.

Second, consider the case where a household with a capacity for redistribution makes choices about market goods which are nonrival within the household. Such a household will unanimously approve the provision of all and only public goods for which the household WTP is greater than the cost of provision. Aggregating across households will yield the aggregate market demand for the good.

Third, consider a household made up of identical individuals. Every member of such a household will favor an increase from $\boldsymbol{q}^0$ to $\boldsymbol{q}^1$ if and only if the required individual payment is less than $WTP_{PPI}(\boldsymbol{q}^1)$/N.

There are, however, some difficulties with the household WTP approach. Where households are made up of different individuals and there is limited capacity for redistribution, it cannot be guaranteed that the use of household WTP will lead to Pareto-optimal outcomes. For example preferences may differ by gender (Swallow et al. 1994), but redistribution within the household may be limited by gender roles. In these circumstances, provision of a public good for which household WTP exceeds the cost of provision may make some members of the household worse off, and elicitation of individual WTP may provide relevant information that is lost when the household WTP approach is used.

Elicitation of household WTP

The discussion in the previous section suggest that, in many cases, it will be desirable to measure household WTP rather than individual WTP. Most previous discussions of problems in eliciting WTP have focused on individual WTP. It is, therefore, of interest to consider how household WTP might be elicited. Three alternative methods of eliciting household WTP may be considered: the first is to elicit individual values which may be aggregated to yield household WTP; the second is to treat the household as a unit and attempt to elicit household WTP directly; and the third is to apply a referendum procedure.

Elicitation of personal utility

The first procedure is to interview a randomly selected member of each household in the sample population and to elicit WTP contingent on the hypothesis that all other household members will make a payment sufficient to leave them exactly indifferent between the implementation of the project and the original position. Under the conditions of Result 2, this is equivalent to eliciting WTP^*_i. Assuming that v_i represents personal utility, it may be possible to elicit WTP^*_i by asking a question of the form 'What payment would leave you *personally* indifferent between $\boldsymbol{q}^0$ and $\boldsymbol{q}^1$, assuming that the welfare of family members was unchanged'.

The most obvious difficulty with questions of this form is that they refer to a hypothetical situation that cannot be specified precisely in the absence of knowledge of the utility functions of all household members. The payment required of other household members to leave their utility unchanged will, in general, depend on the amount paid by the individual being questioned. This form of question is excessively complicated. Also, because it refers to an highly artificial situation, the question raises the possibility of strategic responses.

A more general difficulty with this approach is that it requires the selection of an appropriately randomized sample of individuals as representatives of households. Yet the household (that is, the group of people whose consumption enters into a given individual's utility function) will frequently include children and may include people who are not yet born. If personal utility is elicited from a sample that includes only adults, public goods that benefit children and future generations will be underprovided relative to household WTP[3].

Direct elicitation of household WTP

The second possible procedure is direct elicitation of household WTP. Such direct elicitation is commonly attempted by using either an open-ended question of the form, 'How much would your household be willing to pay ...' or a dichotomous choice asking the respondent to accept or reject a proposition in which the household would be required to pay a given amount in return for provision of the public good.

Several difficulties arise here. First, it is normally impractical to interview all household members and elicit a consensus decision. In practice, it is normal to interview one household member, possibly, but not always, one identified as the head of the household. Even if redistribution is possible, this member is likely to estimate the household WTP with error. If the member selected for interview is, on average, not representative of the

[3] Note that even household WTP is effectively determined by today's adults since they control the distribution of **y** within the households including, via bequests, the amount transferred to future generations. Thus the treatment of future generations associated with elicitation of household WTP is consistent with standard benefit–cost practice where the discount rate is determined by the preferences of the current (adult) generation, including the altruistic elements of u. Critics of benefit–cost analysis frequently argue that this implies excessive discount rates. *A fortiori*, this criticism applies to elicitation of personal utility values from current adults only.

household, estimates of the household WTP may be biased.

The referendum method

The third possible procedure for eliciting household WTP is based on surrogate referendum methods. Rather than using a hypothetical payment vehicle, the referendum method should specify both the good to be provided and the actual payment vehicle under consideration, for example, an increase in the rate of income tax or property tax. Thus, for any given tax rate it is possible to identify the payment consequences for each member of the household. However, the level of the payment vehicle for which a 'Yes/No' response is elicited, for example the increase in the property tax rate, will differ between respondents. This is the critical feature distinguishing the referendum method from a simple opinion poll.

Assume that the decision rule when using the referendum method is to provide the public good if and only if the median voter is in favor when the tax rate is sufficient to pay for provision of the good. Then, in the case where respondents are self-interested individuals, the referendum method is incentive-compatible; that is, for any individual, the optimal response is always to answer truthfully (Zeckhauser 1973).

It is straightforward to establish that this result extends to the case analyzed here. First, suppose that the household redistributes income to ensure a Pareto-improvement whenever this is feasible. Then all members of the household will vote in favor of any proposal for which the aggregate cost to household members is less than household WTP, and against all other proposals.

Alternatively, suppose that no redistribution is feasible. Given the specified vector of payments $\boldsymbol{t} = (t_1, t_2 \ldots t_N)$, standard arguments based on the concept of incentive-compatibility show that the individual will vote 'Yes' if and only if $u(y^0_{\mathrm{i}} - t_i, \boldsymbol{y}^0_{-i} - \boldsymbol{t}_{-i}, \boldsymbol{q}^1) \geq u(y^0_{\mathrm{i}}, \boldsymbol{y}^0_{-i}, \boldsymbol{q}^0)$. If $\sum_{i=1}^{N} t_i \leq WTP_{PPI}(\boldsymbol{q}^1)$, this condition must be satisfied for at least one *i*. If the net benefits of proposals are uniformly distributed within the household and $\sum_{i=1}^{N} t_i \leq WTP_{PPI}(\boldsymbol{q}^1)$, a majority of household members will vote in favor of the proposal.

Two main difficulties arise with the referendum method. The first is the need to specify the payment vehicle as well as the good to be provided. This difficulty is unavoidable when altruistic preferences are present. In eliciting individual WTP, it is normally assumed that rational individuals care only about the amount they pay for provision of a public good and not about the payment vehicle. The term ‘vehicle’ reflects the idea that the mode of payment is irrelevant.

The fact that some payment vehicles, when used in contingent valuation studies, tend to produce inconsistent replies or protest responses is regarded as a problem of communication rather than a violation of this assumption. Since it is assumed that the only thing that matters is the amount paid, a payment vehicle may be chosen because it is familiar to respondents or because it has been designed to minimize protest responses.

However, when altruism is present, individuals will, in general, care about the amounts paid by others, as well as the amount they themselves pay. For any given amount paid by one individual the amount paid by others will depend on the choice of payment vehicle. Hence, individuals may support a proposal if it is financed by, say, a property tax, but not if it is financed by a user charge, even though the amount they themselves are asked to pay is independent of the choice of payment vehicle.

A second difficulty with the referendum method is that incentive compatibility is preserved only by making the median respondent decisive. If benefits are unevenly distributed, proposals with $\sum_{i=1}^{N} t_i \leq WTP_{PPI}(\boldsymbol{q}^1)$ may be rejected and *vice versa*. The response of the median respondent may, however, be treated as a robust estimator of mean WTP (Mitchell and Carson 1989).

Conclusion

The choice between individuals and households as units of analysis is often regarded as a mere technical detail in the implementation of the contingent valuation method. As has been shown here, however, analysis of the problem reveals issues that go to the heart of the interpretation of the notion of passive use value and particularly of WTP based on altruism.

In the absence of altruism, or where altruism is paternalistic and only arises with respect to consumption of the public good, the choice between eliciting individual and household WTP is largely a matter of convenience, since both procedures should yield the same result. In the presence of nonpaternalistic altruism, standard procedures for eliciting individual WTP will yield aggregate benefit estimates greater than the WTP of the household as a whole.

This result arises because the standard definition of compensating variation involves only a partial specification of consequences affecting others; changes in $\boldsymbol{q}$ are included, but changes in $\boldsymbol{y}_{-i}$ are not. For most purposes, therefore, it is appropriate to elicit household rather than individual WTP.

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