Contingent Valuation: How Opportunity Costs Influence the Stated Willingness to Pay

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Abstract

The contingent valuation method is often used to estimate the willingness to pay for changes in a public good (e.g., water quality, public transport or food safety). We show how the stated willingness to pay changes when respondents to a contingent valuation survey believe their response affects not only the provision of the public good offered, but also the provision of an alternative public good in case the government cannot provide both goods. Empirical evidence suggests that at least 10 % of respondents consider alternative public goods when responding to contingent valuation surveys. Consequently, practitioners need to make sure that respondents are not influenced by the value of alternative public goods.

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Contingent valuation method · Negative willingness to pay · Opportunity costs

1 Introduction

Imagine you agreed to participate in a survey organized by your government. You are asked how you would vote in a referendum on a program to triple the frequency of public transport in rural areas. To fund the program, you would have to pay an annual tax. You like the program and tend to agree, but then remember the concept of opportunity costs: if choosing one option means to forgo another option, the value of this other option is the opportunity cost. Assuming the government cannot implement both options (e.g., because imposing additional taxes is politically infeasible), you wonder whether you would prefer the government to collect a tax to improve the quality of rural schools instead of public transport and are unsure how to reply.

According to the contingent valuation (CV) best practice (Phaneuf and Requate 2017), the offered public good is financed by an additional tax. In many cases though, an additional tax (i.e., supplementary to the one at issue in the survey) is unrealistic. Consequently, the provision of the offered public good will be at the cost of an alternative public good. The elicited willingness to pay (WTP) of respondents who take this into account will be biased.[1]

To be consistent with economic theory, a key requirement for unbiased CV surveys is to use an incentive-compatible survey design: it must ensure that for a rational respondent, truth-telling and utility maximization coincide (Bateman et al. 2002, p. 440). The necessary assumptions for a CV to be incentive-compatible depend on the specific elicitation format (payment card, bidding game, single binary choice, etc.). The single binary choice question is a simple elicitation format: the respondent is asked to decide between only two alternatives (e.g., change in the public good funded by a tax versus status quo). For this elicitation format, Carson et al. (2014) make two key assumptions for incentive

[1] Our analysis builds on the idea that considered government activities are financed by additional taxes. The logic of opportunity costs would also apply if no additional taxes are introduced (i.e., the government budget is fixed). However, the analysis in the following sections would differ.

compatibility. First, the vote is coercive in that all members of the population are forced to follow the conditions of the referendum if the required majority favors its passage. Second, the vote on the referendum does not affect other public goods that are available to the relevant population. Carson et al. (2014) show that the first assumption can be reduced to the CV survey having a positive probability of influencing the decision to provide the public good. This makes it relatively easy to meet the assumption in a survey: it is credible to argue that the decision-makers will consider the survey findings.

Failing to fulfill the second assumption, however, renders the survey not incentive-compatible. Instead, the optimal response will incorporate the influence of the choice on the offered and an alternative second-best outcome. Consequently, the response may be different than in the case where only the offered alternative is at stake. Carson and Groves (2007) also draw the parallel to voting in the public choice literature, where there is a sequence of decisions (Romer and Rosenthal 1978). Beyond these discussions, a violation of the second assumption has – to the best of our knowledge – not been discussed in the CV literature. A notable exception is Richer (1994), who tested the influence of alternative options in a real life CV application.

The purpose of this article is to discuss the consequences of alternative public goods on the stated maximum WTP. Specifically, we show theoretically how the stated WTP of rational respondents differs if the second assumption is violated. By formalizing the bias, we go beyond the work of Carson et al. (2014). Additionally, we explain this phenomenon with the concept of opportunity costs. By using opportunity costs in an indirect utility function specification, we use a well-known economic concept that allows us to explain how the stated WTP depends on the reference against which it is measured (status quo or alternative public good). Our article bridges the gap between the theory put forward by Carson and colleagues in several articles (Carson and Groves 2007; Carson et al. 2014) and most empirical applications (most CV applications are framed in an indirect utility function specification). We hope that CV practitioners can easily relate to the concept we put forward.

To strengthen our argument, we reanalyze an open-ended question from a CV survey published in the journal "*Science*" (Bishop et al. 2017): 10 % of all respondents indicate preferences for other government programs (i.e., alternative public goods) as a reason for their vote, even though the CV survey did not claim any influence of the proposed tax on other government programs. Our analysis also provides an explanation for a stated WTP to become a negative value even for utility-increasing public goods. For a discussion on other reasons for a negative stated WTP see, for example, Bohara et al. (2001) or the summary in the online Appendix 1.

2 Standard Single Binary Choice Question

In studies of applied environmental economics, the benefit of a change in a public good is frequently expressed as the compensating variation, i.e., the compensating payment necessary to make the individual indifferent between the current level of a public good and a new level of a public good at the ex-ante level of utility. Specifically, the indirect utility (Phaneuf and Requate 2017), *V(p,q,m)*, is a function of prices of a private numeraire good[2] (*p*), the quality or quantity of a public good (*q*), and the income (*m*). The quantity of private goods consumed is controlled by the individual, whereas the quality or quantity of public goods consumed is not. Hence, individuals can decide what to buy on the market at prices *p*, but they cannot decide on the quality or quantity of the public good. The compensating variation of the public good (denoted as t') is defined as the maximum amount a person is willing to pay in exchange for an improvement in the public good. Formally, the definition of the compensating variation t' is

$$V(p,q,m) = V\left(p, q + e', m - t'\right) \tag{1}$$

where $e' > 0$ is the change in the public good quantity or quality through a policy measure. Throughout the article, we assume that e' is utility-increasing. The maximum income the individual is willing to give up for the public good is t'.

In the single binary choice question, the respondent is assumed to maximize utility by either agreeing to pay the proposed contribution t_0' to fund a change from q to $q+e'$ or voting against the proposal. Carson et al. (2014) have explained the assumptions necessary for rational respondents to reveal their true WTP (t') in a single bounded choice question. For a summary of the six propositions by Carson et al. (2014) see the online Appendix 2.

Assuming that the propositions 1 to 6 for incentive compatibility hold, the respondent's indirect utility is

$$V_1 = V\left(p, q + e', m - t_0'\right) \tag{2}$$

if the public good is provided and her/his contribution is t_0'. If the public good is not provided, the respondent's indirect utility is

$$V_0 = V(p,q,m) \tag{3}$$

[2] A numeraire good is representative of a basket of private goods scaled to have a price of 1 €. This is done for conceptual ease, to avoid having to deal with different goods and prices, and allows expressing income in terms of the number of numeraire goods consumed.

Consequently, if the majority rule leads to the provision of the public good, the respondent must contribute t_0' even if she/he did not vote in favor of the provision. The contribution t_0' may potentially vary for different respondents. If the majority rule results in not providing the public good, the contribution is 0.

In the single binary choice question, the respondent can decide whether to vote "yes" to agree to the change ($D=1$) or "no" to disagree to the change ($D=0$). The decision is taken by setting D equal to 1 or 0 to maximize utility:

$$\begin{aligned} &max\{D \cdot V_1 + (1-D) \cdot V_0\} \\ &= max\left\{D \cdot V\left(p, q+e', m-t_0'\right) + (1-D) \cdot V(p,q,m)\right\} \end{aligned} \tag{4}$$

Examine first the situation where the respondent considers the proposed change (increasing the public good to e' with a contribution of t_0') as utility-increasing (case A1 in Table 1): as the change is utility-increasing compared with the status quo (i.e., spending income on a market good), $t_0'<t'$ must hold. The respondent has an incentive to support the provision of the public good as $(t'-t_0')$ is positive and therefore better than the status quo. Consequently, the respondent supports the proposed change ($D=1$). If, instead, $t_0'>t'$ (case A2 in Table 1), a rational respondent would reject the proposal of the referendum ($D=0$) as the surplus $(t'-t_0')$ is negative. As we have assumed e' is utility-increasing, the rejection does not occur because the public good is utility-decreasing, but because of a contribution t_0' higher than t'.

This result holds regardless of what the respondent believes other respondents will reply: by voting in the referendum, only the provision of the public good is influenced. If the majority decides to provide the public good, the contribution is

Table 1 Available options and responses for different cases if the assumptions for incentive compatibility hold. Own illustration

Available options				
		Change	WTP	Required contribution
	Offered public good	e'	$t'>0$	$t_0'>0$
	Status quo	0	0	0
Cases				
	Utility ranking	Surplus e': $t'-t_0'$	Vote	Bias in binary choice survey
A1:	$V(p, q+e', m-t_0')>$ status quo	>0	"Yes"	No bias
A2:	Status quo $>V(p, q+e', m-t_0')$	<0	"No"	No bias

t_0', regardless of the individual's vote. Hence, there is no strategic behavior for rational respondents in the single binary choice question.

Thus, with the single binary choice question, it is possible to elicit from respondents whether t_0' exceeds t'. The maximum t_0' at which respondents agree to the referendum is therefore t'. As long as the public good is utility-increasing, t' will be positive. Econometric models can then be used to apply welfare evaluations based on the survey data.

This result can be understood in terms of opportunity costs. Opportunity costs are defined as "the value of the next most valuable option sacrificed once a resource commitment is made" (Griffin 2006, p. 41). In the context of the single binary choice question, we measure the value of the offered public good as the WTP for a change relative to the status quo. The status quo is the utility of the optimum bundle of private goods. Thus, the next best option (which determines the opportunity cost) is this bundle of private goods. The value of this bundle determines the maximum WTP that we are interested in measuring ("What is the maximum value from market goods I am willing to give up for the public good?"). If opportunity costs are market goods, they determine the value of an option. However, if the next best option is not a bundle of market goods but an alternative public good, this will cause opportunity costs that are not identical to the value we are typically interested in measuring. In this case, the opportunity cost is the forgone surplus from the alternative public good. The surplus is the value of the alternative option reduced by the required contribution; of course, both are also measured in terms of market goods.

3 Relaxing the Assumption of No Influence on the Provision of Alternative Public Goods in the Single Binary Choice Question

The incentive compatibility of the single binary choice can be lost if an alternative public good is added. This alternative public good may come into play as respondents consider an additional tax unrealistic and believe that the offered public good will be provided at the expense of another public good. Carson et al. (2014) formulate their proposition 7 in order to analyze strategic behavior when there is the possibility of influencing a second outcome. We aim to show how the WTP changes under this condition. Consequently, we also assume propositions 1 to 6 of Carson et al. (2014), see online Appendix 2, in order to ensure incentive compatibility of the mechanism. However, we modify proposition 7 of Carson et al. (2014): If there is a possibility of influencing a second outcome, then the

response to a question is generally not incentive-compatible with respect to preferences concerning the choice posed. In this case, the optimal response will incorporate the change in opportunity costs of choosing the first outcome if the respondent believes the second outcome has a chance of occurring in case the first outcome does not.[3]

Opportunity costs are determined by what the respondent thinks will happen if the offered public good is not provided due to the majority rule: will the alternative public good be provided or will the status quo be maintained? The opportunity costs are then either the forgone surplus of the alternative public good option or the value of the status quo option. In the latter case, the opportunity costs are zero and need not be considered when measuring the WTP. In the former case, the WTP related to the status quo would be of interest, but the *stated* WTP is instead the maximum WTP minus the opportunity costs. This is because the reference level used to measure the value of the offered public good changes depending on the surplus of the alternative public good.

Denote the alternative public good as e'', and define the maximum WTP as t'', similar to (1):

$$V(p,q,m) = V\left(p,q+e'',m-t''\right) \tag{5}$$

To discuss the situation in which an alternative public good is available, we first define the utility of the three options. If the offered public good e' is provided and the contribution is t_0', the respondent's indirect utility is

$$V_1 = V\left(p,q+e',m-t_0'\right) \tag{6}$$

If the alternative public good e'' is provided and the contribution is t_0'', the respondent's indirect utility is

$$V_2 = V\left(p,q+e'',m-t_0''\right) \tag{7}$$

If no public good is provided but the status quo remains, the respondent's indirect utility is

$$V_0 = V(p,q,m) \tag{8}$$

[3] The first sentence is identical to Carson et al. (2014), and the second sentence reads: "In this case, the optimal response will incorporate the influence on both outcomes so that the response may be different than in the case where only the first outcome can be influenced by the vote".

Given these benefits from the three options, what is the response elicited by the single binary choice question?

The respondent is asked whether she/he would agree to a contribution t_0' to finance the offered public good e'. If rejected by the majority rule, an alternative public good e'' with a contribution t_0'' or the status quo would materialize. The respondent holds beliefs about what would happen if the referendum is rejected. For simplicity, we consider only two possible states if the majority rule rejects the offered public good disregarding decision under risk: the respondent thinks either the alternative public good e'' will be provided at costs t_0'' (noted by $\alpha = 1$) or the status quo will be maintained (noted by $\alpha = 0$). A situation where $\alpha = 1$ occurs if the status quo cannot be maintained, e.g., because no additional tax can be introduced and the provision of the offered public good is at costs of a competing alternative public good. A situation where $\alpha = 0$ occurs if there is no change associated with the rejection, i.e., because a new tax is introduced. If the respondent is not aware of being affected, he/she behaves as if $\alpha = 0$.

In addition, for simplicity, we restrict the discussion to e' and e'' being public goods and exclude utility-decreasing public goods ("public bads"). Consequently, t' and t'' are positive. Furthermore, the contributions t_0' and t_0'' are assumed to be positive.

The respondent maximizes the utility by setting $D = 1$ (vote "yes" to agree to the proposed change) or $D = 0$ (vote "no" against the proposed change):

$$\begin{aligned} &max\{D \cdot V_1 + (1 - D)[\alpha \cdot V_2 + (1 - \alpha) \cdot V_0]\} \\ &= max\left\{ \begin{array}{l} D \cdot V\left(p, q + e', m - t_0'\right) + (1 - D) \\ \left[\alpha \cdot V\left(p, q + e'', m - t_0''\right) + (1 - \alpha) V(p, q, m)\right] \end{array} \right\} \end{aligned} \tag{9}$$

As part of the survey question, the respondent is told what t_0', the contribution to the offered public good, would be. The contribution to the alternative public good t_0'', which is part of V_2, can either be explicitly stated or is implicitly assumed by the respondent (and is not observable by the researcher).

We can distinguish six cases by varying the surplus of the two public goods (we ignore situations of indifference between the options). The more interesting situations arise where $\alpha = 1$ (i.e., if the offered public good is not provided, the alternative public good is provided). They are shown in Table 2. Given $\alpha = 1$, the decision problem is reduced to voting "yes" if $V_1 > V_2$ and "no" if $V_1 < V_2$. This translates to the respondent voting "yes" if $(t' - t_0') > (t'' - t_0'')$ and "no" if $(t' - t_0') < (t'' - t_0'')$. In the context of the single binary choice question, the respondent will consequently vote "yes" if $t_0' < t' - (t'' - t_0'')$ and "no" if $t_0' > t' - (t'' - t_0'')$.

Table 2 Available options and responses for different cases if the assumptions of no influence of the alternative public good do not hold. Results for $\alpha = 1$. Own illustration

Available options						
		Change	WTP	Req. contribution		
	Offered public good (usually explicit)	e'	$t'>0$	$t_0'>0$		
	Alternative public good (usually not explicit)	e''	$t''>0$	$t_0''>0$		
	Status quo	0	0	0		
Cases						
	Utility ranking	Surpl. e': $t'-t_0'$	Surpl. e'': $t''-t_0''$	Diff. surplus: $(t'-t_0')-(t''-t_0'')$	Vote	Bias in binary choice survey
B1:	$V(p, q+e', m-t_0')>$ $V(p, q+e'', m-t_0'')>$ Status quo	>0	>0	>0	"Yes"	No bias
B2:	$V(p, q+e'', m-t_0'')>$ $V(p, q+e', m-t_0')>$ Status quo	>0	>0	<0	"No"	Downward by $(t'-t_0')$
B3:	$V(p, q+e', m-t_0')>$ Status quo$>$ $V(p, q+e'', m-t_0'')$	>0	<0	>0	"Yes"	No bias
B4:	$V(p, q+e'', m-t_0'')>$ Status quo$>$ $V(p, q+e', m-t_0'')$	<0	>0	<0	"No"	No bias

(continued)

Table 2 (continued)

B5:	Status quo> $V(p, q+e', m-t_0')$> $V(p, q+e'', m-t_0'')$	<0	<0	>0	"Yes"	Upward by $(t'-t_0')$
B6:	Status quo> $V(p, q+e'', m-t_0'')$> $V(p, q+e', m-t_0')$	<0	<0	<0	"No"	No bias

Turn first to the cases in which the utility of the offered public good is higher than that of the status quo: B1, B2 and B3 in Table 2.

In all three cases, the respondent would vote "yes" if there was no alternative public good because $(t'-t_0')>0$. In cases B1 and B3, the respondent will also vote "yes" if there exists an alternative public good because $(t'-t_0')>(t''-t_0'')$. In case B2 though, the respondent will vote "no" because $(t'-t_0')<(t''-t_0'')$. This leads to a downward bias by $(t'-t_0')$. Thus, the estimated WTP is lower than the true WTP. Holding everything else constant and reducing t_0', the respondent will switch to "yes" if $t_0'<t'-(t''-t_0'')$. Thus, the highest possible downward bias for this one respondent is $(t''-t_0'')$.[4] The stated WTP can become negative if $t'<(t''-t_0'')$, which is possible as $(t'-t_0')<(t''-t_0'')$ and $t_0'>0$. I.e., the surplus of the alternative public good is higher than the surplus of the offered public good, and consequently the respondent needs to be compensated to accept the offered public good.

Turn now to the cases where the utility of the offered public good is lower than that of the status quo: B4, B5, and B6. In all three cases, the respondent would vote "no" if there were no alternative public good because $(t'-t_0')<0$. In case B4 and B6, the respondent will also vote "no" if there is an alternative public good because $(t'-t_0')<(t''-t_0'')$. In case B5 though, the respondent will vote "yes" because $(t'-t_0')>(t''-t_0'')$. This leads to an upward bias by $(t'-t_0')$. Holding everything else constant and increasing t_0', the respondent will switch to "no" if $t_0'>t'-(t''-t_0'')$. The highest possible upward bias for this one respondent is therefore $(t''-t_0'')$, which is the surplus of the alternative public good.

For a respondent who assumes that a rejection of the offered public good by the majority rule leads to the status quo ($\alpha=0$), the six cases reduce to the

[4] This can be seen as follows: The bias is $(t'-t_0')$. The lowest possible value of t_0' before the respondent switches to "yes" is $t'-(t''-t_0'')$. Replacing t_0' in the former expression with the latter gives $t'-(t'-(t''-t_0''))=(t''-t_0'')$.

two cases in Table 1. Cases B1, B2, and B3, in which the offered public good is preferred over the status quo, are identical to case A1. Cases B4, B5, and B6, in which the status quo is preferred over the offered public good, are identical to case A2. For a detailed numerical example see online Appendix 3, and for an analysis under uncertainty which option will materialize, see the simulations in online Appendix 4.

4 Consequences for Empirical Applications and Evidence

Based on the preceding analysis, there are at least two ways to handle the influence of opportunity costs:

- Adding opportunity costs as a variable in a regression analysis. This would require estimating $\alpha(t''-t_0'')$, but estimating t'' leads to the same kind of opportunity costs bias as for the offered public good. Theoretically, it is possible to correct for this bias as well, but in practice this may render surveys too complex for empirical applications. Consequently, if there is an alternative public good with a positive probability of materializing which respondents consider, an unbiased WTP estimate is challenging.
- A more practical approach is to convince respondents that there is no change to the status quo if the offered public good, financed by a separate tax, does not materialize. It depends on the specific context whether this is plausible and convincing. If it is convincing, there is no opportunity cost related bias as $\alpha = 0$. If it is not convincing, the CV method is not an appropriate approach from a theoretical perspective.

A well-published example supporting our concerns is the environmental valuation study by Bishop et al. (2017), assessing the environmental damages caused by the Deepwater Horizon oil spill in the Gulf of Mexico in 2010. Their questionnaire included an open-ended question where respondents were asked for the reasons why they voted for or against an additional tax to fund a governmental program to prevent future oil spills. The responses were coded using a three-phase approach in which each response was ultimately assigned to coding categories (see Appendix 4.1 of Bishop et al. (2017)).

One of the 75 coding categories was “Government should spend money on other programs beside oil spills, or the government shouldn’t add new programs or shouldn’t be involved or responsible”. From the original replies, published

Table 3 Open question categories. Own illustration

	All voters	Yes-voters	No-voters
Number of respondents	3,613	1,508	2,105
Coding category of open question			
"Government should spend money on other programs beside oil spills, or the government shouldn't add new programs or shouldn't be involved or responsible." (original category)	20.51 %	2.85 %	32.35 %
"Government should spend money on other programs beside oil spills." (subcategory)	10.88 %	1.66 %	17.48 %

Note: Respondents which did not vote (1.2 %) or did not give a reason for their vote (7.9 %) were dropped.

in the article's online Appendix, 10.88 % fall according to our counting into the subcategory "Government should spend money on other programs beside oil spills" (Table 3). Among the yes-voters 1.66 % were assigned to this subcategory, and of the no-voters 17.48 %.

Education, health care, poverty prevention, promotion of alternative energy, alternative techniques to prevent oil spills, and support for the military were among the suggested alternatives for using tax money instead of preventing future oil spills. Theses answers suggest that the tax for the oil spill prevention program offered was considered as rival to alternative government programs, even though this was not claimed in the survey. A 63-year-old woman with professional degree, interviewed in January 2014, said: "*Although I personally would be willing to pay more taxes, I am afraid that of the opportunity cost of imposing this tax. SPECIFIC OPPORTUNITY COSTS? It is whatever cost comes from giving up the opportunity to spend on something else. I am afraid in our political climate, it would spend our tax increase capital that might be better spent on things that have permanent effect. SPECIFIC PERMANENT EFFECT? Education, alternative energy sources, support for poor people, strengthen our middle class. WR? None.*" (taken from the online Appendix of Bishop et al. (2017)[5]).

[5] Words in all capital letters are interviewer's questions. WR is short for "WHICH OTHER REASONS?".

Even if not all of the 10.88 % of respondents who mentioned alternative government programs had our article's idea explicitly in mind, a fair share of respondents seem to think along these lines.

5 Discussion and Conclusions

In this article, we emphasize the need to distinguish CV surveys where the provision of the public good influences the provision of an alternative public good and those where this is not the case. We consider this distinction as important as in most real life settings it is difficult to introduce additional taxes. This will make some respondents think that an offered public good will be introduced at the cost of another public good. Mentioning alternative public goods explicitly in the questionnaire, as recommended in the influential NOAA (National Oceanic and Atmospheric Administration) guidelines (Arrow et al. 1993), will influence and potentially standardize the awareness of alternative public goods. However, respondents might also think of alternative public goods without having them mentioned.

If respondents consider opportunity costs associated with alternative public goods, a practical implication is that the individually stated WTP for a public good could become negative even if it is welfare-increasing. Depending on the distribution of the WTP and of the surplus of the alternative public good, the *average* WTP could also become negative. This provides a new explanation for negative and zero bids (i.e., if respondents indicate that their WTP is negative or zero) in CV studies. More frequently, opportunity costs will lead to an upward or downward bias and might remain undetected by researchers. Finally, not only the mean, but also other measures of central tendency can be influenced by the distribution of the surplus of the alternative public good rendering these measures biased as well.

The idea of rational behavior and utility maximization is only one of many explanations for respondent behavior. Many reasons not considered here (such as psychological, political, social, or moral motivations) influence decision-making (Lo and Jim 2015). However, if one argues within a standard economic framework, disregarding opportunity costs renders the CV theory inappropriate to elicit economic valuation if the offered public good is not financed through an additional tax by respondents. We propose to apply the CV method only if it can be credibly stated that the status quo will be maintained if the offered public good is not provided.

Four existing studies suggest that alternative public goods influence respondents' voting behavior: In a study by Bishop et al. (2017), an estimated 17.48 % of "no"-voters thought that the provision of the suggested public good might influence alternative public goods, even though they were told the proposed tax is additional. In a study by Kemp et al. (2017), respondents' WTP increases 6 to 60 times when only the offered public environmental good is valued as opposed to when it is valued jointly with other environmental goods. Richer (1994) does not find an influence of an explicitly specified alternative public good on the mean WTP, but does reveal a reduction in bid variance. Finally, Carson et al. (2014) confirm in an experimental setting that adding a more attractive alternative public good with a positive probability of materializing reduces the support for the original public good. In our opinion, these empirical findings justify at least one survey question to check if respondents consider alternative public goods. This is not routinely done and disregarding alternative public goods may influence the estimated WTP (Morawetz and Koemle 2017).

We conclude that for the interpretation of the stated WTP, it is important to explicitly state the reference against which WTP is measured. In a cost–benefit analysis, it is natural to consider opportunity costs originating from alternative options. If respondents decide in an analogous way, practitioners need to consider this in the CV method as well.

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