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Reconsidering Donations for Nonmarket Valuation

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Abstract Researchers employing the stated-preference technique of contingent valuation have a history of using donations to value public goods despite conceptual differences between willingness to pay and willingness to donate. The practice is justified based on an understanding that willingness to donate can serve as a theoretical lower bound of the appropriate measure of Hicksian surplus. This paper shows that the basis for this understanding in the literature is incomplete and potentially misleading. If donations are used in valuation surveys, greater attention is needed to ensure consistency between the way stated preferences are elicited and donations would occur in practice.

Keywords Contingent valuation · Donations · Impure altruism

1 Introduction

To what extent can donations be used as a vehicle for nonmarket valuation? The question has attracted significant attention from environmental economists focused on developing ways to estimate the benefits of improvements to environmental quality. Where markets for environmental quality do not exist, there are frequently opportunities to make donations. Indeed, charitable giving in the United States to environmental and animal organizations was $8.3 billion in 2012, up 4.7 % from the previous year (Giving USA 2013). One question to consider is whether these revealed preferences can be used to value nonmarket environmental benefits.

The challenges arise because of a mismatch between the objective of valuation and the motives for making a donation. Nonmarket valuation seeks to estimate an appropriate Hicksian welfare measure. In an environmental context, the relevant measure is usually the com-

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pensating surplus for an improvement in environmental quality (Freeman 2003; Haab and McConnell 2003). This translates into an individual's willingness to pay (WTP), which is the amount of income one is willing to give up to obtain the improvement in environmental quality, yet still enjoy the initial level of utility as if the environmental improvement did not occur.

The amount an individual will choose to donate to improve environmental quality is something quite different. One difference is that the level of environmental improvement may be endogenous to the amount an individual chooses to donate. With a standard voluntary contribution mechanism, for example, more contributions fund more environmental improvements. Another important difference is the way that individuals will consider the behavior of others when choosing how much to donate towards the provision of an environmental public good. In particular, the incentive to free ride will affect individual donations, whereas free riding plays no role in the conceptual basis of WTP.

Despite the conceptual differences between WTP and willingness to donate, researchers employing the stated-preference technique of contingent valuation (CV) have a history of using donations as a payment vehicle in valuation surveys. Champ and Bishop (2001) cite many studies and explain how donations are easier to validate against actual behavior, may be less subject to bias than other payment vehicles, and are perhaps more credible for small-scale goods. These advantages do not, however, resolve issues about how to interpret donations—based on either stated or revealed preferences—as meaningful estimates of economic value.

Champ et al. (1997), hereafter CBBM, seek to address the issue and conclude that donations can be interpreted as a theoretical lower bound of the Hicksian compensating surplus. Part of CBBM's analysis is that the result holds even if donations are motivated partly or completely by Andreoni (1989, 1990) "warm glow," whereby individuals benefit simply from the act of donating. CBBM's highly cited paper has provided an important bridge for CV research because it allows practitioners to take advantage of the donation mechanism and still provide meaningful estimates for applied welfare analysis.[1] Unfortunately, while helping to advance the literature, CBBM's analysis includes some conceptual oversights, and the results are potentially misleading for CV researchers seeking to use donations as a payment vehicle.

In this paper, I reconsider the question of whether donations can serve as a theoretical lower bound of Hicksian surplus for a privately provided public good. Contrary to CBBM's conclusion, and apart from reasons related to hypothetical bias, I find that one's willingness to donate can exceed one's willingness to pay depending on the degree of consistency between the elicitation mechanism of a CV survey and the way that private provision of a public good would actually occur. The discrepancy arises because of the way that donation levels are not invariant to the elicitation mechanism. Chilton and Hutchinson (1999) identify limitations of CBBM's result depending on whether public goods are privately or publicly provided. I show further limitations even among mechanisms of private provision. The paper is intentionally short to make a clear and concise contribution with broad application to applied research. The results provide guidance and underscore the importance of even greater caution among CV researchers when using donations for stated-preference, nonmarket valuation.

2 The Model of Impure Altruism

Let us begin with the basic setup of Andreoni's (1989, 1990) model of impure altruism for private provision of a public good. I use this model with standard notation rather than

[1] The paper has been cited 449 times according to Google Scholar on February 28, 2014.

CBBM's original setup to simplify the exposition and focus on the primary results of interest. Anchoring the results in a standard framework will also help generalize the insights. In the "Appendix", I reproduce CBBM's setup and show how their analysis is equivalent to the more parsimonious version here.

A representative individual i solves the following utility maximization problem:

$$\max_{x_i, g_i \geq 0} \{U_i(x_i, G, g_i) : G = G_{-i} + g_i \text{ and } w_i = x_i + g_i\}, \tag{1}$$

where U_i is non-decreasing and concave in all arguments, x_i is a composite private good, and g_i is the individual's donation to the environmental public good G. The aggregate level of G is the individual's donation plus the sum of donations by all others, denoted G_{-i}, which is assumed to be exogenous. The price of the private good is normalized to unity, and income is denoted w_i.

The difference between the model in (1) and the standard model for a privately provided public good (e.g., Bergstrom et al. 1986; Cornes and Sandler 1996) is the inclusion of g_i as a separate argument in the utility function. This implies that individuals may receive a private benefit—a "warm glow"—from their own contribution to the public good, in addition to the public-good benefit captured through the level of aggregate provision G. Let us denote the solution to (1) as $\left(x_i^*, g_i^*\right)$.

It is convenient (and consistent with CBBM's approach) to specify an indirect utility function that admits the possibility for constraints on the individual's ability to make donations. In particular, define the indirect utility corresponding to given levels of g_i as

$$V_i(w_i, G_{-i} \mid g_i) = \max_{x_i \geq 0} \{U_i(x_i, G_{-i} + g_i, g_i) : w_i = x_i + g_i\}. \tag{2}$$

Note that this specification enables us to evaluate different levels of indirect utility when the chosen level of g_i that the individual donates may or may not arise through optimization. In particular, it is useful to note that the function specified in (2) is not an unrestricted indirect utility function in the usual sense, but rather a conditional indirect utility function given different levels of g_i. With utility maximization, however, it follows by definition that the individual's optimal donation is

$$g_i^* = \arg\max_{g_i} V_i(w_i, G_{-i} \mid g_i), \tag{3}$$

where correspondingly $x_i^* = w_i - g_i^*$ and $G^* = G_{-i} + g_i^*$.

I now derive two welfare measures that are analogous to those in CBBM and central to their analysis. First is the individual's compensating surplus associated with the enjoyment of G_{-i} provided by others and one's own donation of g_i^*. This benefit CS_i solves

$$V_i\left(w_i - CS_i, G_{-i} \mid g_i^*\right) = V_i(w_i, 0 \mid 0). \tag{4}$$

The second welfare measure of interest is the benefit that one enjoys from making her own contribution while keeping the contribution of others constant.[2] This benefit d_i solves

$$V_i\left(w_i - d_i, G_{-i} \mid g_i^*\right) = V_i(w_i, G_{-i} \mid 0). \tag{5}$$

[2] It is worth mentioning explicitly that CBBM focuses on a representative individual and do not consider adjustments to the behavior of others. In other words, their analysis does not consider changes in G_{-i} that that would occur in a Nash equilibrium in response to changes in individual i's donation. I follow the same simplifying assumption here.

By this definition, d_i is the extra utility gained from contributing to the public good at g_i^* that comes from the inframarginal dollars donated and may consist of warm-glow and public-good benefits.

CBBM argue that $CS_i \geq d_i$, which follows because utility is non-decreasing in G. The proof is straightforward upon recognizing that the right-hand side of (4) is weakly less than the right-hand side of (5), implying that $CS_i \geq d_i$ must hold because indirect utility is increasing in income. Intuitively, CS_i is greater than d_i by the amount of enjoyment the individual derives from the contributions of others.

Thus far there are no problems with these welfare measures and the relative magnitudes, as described by CBBM and rederived here. The troubles begin, as we will see, with CBBM's interpretation and application of these magnitudes in the context of CV surveys.

3 Willingness to Donate

I begin with donations rather than the overall surplus measure. CBBM interpret $d_i + g_i^*$ as the individual's maximum willingness to donate; and regarding a referendum format CV question, they claim that

> If asked in a dichotomous choice framework whether she would actually be willing to donate some amount more than $d_i + g_i^*$ rather than not donate at all, she would refuse because she can gain more utility by free riding. However, if given the opportunity to donate some amount less than or equal to $d_i + g_i^*$ rather than not donate at all, take it or leave it, she will agree (p. 155).

I argue that $d_i + g_i^*$ is in fact not an individual's maximum willingness to donate, and CBBM's description is incorrect about how an individual would respond to the CV question.

The confusion arises because of the way that d_i as a monetary measure of surplus is not the same as a monetary donation to the public good—the difference being that donations actually provide the public good and produce warm glow. Consider what would happen if the individual actually donated $d_i + g_i^*$. The aggregate level of the public good would increase to $G = G_{-i} + g_i^* + d_i$ from $G^* = G_{-i} + g_i^*$. Thus, not only is the level of the public good endogenous to the individual's donation, different levels of one's own donation also generate different levels of warm glow. CBBM's definition of d_i in (5) captures neither of these effects.

Within a referendum framework, the relevant notion of one's maximum willingness to donate is the donation level that creates indifference between having the option to donate or not, holding the behavior of others constant. For the moment, let's assume such a donation level exists, but we will soon see that indifference between the scenarios is not required for the result of interest. To formally define willingness to donate, let's first consider what would happen if the individual were to increase her donation beyond g_i^* by the amount $\Delta_i \in [0, w_i - g_i^*]$. Indirect utility, as defined in (2) and therefore corresponding to the allocation of income such that $(x_i, g_i) = \left(w_i - \Delta_i - g_i^*, g_i^*\right)$, would be $V_i\left(w_i, G_{-i} | \Delta_i + g_i^*\right)$. We can thus define the individual's maximum willingness to donate in a referendum, take it or leave it, question as the amount $\Delta_i^* + g_i^*$, where Δ_i^* is defined as

$$\Delta_i^* = \underset{0 \leq \Delta_i \leq w_i - g_i^*}{\arg\min} \left\{ V_i\left(w_i, G_{-i} \mid \Delta_i + g_i^*\right) - V_i\left(w_i, G_{-i} \mid 0\right) \geq 0 \right\}. \tag{6}$$

The intuitive case of an interior solution is one where the two levels of indirect utility in (6) are equated, $\Delta_i^* < w_i - g_i^*$, and the maximum willingness to donate creates indifference

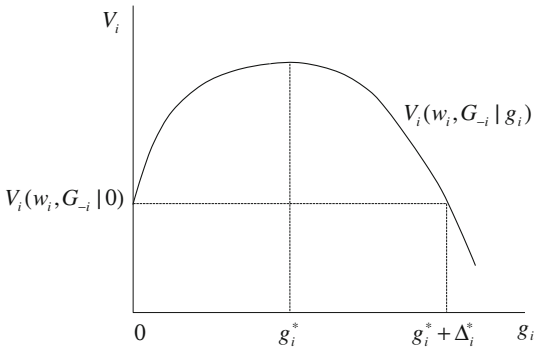

Fig. 1 Graph showing an interior solution of willingness to donate in a referendum setting

between having the option to donate or not. The corner solution where $\Delta_i^* = w_i - g_i^*$ captures the (presumably unlikely) possibility that an individual would strictly prefer the option to donate *all* of her income than to not have the option to donate at all. In this case, the first level of indirect utility in (6) remains greater than the second even when $\Delta_i^* = w_i - g_i^*$.

Figure 1 illustrates the definition of Δ_i^* graphically for the case of an interior solution. With indirect utility on the vertical axis and g_i on the horizontal axis, $V_i\ (w_i, G_i|0)$ indicates the level of utility when the individual is constrained to *not* make a donation. Increases in g_i due to relaxing the constraint cause utility to increase until it reaches a maximum at $g_i = g_i^*$. With further increases in g_i, the individual is being pushed beyond her chosen donation level, so utility is declining. Nevertheless, utility is still greater than if she is not able to donate at all up until the point where $g_i = \Delta_i^* + g_i^*$, where utility is equated between the options of donating $\Delta_i^* + g_i^*$ or not donating at all.[3]

Now that we have defined Δ_i^*, we can compare its magnitude to that of CBBM's measure of d_i.

Claim: *It holds that* $d_i \leq \Delta_i^*$.

Proof First consider an interior solution to (6). We know that

$$\begin{aligned} V_i\left(w_i - d_i, G_{-i} \mid g_i^*\right) &= V_i\left(w_i, G_{-i} \mid \Delta_i^* + g_i^*\right) \\ &\geq V_i\left(w_i - \Delta_i^*, G_{-i} \mid g_i^*\right), \end{aligned}$$

where the first equality follows from (5) and (6), and the inequality follows because V_i is increasing in income and non-decreasing in g_i. Satisfying the inequality therefore requires that $d_i \leq \Delta_i^*$. Now consider a corner solution to (6). It follows that $g_i^* + \Delta_i^* = w_i$, and it must also hold that $g_i^* + d_i \leq w_i$. These two expressions imply $d_i \leq \Delta_i^*$, and this complete the proof. □

The preceding result establishes that the willingness to donate defined here, $\Delta_i^* + g_i^*$, exceeds that defined by CBBM, $d_i + g_i^*$. The reason, as mentioned previously, is that there are additional benefits that a greater donation provides that are not captured by simply removing income as in Eq. (5). In effect, d_i is a deadweight loss of money that does not generate any warm-glow or public-good benefits.

Figure 2 demonstrates graphically the distinction between the two measures, and shows how the inequality that distinguishes them will, in general, hold strictly. The figure shows

[3] Though not shown in the figure, the corner solution of $\Delta_i^* + g_i^* = w_i$ occurs when $V_i\left(w_i, G_{-i}|\Delta_i^* + g_i^* = w_i\right)$ remains greater than $V_i\left(w_i, G_{-i}|0\right)$.

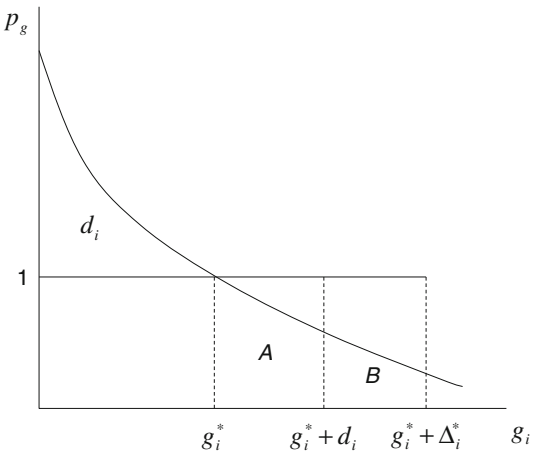

Fig. 2 An individual's Hicksian demand curve illustrating maximum willingness to donate with referendum, take it or leave it, question

an individual's Hicksian demand curve for g_i. Although the price is normalized to unity (as indicated), the curve is useful for illustrating the compensated marginal willingness to pay and therefore surplus measures. The quantity d_i is the Hicksian surplus associated with the optimal choice of g_i^* with the price normalized to unity. This d_i corresponds to the welfare measure defined in (5). Now, assuming the individual were asked to donate $g_i^* + d_i$, take it or leave it, it is straightforward to see what would happen. She would not be indifferent between saying "yes" or "no," as CBBM claim. The reason is that she would obtain the additional benefit, denoted area A, of actually donating, while at the same time incurring the additional cost d_i. In general, the additional benefit may arise through a combination of both public-good and warm-glow benefits. Hence she would certainly say "yes" because her net benefit is positive by the amount A.[4] The actual donation level of indifference must be higher, at $g_i^* + \Delta_i^*$, where $\Delta_i^* = d_i + A + B$, meaning there is no surplus left over from one's own donation after donating that amount. That is, the cost of the additional donation of Δ_i^* offsets surplus d_i from the optimal donation plus the additional benefits of $A + B$. As the figure makes clear, the difference, $\Delta_i^* - d_i = A + B \geq 0$, will be strictly positive as long as there is some marginal benefit of making a donation beyond g_i^*, be it through the purchase of warm glow or provision of the public good.

To get a sense for the potential magnitude of the difference, and whether it might be economically meaningful, consider a simple numerical example. The simplest possible case is one in which the individual has purely warm-glow preferences for a single "public" good. Assume quasi-linear preferences of the form $U_i = x_i + g_i^\alpha$, where $0 < \alpha < 1$, and all prices are normalized to unity. With this example, it is straightforward to solve numerically for the variables of interest—g_i^*, d_i, and Δ_i^*—given different values of α. Table 1 reports selected results. According to the case where $\alpha = .1$, for example, CBBM's analysis suggests that the individual would decline any take it or leave it offer to donate above $g_i^* + d_i = .774$, but the analysis here shows that the correct threshold is $g_i^* + \Delta_i^* = 1.0$. The table also reports the difference $(\Delta_i^* - d_i)$ and the ratio of the difference to the corresponding optimal donation. The important takeaway is that the difference between CBBM's measure and the one defined here ranges between approximately 1.8 and 2.9 times the optimal donation level itself—implying that the magnitudes can indeed be economically meaningful.

[4] Note that the additional cost of d_i offsets the initial net benefit of d_i, leaving the area A as the net benefit after agreeing to donate $g_i^* + d_i$.

Table 1 Numerical example results

		Values of α		
		.1	.5	.9
Quasi-linear utility, $U_i = x_i + g_i^\alpha$	g_i^*	.077	.250	.349
	d_i	.697	.250	.039
	Δ_i^*	.923	.750	.651
	$\Delta_i^* - d_i$	.226	.500	.613
	$(\Delta_i^* - d_i)/g_i^*$	2.935	2.000	1.756

4 Benefits Estimation

Let us now consider the welfare benefits of a privately provided public good and the relationship between these benefits and willingness to donate. Recall the surplus measure CS_i from Eq. (4). CBBM interpret $CS_i + g_i^*$ as the individual's maximum willingness to pay for the public good (p. 155). While there is nothing incorrect about this interpretation, more specificity is helpful to clarify exactly what the measure captures. In particular, $CS_i + g_i^*$ is an individual's willingness to pay for G^* under the necessary conditions that she donates g_i^*, which is included in the WTP, and others exogenously provide G_{-i}. The measure thus consists of the individual's optimal donation plus the surplus from her own donation and from others' provision.

Troubles arises again, however, when relating this welfare measure to one's willingness to donate. CBBM claim that the individual would not be willing to donate the full amount $CG_i + g_i^*$ (p. 155). I argue that this claim is not correct in CBBM's setting of interest—namely a dichotomous choice referendum CV question.

Consider the numerical example described above with quasi-linear preferences and only warm-glow benefits from the "public" good. In this case, it is straightforward to verify using (4) and (5) that $CS_i = d_i$. Then, referring back to Table 1, it is immediately clear in all cases that $\Delta_i^* > d_i = CS_i$, which is sufficient to prove that one's maximum willingness to donate in a take it or leave question format $(\Delta_i^* + g_i^*)$ can exceed CBBM's measure of total willingness to pay $(CS_i + g_i^*)$. Yet, in general, the sign of the difference between Δ_i^* and CS_i is indeterminate. To show the other possibility of $\Delta_i^* < CS_i$ simply expand preferences for the public good such that $U_i = x_i + g_i^\alpha + \beta G$, where $\beta < 1$. It follows that if $\alpha = \beta = 0.5$, then $\Delta_i^* \gtreqless CS_i$ if and only if $G_{-i} \lesseqgtr 5$, revealing how, intuitively, willingness to pay becomes greater compared to willingness to donate when there is greater public-good provision by others.

The problem enters CBBM's analysis because of the way that an individual's willingness to donate depends on how she is asked to contribute.[5] I have established that an individual's optimal donation is g_i^*, but she would donate up to $\Delta_i^* + g_i^*$ if asked in a take it or leave it question format. Hence a mismatch exists between CBBM's measure of willingness to pay under a voluntary contribution mechanism—where individuals are free to choose their contribution level—and the relevant willingness to donate when faced with a dichotomous choice at a given contribution level. With such a mismatch, I have shown—contrary to CBBM's claim—that an individual's stated willingness to donate is *not* a theoretical lower bound of her willingness to pay. Indeed, even without hypothetical bias, one's stated preference for a

[5] Kotchen and Moore (2007) show how the elicitation format can result in different levels of private provision of environmental public goods. The idea here is similar, though the focus is on consistency between the way stated preferences are elicited and donations would occur in practice.

donation in a referendum format question can exceed her total willingness to pay for a public good provided through a standard voluntary contribution mechanism.

A further question to consider is whether donations can serve as a theoretical lower bound if there is no mismatch between the CV question format and the actual provision mechanism. In such cases, CBBM's result would hold, and seeing why is simply a revealed-preference argument. If an individual chooses a donation level or responds "yes" to a suggested donation amount, it is clear that she values the good's provision by at least this amount, upon which there may be additional surplus. Whether the choice is hypothetical or not makes not difference in theory.[6] The argument is also invariant to whether donations are motived by public-good or warm-glow benefits, or some combination of both. Hence, CV scenarios that elicit donations in a way that would match an actual provision mechanism introduce no additional problems other than biases standard to CV more generally (see Mitchell and Carson 1989; Boyle 2003).

5 Conclusion

This paper reconsiders the question of whether donations can serve as a theoretical lower bound of willingness to the pay for a privately provided public good. In situations where provision actually occurs, the answer is a straightforward "yes" based on a revealed-preference argument, and the conclusion holds regardless of whether contributions are motivated partly or completely by warm glow. However, the presence of warm glow does create non-neutrality between private provision and public provision, because how the good is actually provided matters to potential donors. Recognition of the non-neutrality was central to the original models of warm glow (Andreoni 1989, 1990), and Chilton and Hutchinson (1999) emphasize its importance if donations are used for nonmarket valuation, yet actual provision occurs through some other mechanism such as taxation. In particular, they show that CBBM's result that donations serve as a lower bound of Hicksian surplus may be invalidated in such settings.

This paper shows that CBBM's result, which has provided an important bridge within the CV literature, may not hold even if both valuation and actual provision were to occur through donations. The lower-bound result holds only if hypothetical valuation and actual provision occur using the same elicitation mechanism. If, for example, a valuation exercise is carried out using the common dichotomous choice referendum format, but actual provision of the public good occurs through a standard voluntary contribution mechanism, then willingness to donate can in theory be greater than or less than the correct Hicksian surplus measure. The differences arise not because of differences in free riding between scenarios, but rather because choices may not be continuous and therefore imply a different set of tradeoffs.

Underlying the main result of this paper is the fact donation levels are not invariant to the question format of elicitation, and this holds in models of privately provided public goods that are based on individuals valuing the public good, on warm-glow motives, or on combinations of both. These findings imply that CV researchers should be even more cautious about using donations for valuing nonmarket, environmental public goods. The results also have implications for using CV to forecast donations in an actual fundraising campaigns and, similarly, for testing hypothetical bias using a donation mechanism. In all cases, particular

[6] This statement assumes that several elements are held constant between the hypothetical and actual scenarios. There are no strategic effects that the CV question induces. For example, Carson and Groves (2007) explain how stated donations are likely to exceed actual donations if survey respondents believe their CV donations might be used to justify an actual fundraising campaign. Moreover, in both settings, the population of potential donors, or at least expectations about it, should remain the same. Also, any mechanism that seeks to bolster donations, such as information about leadership giving (Andreoni 2006), should be presented in both cases.

attention needs to focus on maintaining similarities between the stated and revealed elicitation mechanisms.

Appendix

This Appendix reproduces CBBM's setup and shows that their analysis is equivalent to the one is the main text. CBBM assume that the representative individual solves

$$\max_{Q_i, g_i, \gamma_i} \{U_i\left(Q_i, \Gamma, G, \gamma_i, g_i\right) : Y_i = P \cdot Q_i + u \cdot \gamma_i + g_i\},$$

where Q_i is a vector of private goods at prices P; G is the aggregate level of the public good of interest, where $G = G_{-i} + g_i$; Γ is a vector of the aggregate levels of other public goods, where $\Gamma = \Gamma_{-i} + \gamma_i$; u is a vector of 1's conforming to γ_i; and Y_i is the individual's income. Apart from notation, the differences between this setup and the one in the main text are the inclusion of other public goods and multiple private goods with non-normalized prices. While these features enable additional dimensions for the individual to adjust behavior, they do not affect comparisons among the two key welfare measures, which are the focus of analysis. CBBM's analog to Eq. (4) is their Eq. (4):

$$V_i\left(P, Y_i - CS_i, \Gamma_{-i}, G_{-i} \mid \gamma_i^*, g_i^*\right) = V_i\left(P, Y_i, \Gamma_{-i}, 0 \mid \gamma_i^{**}, 0\right),$$

where γ_i^{**} is the individual's optimal donations to other public goods conditional on constraining $G_{-i} = g_i = 0$. The analog to Eq. (5) is their Eq. (5):

$$V_i\left(P, Y_i - d_i, \Gamma_{-i}, G_{-i} \mid \gamma_i^*, g_i^*\right) = V_i\left(P, Y_i, \Gamma_{-i}, G_{-i} \mid \bar{\gamma}_i, 0\right),$$

where $\bar{\gamma}_i$ is the individual's optimal donations to other public goods conditional on holding G_{-i} constant but constraining $g_i = 0$. It is straightforward to verify that CS_i and d_i as defined here have the same interpretations as those provided in the main text, and that the analysis carries through with CBBM's setup, albeit with a bit more notation.

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