PUBLIC-GOOD VALUATION AND INTRAFAMILY ALLOCATION

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Abstract

I derive values of marginal changes in a public good for two-person households, measured alternatively by household member i's willingness to pay (WTP) for the good on behalf of the household, $WTP_i(H)$, or by the sum of individual WTP values across family members, WTP(C). Households are assumed to allocate their resources in efficient Nash bargains over private and common household goods. $WTP_i(H)$ is then found by trading off the public good against household goods, and WTP(C) by trading the public good off against private goods. I then find that $WTP_i(H)$ is higher (lower) when member i has a high (low) marginal valuation of the public good, but on average represents WTP(C) correctly. Individuals then tend to represent households correctly on average when questioned about the household's WTP for a public good, even when they are purely selfish and answer truthfully. Counting all members' WTP answers on behalf of the household then leads to double counting. Pure and paternalistic altruism (the latter attached to consumption of the public good) move each member's WTP on behalf of the household closer to the true aggregate WTP, but only the latter raises aggregate WTP.

JEL Code: D13, D64, H41, Q26.

Keywords: public goods, willingness to pay, contingent valuation, intrafamily allocation, Nash bargaining.

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1. Introduction

A substantial and very important research activity has for long been going on to elicit the true population welfare effect of increases in public goods provision. The most widely used approach is contingent valuation (CV) whereby maximum willingness to pay (WTP) is elicited among random population samples. Such survey questions can be phrased to individuals in two main alternative ways, as follows:[1] "How much are you willing to pay, <u>on behalf of your household</u>, for a (small) increase in the quantity of a public good?"; or: "How much are you, <u>personally</u>, willing to pay for a (small) increase in the quantity of a public good?". It is an important issue since, for a household with m≥2 members, the derived per-person value will differ by a factor of m, according to which of the two interpretations of the answers to use. The literature is mostly unclear as to which approach is correct, whether they are likely to give different or similar results, or even which approach that is actually being used in particular cases.[2] Prevailing views (or conjectures) among CVM researchers are that individual family members in multi-person families (when answering truthfully) may very well represent their families correctly; and that the valuation answer to the first question is higher than that to the second, but only when family members exhibit interpersonal preferences such as altruism or empathy.[3]

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[1] For a presentation of the CV method see Mitchell and Carson (1989). For overviews of recent applications and developments of the method, see Carson, Flores and Meade (2001) and Boyle (2003).

[2] As an example of this uncertainty in the literature, Boyle (2003) states that "..when the household decision maker is the response unit in a contingent valuation study, it is important to identify who is the appropriate decision maker in the household. Do households pool their income and make group decisions? Do individuals make their own decisions? … .Answers to these questions have important implications for the credibility of the welfare estimates from contingent valuation studies." (p. 120)

[3] Mitchell and Carson (1989), in their seminal presentation of the CV method, claim that "household heads" are normally able to answer correctly on behalf of the household, and that this approach ought typically to be taken: "...payments for most pure public goods are made at the household level … the appropriate sampling procedure is to allow any adult who claims to be a household head to be a spokesperson for the household." (pp 265-266).

Otherwise, the prevailing view seems to be that individuals typically underestimate household WTP when answering "on behalf of the household".[4]

This paper clarifies these issues by embedding the CV procedure in a model of household behavior where household members allocate their common resources through efficient Nash bargains. I then show that both conjectures stated above are correct in a wide set of circumstances, regardless of whether household members are selfish or altruistic. An individual's true WTP on behalf of the household is shown to be identical to the sum of household members' personal WTP levels, if and only if the two members have the same marginal valuation of the public good in terms of the household good. If different members value the public good differently, a given member over (under-) values the public good on behalf of the household when his or her value is higher (lower) than that of the other member. <u>On average</u> these values are however correct. In a large sample of respondents, individual household members will then represent the entire household correctly.

In the model, each household is assumed to consist of two members, each with cardinal and selfish preferences over three distinct goods: a private good, a household good consumed commonly within the household only, and a pure public good (consumed by all in society) provided outside of the household. The household is assumed to have a given common budget and determines its allocation in an efficient asymmetric Nash bargain. A key point is that the model solution implies, for any one household member, a lower marginal utility of consumption for the household good than for the private good, and this difference is larger for members with lower bargaining strength. The aggregate household WTP for the public good is here taken as the sum of individual private WTP levels for the public good, <u>in terms of each</u>

[4] There is little previous theoretical work to clarify these relationships or formally back up such views.

member's own private good. Member i's WTP for the public good on behalf of the household is instead derived considering this member's willingness to give up units of the household good.

In section 3 I show that the same basic results hold also under "pure" altruism among family members, where the utility level of each member enters into the utility function of the other. Given that both members are to pay their marginal valuations, overall valuations are unaffected by altruism. Individual valuations on behalf of the household are however closer to true aggregate household valuation given that they differ. In section 4 I instead consider "paternalistic" altruism where a given household member cares about the other member's consumption of the public good. Then greater altruism leads to higher public-good valuations. Altruism also here makes one member's WTP on behalf of the household more equal to the sum of individual WTP levels, much in the same way as under pure altruism. Section 5 extends the non-altruistic case to more general utility functions where the three goods are no longer strongly separable in consumption. The main conclusions from section 2 (in particular, that the individual's expressed valuation on behalf of the household is always correct on the average) then still hold.

This paper contributes to a resolution of the above-noted long-standing controversies and confusions over how to interpret answers to survey questions for valuation of public goods. I show that one household member always tends to represent the household correctly, at least in expectation, whenever households bargain efficiently. Although ignored in much of the earlier family economics literature (such as Becker (1991)), several contributions (in particular more recent ones) have argued that efficient bargaining among family members is an appropriate

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The most prominent related reference seems to be the Quiggin (1998) paper discussed below, where assumption.[5] On the other hand, and as noted in the final section, whenever households act non-cooperatively these results no longer hold. Then the marginal utilities of private and household goods tend to be similar for any one household member, and the valuing member tends to only express his or her purely private valuation when asked about household valuation provided that the person has purely selfish preferences. We then reach a similar conclusion as Quiggin (1998), who studies household versus individual WTP assuming that a purely private good is traded off against a public good only.[6] In his model high degrees of altruism are necessary to make individual and household valuations similar, something that is necessary also here when households act non-cooperatively, but not necessary when they act cooperatively. The fundamental difference between Quiggin's model and mine is the introduction of an additional third (household) good here, as in Chen and Wooley's (2001) family allocation model. These issues are commented on further in the final section 5, where I also make a strong case for the cooperative solution within the household.

2. The basic model with no altruism

Consider a household with two members. The household has a given common budget R, spent on purely private consumption C_i for members i = 1,2, and on a household good consumed jointly by members in the amount H.[7] The family budget constraint is then simply $R = C_1 + C_2 + H$. The two members bargain over C_1, C_2 and

any difference between the two types of answers is based on altruistic motivations.

[5] See Bergstrom (1997) for a survey, Chen and Woolley (2001) for perhaps the most closely related existing theoretical family model, and Browning and Chiappori (1998) and Aura (2002) for recent empirical evidence in favor of the household bargaining model.

[6] In Quiggin (1998) one interpretation of the "public" good is as a good consumed exclusively within the household. He however does not clarify the implications of this assumption for the equilibrium allocation of the "globally public" good, which is the main issue here.

H in an asymmetric Nash bargain with relative bargaining strengths β and 1-β.[8] We initially disregard altruism, i.e., no element of other individuals' utility or consumption enters into the utility function of a given member. Member i's utility function is strongly separable in its three arguments, as follows:

$$(1) \qquad U_i = u_i(C_i) + v_i(H) + z_i(P), \; i = 1,2,$$

where the u_i, v_i and z_i can be viewed as cardinal (von Neumann-Morgenstern), increasing and strictly concave utility functions, and fulfil standard Inada conditions, i.e., $f' > 0$, $f'' < 0$ and $\lim (A \to 0) f' = \infty$, $\lim (A \to \infty) f' = 0$, for f = u, v and z, and A = C, H and P, respectively. The Nash product will be expressed as[9]

$$(2)\; NP(1) = \left[u_1(C_1) + v_1(H) - u_1(C_{10}) - v_1(H_0)\right]^{\beta} \left[u_2(C_2) + v_2(H) - u_2(C_{20}) - v_2(H_0)\right]^{1-\beta}.$$

Here C_{i0} and H_0 are the "conflict" levels of private and common consumption for the household members, which we assume to be exogenous; these could, e.g. as in Chen and Woolley (2001), be determined as part of a non-cooperative Nash-Cournot solution. As long as they are exogenous, however, and the utility function separable as here, they do not affect any important aspects of the solutions to be derived in this or

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[7] In our model "public goods" also comprise private goods whose costs are not charged to users, as is the case for many educational, health and cultural services in many countries.

[8] We ignore the possibility of family break-up or outside options yielding higher utility than our bargaining solution. A divorce option is considered by Manser and Brown (1980) and McElroy and Horney (1981). Our approach here is to depart from an "inside" noncooperative breakdown option, as in e.g. Lundberg and Pollak (1993) and Chen and Woolley (2001). Arguably, when household goods command a large share of the common budget, the divorce option may be unattractive even for spouses with low bargaining power, since this is likely to go together with low relative income as a single.

[9] Note that the z_i functions need not be included in NP(1) when the utility function is separable as here, since a partial increase in P will then move the efficiently bargained utility and the conflict utility in exactly the same way and thus not affect the efficient bargain. This property however does not

the next two sections. In line with the comments in footnote 9 above, neither will any exogenous change in P here affect the "conflict" values C_{i0} and H_0.

To derive the Nash bargaining solution, maximize the Lagrangian L(1) = NP(1) - $\lambda(C_1 + C_2 + H – R)$ with respect toC_1, C_2 and H, to yield the first-order conditions[10]

(3) $$\frac{\partial L(1)}{\partial C_1} = \beta N_1^{\beta-1} N_2^{1-\beta} u_1^{'}(C_1) - \lambda = 0$$

(4) $$\frac{\partial L(1)}{\partial C_2} = (1-\beta) N_1^{\beta} N_2^{-\beta} u_2^{'}(C_2) - \lambda = 0$$

(5) $$\frac{\partial L(1)}{\partial H} = \beta N_1^{\beta-1} N_2^{1-\beta} v_1^{'}(H) + (1-\beta) N_1^{\beta} N_2^{-\beta} v_2^{'}(H) - \lambda = 0 .$$

Here the N_i are the Nash maximands (i.e., expressions inside the respective square brackets in (2)). Eliminating λ implies

(6)-(7) $$\frac{1}{1+n} u_1^{'}(C_1) = \frac{n}{1+n} u_2^{'}(C_2) = v^{'}(H),$$

where n = $[(1-\beta)/\beta](N_1/N_2)$. For convenience we from now on take n to be the "primitive" of the bargaining solution.[11] We have used the normalization v_1'(H) = v_2'(H) = v'(H), for any equilibrium value of H.[12] When $n \to 0$, only member 1 has

automatically carry over to the case where utilities are non-separable, as presented and discussed in section 5 below.

[10] Asymmetric information about household members' individual income contributions may complicate this problem relative to our exposition. Arguably asymmetric information is a small problem in households where members interact daily. It may e.g. be difficult for one member to maintain a high consumption level without the other member discovering this.

[11] The standard (cooperative Nash) approach is here of course to take β as the primitive. N_1 and N_2 and thus their ratio are here endogenous, but will in any case change only marginally when exogenous variables change marginally. Thus exogenous n is a good approximation to exogenous β.

[12] This is not restrictive, at least not locally in the vicinity of the preferred solution. Since the utility functions utilized here fulfil standard vNM criteria of invariance to an increasing linear transformation,

bargaining power; when n = 1, both members have the same "effective bargaining power" (as under identical utility functions and $\beta = ½$); and when $n \to \infty$, only member 2 has bargaining power. (6)-(7) give the marginal rates of substitution between the private goods C_i and the family good H, under an efficient Nash bargaining solution. It is a standard (Samuelsonian) solution dictating that the marginal value of the household ("local public") good equal a (weighted) sum of marginal private-good values.[13] Generally, when $\beta \in (0,1)$ (and thus n > 0), $u_i'(C_i)$ exceeds $v_i'(H)$. When R increases marginally, the amounts of household goods H or private goods C_i increase. In the latter case household member 1 (2) however only receives a fraction 1/(1+n) (n/(1+n)) to spend on increased C_i. At an optimum the consumption value of increased C_i must equal the value of the increase in H. The marginal utility of personal consumption must then exceed that of common consumption.

Face now member i with the question: "What is the highest payment you are willing to make, on behalf of your household, in return for a (small) increase in the public good P; i.e., what, in your view, is your household's maximum willingness to pay (WTP) for such an increase in the public good?" For "small" changes in P, we take this to be the same as asking how many units of H member i would be willing to give up, with basis in the initial bargaining solution between the two family members, in order to obtain this increase in P.[14] We find this value to be

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we may without loss of generality normalize to set marginal utilities of common household consumption equal at this point.

[13] My model assumes that the "Coase theorem" holds for intrafamily allocations. In my view, if this theorem is to hold approximately anywhere, this is likely to be in intrafamily contexts where the setting is typically cooperative and individuals interact almost continuously.

[14] For marginal changes in P, this would be the same as asking what amount of common budget resources the two spouses together ought to give up, in the view of individual I, to obtain this small change in P. At the margin, a marginal reduction in the common budget can, without loss of generality, be assumed to reduce common household consumption H only.

(8) $$WTP_i(H) = -\frac{dH}{dP}(U_i = const.) = \frac{z_i'(P)}{v'(H)}, i = 1,2.$$

$WTP_i(H)$ is household member i's WTP for the public good in terms of H, here interpreted as the member i's WTP on behalf of the household.

Face now member I instead with the question: "What is the highest payment you are willing to make, on your own behalf, in return for a (small) increase in the public good P; i.e., what, in your view, is your personal maximum willingness to pay (WTP) for such an increase in the public good?" Denote this value for household member i by $WTP_i(C)$, and the sum of the two members' values by WTP(C). We take $WTP_i(C)$ to be the correct answer to the alternatively formulated question: "How much are you willing to give up, in terms C_i, for a small increase in P?"[15] We find

(9) $$WTP_i(C) = -\frac{dC_i}{dP}(U_i = const.) = \frac{z_i'(P)}{u_i'(C_i)}, i = 1,2.$$

From (6)-(7), $WTP_i(C) < WTP_i(H)$ since $u_i'(C) > v'(H)$. We then have

(10) $$WTP(C) = \frac{z_1'(P)}{u_1'(C_1)} + \frac{z_2'(P)}{u_2(C_2)} = \frac{z_1'(P) + nz_2'(P)}{(1+n)v'(H)} \quad ,$$

where the latter equality is found using (6)-(7). The ratio of $WTP_1(H)$ to WTP(C), denoted R(1), is then given by

[15] The interpretation in this case is that individual i's total budget for private goods including the additional amount of the public good is given. A small increase in P then leads to a small reduction in

(11) $$R(1)=\frac{WTP_1(H)}{WTP(C)}=\frac{(1+n)z_1(P)}{z_1(P)+nz_2(P)}.$$

(11) leads to the following result.

<u>Proposition 1:</u> *Assume that the intra-household allocation of private and household goods is decided by efficient Nash bargaining, and that there is no altruism. Then WTP for a public good, as expressed by household member 1 on behalf of the household, is greater (smaller) than the sum of the two household members' private WTP for the good, if and only if member 1's marginal valuation of the public good in terms of the common household good is higher (lower) than that of member 2.*

Proposition 1 implies that if and only if the two family members have the same marginal value of the public good in terms of the household good, any one of them expresses household WTP correctly. Perhaps surprisingly, this result does not depend on altruism nor the relative bargaining powers of family members. It only depends on efficient Nash bargaining over private and household goods within the household. The result also implies that aggregating up individual WTP values stated on behalf of the household, across household members, leads to double counting. This contrasts other work, in particular Jones-Lee (1992) and Quiggin (1998), where such double counting is claimed to follow from altruistic preferences.

Certain generalizations are straightforward. First, with m>2 household members and a symmetric solution where each member has the same bargaining parameter 1/m, the sum of private WTP still equals one member's WTP in terms of the household

C_i, while everything else is unaltered (note in particular that the bargaining solution is unaltered when P increases, as commented above.

good given that members' marginal valuations of the pure public good are identical. Secondly, in section 5 below I generalize to a class of more complex utility functions where the three goods in question may be complements and substitutes in consumption, and still find similar results. Thirdly, while the model framework above is cardinal, most of the results readily generalize to an ordinal one where we only require efficient household resource allocation over private and household goods. The main difference is that the bargaining parameter n would then be indeterminate. Other main results (that one household member always represents the household correctly given that marginal rates of substitution between the pure public good and the household good are the same for both members; and that one member "on average" always represents the household correctly) then however still hold.

3. Pure intra-household altruism

In this and the next section I generalize the above model in two directions, to take into consideration the possibility of altruistic preferences, of two different types. In this section I consider the case of only "pure" (nonpaternalistic) intrafamily altruism.[16] Each household member now attaches utility to the general utility level enjoyed by the other member. The utility of household member i can then be expressed as

$$(12) \qquad U_i = u_i(C_i) + v_i(H) + z_i(P) + \alpha_i [u_j(C_j) + v_j(H) + z_j(P)], i, j = 1,2, i \neq j.$$

[16] We consider only intrafamily altruism. As justified e.g. by Becker (1991) and Jones-Lee (1992), this is likely to be the dominating type of altruism for a majority of individuals.

Here $\alpha_i \in (0,1)$ is a relative weight attached by member i to member j, relative to the weight attached to oneself. $\alpha_i = 1$ represents what may be denoted <u>complete altruism</u>, which we rule out except as a possible limit case. We may have $\alpha_1 \neq \alpha_2$ whereby members have different degrees of altruism. The Nash product is now assumed to be given by

$$(13) \qquad NP(2) = \left[N_1 + \alpha_1 N_2\right]^{\beta} \left[N_2 + \alpha_2 N_1\right]^{1-\beta},$$

where N_1 and N_2 are given from (2).[17] The Lagrangian L(2) is formed in a way corresponding to L(1), and maximized with respect to the C_i and H under the budget constraint to yield

$$(14) \qquad \frac{\partial L(2)}{\partial C_1} = \left[\beta N_1^{\beta-1} N_2^{1-\beta} + \alpha_2(1-\beta) N_1^{\beta} N_2^{-\beta}\right] u_1'(C_1) - \lambda = 0$$

$$(15) \qquad \frac{\partial L(2)}{\partial C_2} = \left[(1-\beta) N_1^{\beta} N_2^{-\beta} + \alpha_1 \beta N_1^{\beta-1} N_2^{1-\beta}\right] u_2'(C_2) - \lambda = 0$$

$$(16) \qquad \begin{aligned} \frac{\partial L(2)}{\partial H} &= \beta N_1^{\beta-1} N_2^{1-\beta}\left[v_1'(H) + \alpha_1 v_2'(H)\right] \\ &+ (1-\beta) N_1^{\beta} N_2^{-\beta}\left[v_2'(H) + \alpha_2 v_1'(H)\right] - \lambda = 0 \end{aligned} .$$

Again we use the normalization $v_1'(H)=v_2'(H)=v'(H)$, and derive the first-order conditions

$$(17)\text{-}(18) \qquad (1+\alpha_2 n) u_1'(C_1) = (\alpha_1 + n) u_2'(C_2) = \left[1 + \alpha_1 + n(1+\alpha_2)\right] v'(H).$$

[17] Thus formally, it is the utility gain over the non-cooperative solution for the other individual, and not the utility level, that enters into (13). This however changes nothing substantial, as the non-cooperative solution is neither in this case altered by exogenous changes in P.

The new parameters α_i here affect the intrafamily resource allocation, relative to the conditions (6)-(7) under no altruism. A marginal increase in P now has total utility effect $z_i'(P) + \alpha_i z_j'(P)$ for household member i ($\neq$j). Differentiating (12) with respect to H and P we find member i's WTP <u>on behalf of the household</u> as

$$(19) \qquad WTP_1^N(H) = -\frac{dH}{dP} = \frac{1}{1+\alpha_i}\frac{z_i'(P)+\alpha_i z_j'(P)}{v'(H)}, i, j = 1,2, i \neq j.$$

To derive private valuations in this case, it now matters exactly how the valuation question is posed to the respondent. Consider the following two possibilities:

1. What is your private WTP for an extra unit of the public good, in terms of reduced consumption of your own private consumption good, given that you only, and not the other family member, is to pay for this good?
2. What is your private WTP for an extra unit of the public good, in terms of reduced consumption of your own private consumption good, when also the other family member pays his or her own private WTP for the good?

Given that WTP for the public good is elicited from <u>one family member, and only this member is to pay</u>, the first interpretation may appear reasonable. WTP values, denoted $WTP_i^N(C)$, can then be found differentiating (12) with respect to C_i and Z (and holding C_j and H constant):

$$(20) \qquad WTP_i^N(C) = -\frac{dC_i}{dP} = \frac{z_i'(P)+\alpha_i z_j'(P)}{u_i'(C_i)}, i, j = 1,2, i \neq j.$$

Aggregate household WTP is then found aggregating (20) over i, as

(21) $$WTP^N(C) = \frac{z_1'(P) + \alpha_1 z_2'(P)}{u_1'(C_1)} + \frac{z_2'(P) + \alpha_2 z_1'(P)}{u_2'(C_2)}.$$

When instead all members of society are required to pay for increases in the public good, question alternative 2 is more relevant.[18] The WTP measure can then be derived from the equation set

(22) $$u_1'(C_1)dC_1 + \alpha_1 u_2'(C_2)dC_2 = -(z_1'(P) + \alpha_1 z_2'(P))dP$$

(23) $$u_2'(C_2)dC_2 + \alpha_2 u_1'(C_1)dC_1 = -(z_2'(P) + \alpha_2 z_1'(P))dP.$$

Solving (22)-(23) simultaneously for dC_1 and dC_2 in terms of dP yields (9), as under purely selfish preferences. Aggregate household WTP then equals WTP(C) from (10), where $WTP(C)<WTP^N(C)$.[19] Intuitively, when member 2 pays, member 1's utility is reduced due to altruistic concerns about member 2's reduced personal consumption.

WTP(C) will in the following be viewed as the true measure of household WTP for a small increase in P, as it involves simultaneous changes in C_1 and C_2 for the two household members such that both utilities are kept constant. We then have:

Proposition 2: *Assume that the analysis in section 2 applies except that household members exhibit pure altruism as defined. Aggregate WTP for the public good is then invariant to a change in the degree of altruism.*

[18] A third relevant alternative, important in practical CV applications but not pursued here, is to base the WTP question on an assumption that all individuals are to pay the same amount toward the public good.

Compare now individual WTP on behalf of the household, to the "true" sum of individual WTP levels, WTP(C). Using (17)-(18), WTP(C) can be expressed as

$$(24) \qquad WTP(C) = \frac{(1+\alpha_2 n)z_1'(P) + (\alpha_1 + n)z_2'(P)}{1+\alpha_1 + n(1+\alpha_2)} \frac{1}{v\ '(H)}.$$

The ratio of $WTP_1^N(H)$ to WTP(C), denoted R(2), is

$$(25) \quad R(2) = \frac{WTP_1^N(H)}{WTP(C)} = \frac{1+\alpha_1 + n(1+\alpha_2)}{1+\alpha_1} \frac{z_1'(P) + \alpha_1 z_2'(P)}{(1+\alpha_2 n)z_1'(P) + (\alpha_1 + n)z_2'(P)}.$$

We can now demonstrate the following result:

Proposition 3: *Assume that marginal valuations of the public good differ. Then one individual's expressed marginal WTP for the public good, on behalf of the household, is closer to correct aggregate household WTP, the greater the degree of pure altruism for either member*.

This result is found differentiating R(2) with respect to the α_i. Altruism here leads to averaging of marginal valuations across household members. The closer α_1 and α_2 are to one (the "complete altruism" case) the closer R(2) is to one when $z_1'(P) \neq z_2'(P)$.

Under pure altruism, individual expressed WTP on behalf of the household is always moved in the direction of true aggregate WTP, which is generally unaltered.

[19] This conclusion is identical to Result 1 in Quiggin (1998); see also Johansson (1994) for similar results.

4. Paternalistic altruism with respect to the public good

In this section I consider "paternalistic" altruism, where the utility of each member depends on the other member's consumption of the public good but no that of other goods.[20] This can be relevant e.g. when P is a cultural or educational good and members care about each other's "cultivation" or education level; or when P is health or environmental goods and members care about each other's health state and longevity. The underlying motivation for the "altruistic" member may then be at least partly selfish.[21] Now the utility of member i is expressed as[22]

$$U_i = u_i(C_i) + v_i(H) + z_i(P) + \alpha_i\, z_j(P),\ i,j = 1,2,\ i \neq j. \tag{26}$$

With separable utilities the intrafamily resource allocation is unaltered by such altruism given that payments for the public good do not change. Thus (3)-(7) still describe this allocation. Member i's WTP on behalf of the household is now

$$WTP_i^A(H) = -\frac{dH}{dP}(U_i = const.) = \frac{z_i'(P) + \alpha_i z_j'(P)}{v'(H)},\ i, j, = 1,2, i \neq j. \tag{27}$$

[20] I here adopt Quiggin's (1998) terminology; perhaps a better term would be "public-good focussed" altruism as used by Jones-Lee (1992).

[21] We are ignoring possible selfishly motivated altruism related to personal or household goods. For household goods such effects could be present if increased consumption of common household items develops preferences that are more similar among family members, or improves the other person's health status or longevity (as could be the case with a better dwelling, located in a safer and cleaner place, or better prepared common meals). For purely private goods, opposite paternalism is possible where one member prefers the other member to consume less of particular goods (as when the other member overeats, drinks or smokes, or spends time in some hazardous activity).

[22] (26) implies that the other member's utility of public-good consumption (and thus not the consumption level) enters the first member's utility function. This is a simplification which can be motivated if $z_i(P)$ represents member i's actual use of a public good such as cultural or health services.

The expression for aggregate household WTP, as the sum of individual values (in terms of the private good), is here $WTP^N(C)$ from (21), as under pure altruism when question 1 in section 3 is evoked. Since $WTP^N(C)>WTP(C)$, and this disparity increases in the α_i, we have

<u>Proposition 4:</u> *Assume that each household member's altruism is paternalistic with respect to the other member's public-good consumption. Then household WTP for the public good is increased by higher degrees of altruism.*

The ratio $WTP_1^A(H)$ to $WTP^N(C)$, denoted R(3), given by

$$(28) \qquad R(3) = \frac{WTP_1^A(H)}{WTP^N(C)} = \frac{(1+n)(z_1'(P)+\alpha_1 z_2'(P))}{z_1'(P)+\alpha_1 z_2'(P)+n(z_2'(P)+\alpha_2 z_1'(P))}.$$

From (28), member 1's WTP for the public good on behalf of the household equals true aggregate household WTP in the special case of $(1-\alpha_1)z_2'(P) = (1-\alpha_2)z_1'(P)$. One also easily finds, from (28), that when $\alpha_1 = \alpha_2 = \alpha$, an increase in α moves R(3) closer to unity whenever $z_1'(P) \neq z_2'(P)$; when $\alpha_2 = 0$, R(3) increases uniformly in α_1; and when $\alpha_1 = 0$, R(3) is reduced uniformly in α_2. A proportional increase in the degree of mutual altruism always makes one member's valuation on behalf of the household more equal to true aggregate valuation, as under pure altruism in section 3. Now, however, that when only the valuing member is altruistic, increased altruism increases that member's valuation on behalf of the household, relative to true aggregate valuation. The opposite happens when the other member only is altruistic, and altruism increases. These cases are intuitively obvious. To take the last case, increased altruism does not change member 1's valuation on behalf of the household, but increases true aggregate valuation, and R(3) drops.

5. More general preference relationship in the non-altruistic case

A possible objection to the model above is that preferences often are not strongly separable in the three goods C, H and P in the way assumed. I will now consider implications of more general preference relationships for the two household members over these goods. For simplicity I now revert to the case of no altruism in section 2. Assume that

$$U_i = U_i(C_i, H, P), \quad i = 1,2, \tag{29}$$

where U_i is a standard (vNM) utility function, assumed strictly concave in C_i, H and P, which may generally differ between the two individuals. The Nash bargaining solution now has the same basic setup as before. The Nash maximands entering into the bargaining solution can now be specified as $N_i = U_i(C_i, H, P) – U_i(C_{i0}, H_0, P)$, i = 1,2, and the solutions corresponding to (8)-(9) are:

$$\text{(30)-(31)} \qquad \frac{1}{1+n}u_{1C}{}'(C_1,H,P) = \frac{n}{1+n}u_{2C}{}'(C_2,H,P) = u_H{}'(C_1,H,P).$$

Again the u_H are normalized to be identical in equilibrium. Simplify also by setting cross second derivatives with respect to C_i and H, u_{iCH}, equal to zero; other cases complicate without yielding further significant insights. The main new issue is how a change in P changes the bargaining solution and thus the equilibrium distribution of consumption between the two spouses. This in turn affects individual WTP for a changed supply of P. In principle such an effect could arise for two different reasons. First, relative inside bargaining positions of the two members could be affected. Secondly, outside options could be affected. Here we focus on the former effect. This implies an assumption (as in the main body of the paper above) that outside options are not exercised at equilibrium and that the inside utility level is always higher than the outside option level (e.g. from breaking up a marriage).

Consider now the effects of an increase in P on C_1, C_2 and H from changes in the bargaining solutions (30)-(31). Since such an increase in P leaves R constant, dH = -dC_1 -dC_2, from (1). Differentiating (30)-(31) with respect to C_1, C_2 and H then yields the following approximate solutions:[23]

$$(32)\quad \frac{dC_1}{dP} = \frac{1}{D}\left[(u_{1HP} - \frac{1}{1+n}u_{1CP})(\frac{n}{1+n}u_{2CC} + u_{2HH}) - (u_{2HP} - \frac{n}{1+n}u_{2CP})u_{1HH}\right]$$

$$(33)\quad \frac{dC_2}{dP} = \frac{1}{D}\left[-(u_{1HP} - \frac{1}{1+n}u_{1CP})u_{2HH} + (u_{2HP} - \frac{n}{1+n}u_{2CP})(\frac{1}{1+n}u_{1CC} + u_{1HH})\right]$$

$$(34)\quad \frac{dH}{dP} = \frac{1}{D}\left[(\frac{1}{1+n}u_{1CP} - u_{1HP})\frac{n}{1+n}u_{2CC} + (\frac{n}{1+n}u_{2CP} - u_{2HP})\frac{1}{1+n}u_{1CC}\right],$$

where

[23] These solutions are likely not to be exact, for at least two separate reasons. First, n and thus the "effective bargaining parameters" 1/(1+n) and n/(1+n) are generally affected, while in these calculations I take n to be a constant in the same way as above. The qualitative effects of this amendment are however small, as the adjustments of the N_i and the respective effective bargaining parameters typically go in opposite directions. Thus when e.g. member 1's net utility N_i goes up in the new solution, ceteris paribus, his or her relative bargaining strength is reduced somewhat to eliminate part of this increase. The other, and potentially more serious, aspect is that the threat-point values of C_{i0} and H_0 may change when P changes. An analysis of such issues requires that the non-cooperative game between family members be specified in more detail under such circumstances, something that is left for future research. My conjecture is however that effects on equilibrium threat points are small in most cases.

(35) $$D = \left(\frac{1}{1+n}u_{1CC} + u_{1HH}\right)\left(\frac{n}{1+n}u_{2CC} + u_{2HH}\right) - u_{1HH}u_{2HH}$$

is a positive determinant. While this solution appears complex in general, we may illustrate its main properties by considering two relevant and simpler cases.

<u>Case I: $u_{1CP} \neq 0$, $u_{2CP} = u_{iHP} = 0$, $i = 1,2$.</u> Here the supply of the public good affects the marginal utility of private consumption for household member 1 but no other marginal utilities. Now (32)-(34) simplify to

(36) $$\frac{dC_1}{dP} = \frac{1}{D}\left[-\frac{1}{1+n}u_{1CP}\left(\frac{n}{1+n}u_{2CC} + u_{2HH}\right)\right]$$

(37) $$\frac{dC_2}{dP} = \frac{1}{D}\frac{1}{1+n}u_{1CP}u_{2HH}$$

(38) $$\frac{dH}{dP} = \frac{1}{D}\frac{n}{(1+n)^2}u_{1CP}u_{2CC.}$$

Consider $u_{1CP} > 0$: an increase in the supply of P raises the marginal utility of the private good for member 1 only. This leads to higher private consumption for member 1, and to lower common household consumption as well as private consumption for person 2. The utility change for member i when P is increased can be expressed as

(39) $$\frac{dU_i}{dP} = u_{iC}\frac{dC_i}{dP} + u_H\frac{dH}{dP} + u_{iP}, i = 1,2.$$

The sum of the two first terms is here positive for member 1 and negative for member 2. Consequently, member 1 is willing to pay more for the increase in P, than what appears from the analysis in section 2 above.

Intuitively, the increase in marginal utility of private consumption for member 1 makes it efficient for the household to also increase member 1's private consumption (in order to fulfil the efficiency conditions (30)-(31)). Consider a more concrete example where spouse 1 only is a potentially eager golfer, and the increase in P is the building of a public golf course nearby, making golf a new option. This raises the marginal utility of private consumption for the golfing spouse, leading the household to allocate more of the common resources to this spouse's golfing hobby. (Thus in this particular case, spouse 1's increase in utility due to a higher P is greater than that of spouse 2 for two separate reasons: first, because the direct utility effect, u_{1P}, is much higher, but also because the indirect effect via the household bargaining solution is positive.) Examples where the marginal utility of private consumption is lowered when P is increased are perhaps easier to find. Assume that spouse 1 has a medical problem that requires private treatment in the absence of a publicly available treatment, and assume that the increase in P implies that such a public treatment becomes available. Then spouse 1's marginal utility of private consumption is lowered, implying that the household is willing allocate less of its common resources to such costs for spouse 1. This implies that the overall utility change, and WTP, for spouse 1 is smaller than that found in section 2 (in the concrete example, though, the total utility effect of the change in P may still be much higher for spouse 1, which after all has the benefit of the treatment; the main overall positive effect for spouse 2 may be that private and household consumption are raised).

Case II: $u_{1HP} \neq 0$, $u_{iCP} = u_{2HP} = 0$, $i = 1,2$. Here an increase in P affects the marginal utility of H, for spouse 1 only. The effects on consumption are now

(40) $$\frac{dC_1}{dP} = \frac{1}{D} u_{1HP} \left(\frac{n}{1+n} u_{2CC} + u_{2HH}\right)$$

(41) $$\frac{dC_2}{dP} = -\frac{1}{D} u_{1HP} u_{2HH}$$

(42) $$\frac{dH}{dP} = -\frac{1}{D} \frac{n}{1+n} u_{1HP} u_{2CC} .$$

A positive u_{1HP} now reduces C_1, and increases C_2 and H. Overall utility of private and household consumption is now reduced for member 1, and increased for member 2. This is the opposite of what was found in case I. Here, when the marginal utility of common household consumption is increased for member 1, the marginal utility of private consumption should also be raised for that individual. This in turn implies that overall private consumption must fall for that individual. (Private consumption will be raised for the other individual, since H is raised and (30)-(31) must still hold.)

Consider two concrete examples. First, assume that only spouse 1 suffers from noise or air pollution, and that the increase in P takes the form of reductions in such pollution. This reduces spouse 1's utility from having an expensive house location (in an expensive neighborhood with low pollution levels to start with), or from taking strong defensive measures against pollution such as air filtering and window glazing. In this case $u_{1HP} < 0$. The Nash bargaining solution then dictates that H be lowered (the couple moves to a less expensive location, or to a house with less defensive equipment). Private consumption for spouse 1 is increased (in order to bring the marginal utility of C_1 down, in line with the reduction in the marginal utility of H for spouse 1). Then spouse 1's utility, and thus WTP for the increase in P, are raised by these consumption reallocations.

In the other example, assume that a husband (member 1) benefits from his wife's production of certain common household services, such as common meals or home cleaning, and that an increase in the public good reduces these benefits (while the effect is neutral for the wife; e.g., the husband now gets access to free meals or cleaning services from his employer, making him use these services instead of the previously-used common-household services). Then also here $u_{1HP} < 0$, while $u_{1HP} = 0$. By the argument above, the husband's effective relative bargaining power is increased when the public good supply increases. His equilibrium utility is raised beyond that found under separability, and his WTP for increases in the public good raised accordingly, while the wife's WTP is lowered.

6. Conclusions

Efficient household bargaining over private and common-household goods has important implications for the way that members of multi-person households value public goods, in particular as these values are revealed through questionnaire surveys., when a family member is asked to value a public good "on behalf of oneself" Assuming efficient Nash bargaining between two household members (as here considered reasonable), this good is traded off the public good against that person's private-good consumption. When the member is instead asked to provide a public-good value "on behalf of the household", the public good is traded off against common-household goods. Provided that answers are truthful, individual members' expressed valuation of the public good tends to be correct "on behalf of the household", on the average. The particular member who conducts the valuation, overvalues (undervalues) the good on behalf of the household only when he or she has a higher (lower) marginal valuation of the public good than the other member. I moreover show that such over- or under-valuation is even less of a problem under altruism, interpreted either as "pure" altruism, or as mutual "paternalistic altruism" with respect to consumption of the public good.

Note that these results depend strongly on the chosen model of the family, whereby household members are assumed to reach efficient and cooperative bargaining solutions. As discussed and argued above, this model is highly plausible in the family context, and most recent empirical literature dealing with household allocation strongly supports it. It may still be of interest to consider alternative cases, where household members act non-cooperatively and/or inefficiently. With non-cooperative household allocations of private and household goods, there will be a tendency for marginal valuations of the two types of goods to be similar, for any one household member.[24] In such cases the valuation of the pure public good, "personally", and "on behalf of the household", will tend to be similar. Any one person then cannot truthfully represent the entire household. An important future research task is here clearly to further investigate the properties of representative household behavior.

The results found in this paper have important implications for the interpretation of results from CV surveys, which have for long been, and today still are, the most popular tool for valuing a wide range of public goods, in e.g. the environmental,

[24] See Chen and Woolley (2001) for a discussion of properties of such non-cooperative allocations.

health, cultural and transportation sectors. My results indicate that there should normally not be any fundamental problem with letting one sample (adult) person conduct such valuation on behalf of the household. In a large random sample of households, such individual valuations should on average represent the respective households correctly, only provided answers are truthful. Summing up individual valuations on behalf of households across household members will then lead to double counting. Altruism plays no basic role in establishing these results. Still, higher degrees of altruism tend to make individual valuations within a household more equal, and one person's valuation on behalf of the household more precise.

Several extensions can be interesting for future analysis. Further research is required to determine the relevance of the unitary, bargaining and conflict views on household allocation.[25] Secondly, many goods are on a more diffuse continuum between our extremes of purely private or household goods. Thirdly, children and their preferences need to be incorporated more directly, perhaps as individuals with low bargaining power and sharing the common household budget, and subject to altruism (by parents). The analysis under either of the two altruism variants considered (or a combination) may then apply. Fourthly, altruism outside of the household may play important roles, not explored here.

[25] A recent study based on bargaining but emphasizing a conflict view is Anderson and Baland (2002).

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