Asking for Individual or Household Willingness to Pay for Environmental Goods?

Implication for aggregate welfare measures

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Accepted and in press *Environmental and Resource Economics*, Special Issue: The household, gender, children and environmental economics.

December 2008

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Abstract

The aggregate welfare measure for a change in the provision of a public good derived from a contingent valuation (CV) survey will be higher if the same elicited mean willingness to pay (WTP) is added up over individuals rather than households. A trivial fact, however, once respondents are part of multi-person households, it becomes almost impossible to elicit an "uncontaminated" WTP measure that with some degree of confidence can be aggregated over one or the other response unit. The literature is mostly silent about which response unit to use in WTP questions, and in some CV studies it is even unclear which type has actually been applied. We test for differences between individual and household WTP in a novel, web-administered, split-sample CV survey asking WTP for preserving biodiversity in old-growth forests in Norway. Two samples are asked both types of questions, but in reverse order, followed by a question with an item battery trying to reveal why WTP may differ. We find in a test between samples that the WTP respondents state on behalf of their households is not significantly different from their individual WTP. However, within the same sample, household WTP is significantly higher than individual WTP; in particular if respondents are asked to state individual before household WTP. Our results suggest that using individual WTP as the response unit may overestimate aggregate WTP. Thus, the choice of response format needs to be explicitly and carefully addressed in CV questionnaire design and further research in order to avoid the risk of unprofitable projects passing the benefit-cost test.

Keywords: Contingent valuation, household, individual, WTP;

Abbreviations: WTP= Willingness to Pay, PC=payment card

JEL Classification: Q51, H41

Introduction

The aggregate welfare measure for a change in the provision of a public good derived from a contingent valuation (CV) survey will be higher if the same elicited mean willingness to pay (WTP) is added up over (adult) individuals rather than households. A trivial fact, however, once respondents are part of multi-person households it becomes almost impossible to elicit an "uncontaminated" WTP measure that with some degree of confidence can be aggregated over one or the other response unit (e.g. Quiggin (1998), Bateman and Munro (2006)). The correct unit will not only depend on how and to whom the WTP question is phrased, but on the respondent's self-perceived agency and the type of resource allocation model prevailing in her[2] household (Delaney and O'Toole 2006; Strand 2007). Failing to appreciate this problem has important implications for the credibility of welfare estimates from CV studies, and stated preference research more generally (as for example acknowledged by Boyle (2003))[3]. The issue has received little attention in the extensive CV literature, though response unit distortions in welfare estimates could be higher than other more "high-profile" CV biases, discussed for example in Carson et al. (2001). The result is an ambiguous CV practice applying a mix of approaches asking respondents for their personal WTP, their WTP on behalf of the household, or even leaving the unit unspecified.

The aim of this paper is to investigate the empirical consequences of the choice of response unit – household or individual – and to inform the theoretical debate about household decision-making models in the context of CV of environmental goods. We attempt to answer the following questions: (1) What is the relationship between

[2] Gender-neutral pronoun variation may be confusing in a paper on household preferences, where gender differences are well known. However, no such differences are intended unless explicitly stated.

[3] In fact, this is part of a wider problem as traditional microeconomics typically leave the definition of the "consumer" rather obscure – treating households and individual consumers the same (Vermeulen 2002).

individual and household WTP?; (2) Do respondents within the same sample change their WTP when prompted instead to state individual or household WTP, and if so what are their stated reasons?; and finally; (3) Can household and respondent characteristics explain the observed relationship between household and individual WTP? The spill over and use of models from the large household decision-making literature to answer such questions has been limited to date within environmental valuation research. No generally agreed theoretical framework has been developed, though some attempts have been made (notably Quiggin (1998), Bergstrom (2003), Strand (2005; 2007), Smith and Van Houtven (1998; 2004), Munro (2005) and Bateman and Munro (2003)). We compare Strand's (2007) collective household decision model, which predicts that response unit bias may actually not be a problem in large samples, with other models deriving hypotheses we test within and between samples. This paper is, to our knowledge, the first empirical contribution investigating the relationship between household and individual WTP for CV of environmental goods. Our study also supplements the results from a few limited empirical studies for other types of goods (e.g. TV broadcasting, health risks) or valuation methods (choice experiments) (Bateman and Munro 2006; Beharry and Scarpa 2006; Delaney and O'Toole 2006; Hasler et al. 2008; Delaney and O'Toole 2008). Compared to previous research, we add several new dimensions: (1) Core elements of our CV questionnaire (e.g. type of good, scenario, payment vehicle, budget reminders) are consistent with eliciting both household and individual WTP from individual respondents; (2) Within this framework, all respondents are given both household and individual WTP questions, but the order is varied between samples, offering a clean test of differences in WTP; finally (3) We utilise both respondents' stated reasons and a CV dataset merged with previously collected respondent web panel information to explain the observed differences in individual and household WTP. We find that people state a higher WTP on behalf of the

household than as individuals, though this difference is not significant between samples at the 5 % level. However, when people are prompted to answer using the other response unit, the WTP difference increases and becomes significant, especially if they have been asked individual WTP first. Results suggest that response unit uncertainty may continue to be a source of substantial noise in aggregate welfare estimates, unless the issue is much more carefully addressed in survey design and testing.

Theoretical framework and empirical expectations

In a typical CV survey a random household member would be asked WTP for a change in the provision of an environmental good in one of two main ways[4]:

(I) What is your maximum individual (or personal) WTP (on your own behalf)?; or

(II) What is your maximum WTP on behalf of your household (or your household's maximum WTP)?[5]

In CV studies, WTP from question I would normally be aggregated over individuals, and from II – the most frequently used – over households. A commonly held view, as pointed out by Strand (2007), is that the answer to II is higher than to I, but only if the respondent shows interpersonal preferences, such as altruism, towards other household members. If there are no such preferences, aggregating WTP from question II over households would underestimate the total welfare change. In their landmark book on CV, Mitchell and Carson (1989: p265-266) advise for pure public goods simply to

[4] The third way, not specifying the unit, as is frequently observed in CV would not be advisable. Further, in English "you", without reference to unit, introduces ambiguity since there is no difference between plural and singular interpretation.

[5] We use the open ended WTP question format here, but what we write would naturally extend to other formats, such as dichotomous choice.

"allow an adult who claims to be the household head" to answer question II[6]. In a footnote they refer to Becker (1981)'s unitary model, in which household choices can be described as if they were made by a single individual (Samuelson 1956; Becker 1973)[7]. A feature of the model is income pooling among household members, implying that the source of income does not influence consumption decisions. The unitary model has increasingly come under fire (see e.g. Vermeulen (2002)) and is being replaced by collective models where resource allocations are determined by cooperative (Pareto efficient) or non-cooperative bargaining among household members.

The most advanced attempt to investigate household decision making in this context is Strand (2007). Introducing some notation is useful. Let: hwtp = the maximum amount a household would be WTP for the environmental good, so that all household members' utility levels are unchanged (which is typically unobserved in CV surveys); $iwtp^i$ = household member i's response to WTP question I; and $hwtp^i$ = household member i's response to WTP question II. Strand (2007) presents a collective model with no altruism assuming that the "true" hwtp is measured as the sum of the adult household members'

[6] The two reasons Mitchell and Carson put forward for this advice were in our view both somewhat misguided. First, they claimed that most payments for pure public goods are made at the household level, using income tax as one example. But income tax was always measured out and paid individually (though at that time household income was more commonly derived from only one income earner). Second, they claimed that choosing a household head was the U.S. Census Bureau practice at the time, though this rather archaic practice seems to have been abandoned already in 1980 partly due to feminist critique (Presser 1998). For quasi-private goods such as hunting Mitchell and Carson recommend eliciting individual WTP

[7] This outcome results either from imposing a structure on the household decision-making problem so that the household utility function reduces to one (Samuelson), or through an altruistic (benevolent) head optimally allocating household resources (Becker).

individual WTP (suppressing the summation index: $\sum$iwtp$_i$) i.e. each adult members' reply to WTP question I above[8]:

(1) $\text{hwtp} \equiv \sum_{i=1}^{m} \text{iwtp}^i \equiv \sum \text{iwtp}$, where the household has m (adult) members[9].

Strand's (2007) model assumes that the household allocates resources in efficient Nash bargains over a private and a household good (i.e. a good consumed commonly within the household). WTP question I is then interpreted as member i's willingness to give up units of the privately consumed good for the increase in the public good. Question II is member i's trade-off between the household good and the public good. A key result from the bargaining solution is that a member is generally willing to give up more of the household good than the private good:

(2) $\text{hwtp}^i > \text{iwtp}^i$

The reasons for this is that only a share of a common budget increase can be spent on the private good and the marginal consumption values for both goods have to be equal in optimum for each member. Note that (2) does not arise from altruism, the commonly

[8] In contrast to Strand, Quiggin (1998) and Bateman and Munro (2006) consider hwtp to be WTP obtained by consensus if adult household members are asked question II jointly. However, this interpretation makes implicit assumptions about the household bargaining structure allowing a consensus to be reached in a survey setting. Further, Bateman and Munro (2006: p3) state that "In one treatment a randomly selected individual is chosen from the couple [..] *providing responses on behalf of the household"* [our italics]. This is what they call "individual WTP", in our terminology hwtp^i, which they sum over the two partners to aggregate hwtp. In our setup, this would only make sense for iwtp^i (equation (1)). However, their imprecision may be due the income pooling model assumed in their study, in which the distinction between WTP questions I and II becomes immaterial (see equation (5)).

[9] Strand assumes in his basic model two adult household members only, but his results extend to more than two members, so we take the general case here.

held view. Further, an implication of the model is that that member i generally will misrepresent hwtp, in his answer to question II, i.e.

(3) $\text{hwtp}^{i} \neq \sum \text{iwtp}$

This result arises because the household members generally have different marginal valuations of the public good (in terms of the household good). Higher marginal valuation for the member asked than for the other members implies hwtp^{i} higher than the sum of iwtp, which by definition (1) is hwtp. The converse is true for lower marginal valuation. However, importantly for practical CV research, Strand (2007: p541) argues that: "In a large random sample of households, such individual valuations should on average represent the respective households correctly, only provided answers are truthful". In other words the true, unobservable mean household WTP in a (large) sample ($\overline{\text{hwtp}}$) is equal to the observed mean response to question II ($\overline{\text{hwtp}^{i}}$):

(4) $\overline{\text{hwtp}} = \overline{\text{hwtp}^{i}} = \overline{m} \times \overline{\text{iwtp}^{i}}$

Given the definition of hwtp in (1), equality two in (4), where $\overline{m}$ is average (adult) household size and $\overline{\text{iwtp}^{i}}$ average response to question I in the sample from one random household member from each household[10], should also follow by approximation for large samples. If (4) is supported, the implication is that asking WTP questions I or II should be immaterial to the welfare estimate, as long as the aggregation is done according to the chosen unit.

[10] Equality should also hold if iwtp^{i}'s are added up with respondent-level household sizes instead of average household size in the sample. Note that only in two special cases will $1/m \sum_{i=1}^{m} \text{hwtp}^{i} = \text{hwtp}$, i.e. the error in representation of household WTP for all members will in general not average out within the same household.

Within a fairly general framework that does not depend on the type of household allocation model, Munro (2005) shows that if and only if the household members pool income, $hwtp^i$ and $iwtp^i$ will always be equal, i.e. the distinction between response units introduced with WTP questions I and II is unnecessary:

(5) $iwtp^i = hwtp^i = hwtp = hwtp^j = iwtp^j$, where members i and j are from the same household. The result follows directly from the properties of the standard indirect utility function once the functions depend on the sum of both individuals' income. In this case, summing over $iwtp^i$ for the individuals in the sample would grossly exaggerate hwtp, in contrast with (4), as these are really representations of hwtp.

Finally, in a meta-analysis of CV studies of non-timber benefits Lindhjem (2007) finds a counter-intuitive result from what we have discussed above:

(6) $hwtp^i < iwtp^i$

He suggests that this result may be due to the fact that reference to individual or household in the WTP question triggers different "mental accounts" (Thaler 1999; Li et al. 2005) or "psychological purses" (Webley 1995) from which the payment for the environmental good is drawn. These frequently observed psychological phenomena make money non-fungible in practice. Further, this literature finds that the degree of financial integration within a household, from complete income pooling to separate finances, strongly influences household consumption decisions in general (Pahl 1995) and household vs. individual WTP in particular (Delaney and O'Toole 2008). Being married, having children and being female are factors that suggest people respond more as households than as individuals. Further, bargaining strength between members in a household, typically measured as relative income of partners, has been shown to influence household consumption decisions in various ways (Dosman and Adamowicz 2006). Strand (2007) shows that the difference in (2) above will be larger for members

with low bargaining power. The CV literature also suggests there are many respondent characteristics, often not directly derived from standard economic theory that may explain variation in WTP (e.g. difference between women and men, with or without children etc). Some of these variables may also help our understanding of differences between household and individual WTP.

Testing procedure, survey design and data

Testing procedure

The theoretical predictions and empirically derived expectations discussed above were tested using a 2x2 split sample CV design. In sample A the respondent first got WTP question II ($hwtp^i$) and then prompted to instead think about personal WTP she got WTP question I ($iwtp^i$). After the second WTP question, the respondent was automatically directed in the survey to a question offering 4-6 reasons for why $hwtp^i$ was higher, lower or the same as $iwtp^i$ (see next section). The design was the same in sample B, except the order of the WTP questions and the way the prompt was phrased were reversed. The design allowed us to investigate the hypotheses discussed in the previous section (see Table 1 for summary of these) comparing mean WTP within and between the two samples. Note that we cannot test equation (3) directly with this design since we only collect responses from one random representative from each household. Giving both questions I and II to the same respondents allows us to model the relationship between $hwtp^i$ and $iwtp^i$ using explanatory variables for household and respondent characteristics.

Table 1 Summary of testable hypotheses of mean individual and household WTP[1]

	Within samples (k=A, B)	**Between samples**	**Reference**
H1	$\overline{\text{hwtp}_k^i} > \overline{\text{iwtp}_k^i}$	$\overline{\text{hwtp}_A^i} > \overline{\text{iwtp}_B^i}$	Strand (2007). Equation (2) Basic model
H2a[2]	$\overline{\text{hwtp}_k^i} = \overline{m_k} \times \overline{\text{iwtp}_k^i}$	$\overline{\text{hwtp}_A^i} = \overline{m_B} \times \overline{\text{iwtp}_B^i}$	Strand (2007). Equation (4)
H2b[3]	$\overline{\text{hwtp}_k^i} = \frac{1}{n_k}\sum_{i=1}^{n_k} m_k^i \times \text{iwtp}_k^i$	$\overline{\text{hwtp}_A^i} = \frac{1}{n_B}\sum_{i=1}^{n_B} m_B^i \times \text{iwtp}_B^i$	Response bias evens out in large samples
H3	$\overline{\text{hwtp}_k^i} = \overline{\text{iwtp}_k^i}$	$\overline{\text{hwtp}_A^i} = \overline{\text{iwtp}_B^i}$	Munro (2005). Eq. (5) Income pooling makes units equal
H4	$\overline{\text{hwtp}_k^i} < \overline{\text{iwtp}_k^i}$	$\overline{\text{hwtp}_A^i} < \overline{\text{iwtp}_B^i}$	Lindhjem (2007). Eq.(6) Explorative, based on mental accounting

Note: 1.Deriving the hypotheses it is reasonably assumed that the relationships discussed on the respondent level extend to means of samples. 2. It is somewhat artificial to test this hypothesis between samples for the second WTP question as people are expected to anchor their response to the first WTP question. 3. iwtp^i is multiplied with respondent-level household size (m_k^i) and summed over the sample size (n_k).

CV survey design and environmental commodity

The data were collected from an Internet survey as part of a large multi-mode CV survey of forest protection in Norway. Currently ca. 1.4% of the productive forest area is protected, which according to biological assessments is too little to protect representative parts of forest habitats and endangered biodiversity. There are therefore plans to increase the level of protection, which can be assumed primarily to yield non-use values. A professional polling firm collected the data in the autumn of 2007 from a pre-recruited nation-wide panel of respondents. The panel is informed that surveys should be answered alone, so there is a higher degree of control over who actually answers than can be expected from mail surveys. The survey was designed following similar forest protection surveys well tested and tried in the Nordic context (see

Lindhjem (2007)), and recent best-practice guidelines in the CV field (e.g. Bateman et al (2002), SEPA (2006)). The instrument went through thorough testing in focus groups and two small pilots (using both internet and personal interviews).[11]

The survey first included questions about use of government money for various ends to put the environmental good into a wider context, before focusing on the respondent's use of forests and attitudes towards their perceived biological and aesthetical state. Information was then presented about number and types of species, and the interplay between forestry practices, protection and evolution of ecosystem functions and biodiversity in forests. Six colour photos of endangered species and forest habitats were shown as well as pie and bar charts of number and percentage of species in different habitats, including forests. The information was broken up with questions to activate the respondent and encourage response. Hard-to-avoid technical terms in the text (such as "biodiversity", "nature reserve" etc) were explained in boxes that would pop up when the cursor touched underlined words. Respondents were then presented current forest protection policy (status quo) and future plans. The environmental commodity was specified as two forest protection plans of either an increase to 2.8% (doubling) or to 10% (possible long-term target), presented together. The text was supplemented with digital, zoomable colour maps of current and future forest reserves, and a table giving information about the size of new reserves, location of reserves, and the improvements in the living conditions for main groups of species. The biological information was provided by a team of leading biologists in Norway, and checked by foresters to ensure a balanced presentation of the status quo and future plans.

Household and individual WTP elicitation and follow-up probes

[11] The full survey questionnaire is available in English from the author upon request.

The basis for the comparison of hwtp[i] and iwtp[i] was the 2.8% protection plan. After the information about the two plans, the respondent was given the following text (the bold was varied between Samples A and B):

"We ask you now to consider how much the two alternative plans are worth for **your household/you**. Think through carefully how much the 2.8% plan is worth compared to the current situation, before you give your final answer to the next question. Try to consider what would be a realistic annual amount given **your/your household's** budget. **You/Your household** must choose whether to spend the amount on the forest conservation plan, or on other things. What is the most **your household/you** almost certainly **is/are** willing to pay in an additional annual tax earmarked to a public fund for increased forest conservation from today's level of 1.4% to 2.8% of the productive forest area? Choose the highest amount, if anything, **your household/you** almost certainly will pay".

People could then indicate their maximum WTP in a payment card (PC) in the form of a drop-down menu with a non-linear scale containing 24 amounts (ranging from 0 first to NOK 15000[12]), including "don't know" (at the end). The amounts where chosen on the basis of previous CV studies (e.g. Lindhjem (2007)). PC was chosen as response format over dichotomous choice, to avoid yea saying (at the expense of theoretical incentive compatibility) (Boyle (2003)). PC also lends itself nicely to the drop-down menu format very familiar to internet-users. The payment vehicle (an earmarked tax to a forest protection fund) was chosen because it is response unit neutral, for example compared to an income tax (a potential problem in e.g. Hasler et al. 2008), is realistic and reduces people's scepticism that the money would not be spent on forest protection. The typical

[12] There was also an option to choose "more than 15000", in which case a box would pop up where the exact amount could be specified.

budget reminder, included in most modern CV studies, referred either to "your (personal)" or "your household's budget". Following the first WTP question, the respondent would get the following prompt, before getting the second WTP question with response unit changed: "We now ask you if it matters for your willingness to pay if you state it **for yourself/on behalf of your household** or **on behalf of your household/for yourself**."

After the second WTP question, respondents were automatically taken to a follow-up question asking whether a number of stated reasons were important, not important or not relevant for their response to the two questions. The suggested reasons allow the respondent to express her considerations regarding her (and her partner's) preferences (for herself, family), budget (individual, household, common), and role in the household (e.g. usually paying household expenses). The respondent could also state openly other reasons that may have been important. The details of these are given in the Appendix, and the descriptive statistics of peoples' responses given in the next section. The rest of the CV survey followed standard procedure, probing into why people answered zero or positive, checking their understanding and perceived realism of the scenario and WTP questions. The final part collected socio-economic background information, which was merged with existing panel information about the respondents and their households.

Results and analysis

Mean individual vs household WTP between and within samples

The response rates were 72% and 69% for Samples A and B, respectively. Before estimating mean WTP the dataset was cleaned. Around 10% of respondents in both samples (and for both WTP questions) chose the "don't know" option in the drop-down menu for the PC, while between 20-25% chose zero. There were no significant differences in these answers across samples. Since our main aim here is to investigate

the relationship between household and individual WTP and people's stated reasons, all zeros and "don't know" responses were therefore removed. Further, respondents from one-person households were taken out. This procedure reduced the samples from around 400 to 240 observations, each. A comparison of mean values of sample characteristics indicated no immediate reason for applying weighting procedures or using covariates in the estimation of mean WTP (see Table 6 in the next section). Since the stated WTP amounts had a skewed distribution with a long right tail, a log-transformation of WTP was applied. Mean WTP for the interval PC data for the two samples and WTP questions were estimated following standard procedures given in Cameron and Huppert (1989) (see Table 2)[13] .

Table 2 Mean annual individual and household WTP (std. error), the two samples (Euros)

	Sample A		**Sample B**	
WTP Quest.	**Mean**	**95% CI**	**Mean**	**95% CI**
1st	$\overline{\text{hwtp}^{i}_{A}}$ = 172 (16)	(141, 203)	$\overline{\text{iwtp}^{i}_{B}}$ = 154 (17)	(121, 188)
2nd	$\overline{\text{iwtp}^{i}_{A}}$ = 147 (13)	(121, 173)	$\overline{\text{hwtp}^{i}_{B}}$ = 237 (28)	(182, 292)
N	239		234	

Note: Estimated using interval regression in STATA 9.2. Confidence intervals were calculated using 1000 bootstrap draws with replacement, following Efron (1997). 1 Euro = 8.07 Norwegian Kroner at time of study.

The response to household WTP (Euro 172) is higher than to the individual WTP (Euro 154) between the samples for the first question as expected from theory, confirming the common view in the CV literature. However, the difference seems not to be significant at the 5% level. We ran a likelihood-ratio test to check statistical significance, see (7):

[13] We compared a normal and lognormal model with a simple non-parametric survival function using the lower bound of the PC intervals. The lognormal model showed a better fit. Mean WTP from this model is given by $E(WTP)=\exp(a+\sigma^2/2)$, where a and σ are the estimated parameters from the lognormal model.

(7) $q = -2[\log L_{PooledAB} - (\log L_A + \log L_B)] \sim \chi^2 (\text{d. f.})$

where $\log L_A$ and $\text{Log}L_B$ refer to the log likelihood values of from the estimated models for individual samples, and $\log L_{PooledAB}$ is the likelihood value for a pooled model. Running the pooled model without a sample dummy, yields a test static $(\hat{q})$ of 6.96, which allow us to reject that both parameters are equal at the 3% level. However, running the same model with a sample dummy yields $\hat{q}$=2.12, which means we cannot reject that the standard errors are the same at the 10% level (i.e. the samples can therefore be pooled). The dummy is significant at the 2.8% level, indicating confirmation of the one-sided hypothesis that $\overline{\text{hwtp}_A^i} > \overline{\text{iwtp}_B^i}$. However, an extended bootstrap (10000 draws with replacement) from each of the sample distributions combined with a simple non-parametric test of means indicates ca 80% $\overline{\text{hwtp}_A^i} > \overline{\text{iwtp}_B^i}$ and 20% $\overline{\text{hwtp}_A^i} \leq \overline{\text{iwtp}_B^i}$. This means that we can reject the hypothesis that household WTP is higher than individual WTP between the samples for the first WTP question[14]. The confidence intervals estimated around the means in Table 2, also indicate that equality cannot be rejected at the 5% level. For the second WTP question where response units are reversed, respondents in Sample A generally reduce their bids (mean Euro 147) while respondents in sample B increase their bids (mean Euro 237), as expected. However, this difference is not symmetric, as can be seen from Table 3.

[14] This arises because sample B's distribution has a lower mean, but a higher standard error than sample A's distribution, effects partly outweigh each other in the formula for mean WTP (see previous footnote).

Table 3 Respondents who answered higher, the same or lower on household WTP compared to individual WTP question (percent)

	Sample A	**Sample B**
Higher ($hwtp^i > iwtp^i$)	32.6	52.9
Same ($hwtp^i = iwtp^i$)	59.4	44.4
Lower ($hwtp^i < iwtp^i$)	7.9	2.5
Total	100%	100%

Around 53% of sample B increase their bid from $iwtp^i$ to $hwtp^i$, while only 33% reduce their bids from $hwtp^i$ to $iwtp^i$ in sample A. The reason for this stickiness downwards is not immediately clear. It is possible that some people in Sample A interpreted the $hwtp^i$ question as an $iwtp^i$ question (despite the unit being explicitly stated), and therefore saw no reason to reduce their bid in the second question (similar to what was found in Delaney and O'Toole 2008)[15]. Drawing parallels to the extensive embedding debate in CV, the whole of a good (i.e. $hwtp^i$ in our case) is typically valued more when valued after a smaller part of the good (i.e. $iwtp^i$) in a sequence than before (see e.g. Clark and Friesen 2008, Powe and Bateman 2003). This phenomenon is often termed sequencing or ordering effects. In our case it may offer an explanation why we observe a higher $hwtp^i$ in sample B, but not why responses in sample A are sticky downwards. However, pairwise t-tests on the difference of bootstrapped mean WTP values between WTP questions I and II within each sample were conducted (for brevity not displayed here), strongly confirming $\overline{hwtp^i_k} > \overline{iwtp^i_k}$ for both samples at the 1% level.

To check hypotheses H2a&b, we also scaled individually stated WTPs with the number of adult household members (> 15 years) from each respondent's household and the average household size in the samples (see Table 4). For the former case, high and low

[15] It was not possible directly to control whether respondents would take the time and trouble to go back a page in the Internet survey to change their response to the first WTP question. However, we included a control sample that only got one $hwtp^i$ question. Mean WTP from this sample was statistically identical with that of Sample A, indicating that this practice was not prevalent in the survey

limits from the PC data were multiplied by the household size, and interval regressions rerun. For the latter case, mean individual WTP was re-estimated and scaled up by the constant average household size for each sample.

Table 4 Individual WTP scaled up by measures of household size (Euros)

Mean adjustment factor	**Sample A**	**Sample B**
Average household size in sample[1]	340	382
Adult members of each respondent's household	345	387
N[2]	224	218

Note: 1. Mean household sizes sample A: 2.29, Sample B: 2.41 (excluding one-person households). 2. The sample sizes are lower than in Table 3 since the respondent database had a few missing household size values. This is also the reason why means from Table 3 scaled up with household sizes here are not exactly equal to 340 and 382.

Interestingly, the two methods to adjust individual WTP with household size yield very similar results. Compared to the household WTP for sample A in Table 2, adjusting individually stated WTP estimates to represent household WTP, yield significant overvaluation. $\overline{\text{hwtp}_A^i}$ is about half of the individual WTP adjusted by household size from sample B, contrary to the expectation in equation (4). Also for the second WTP question where the majority end up answering $\text{hwtp}^i > \text{iwtp}^i$, there is no equality of mean hwtp^i and mean adjusted iwtp^i within samples. Finally, we can summarize our empirical results in Table 5.

Table 5 Summary of empirical results by hypothesis (k=sample A,B)

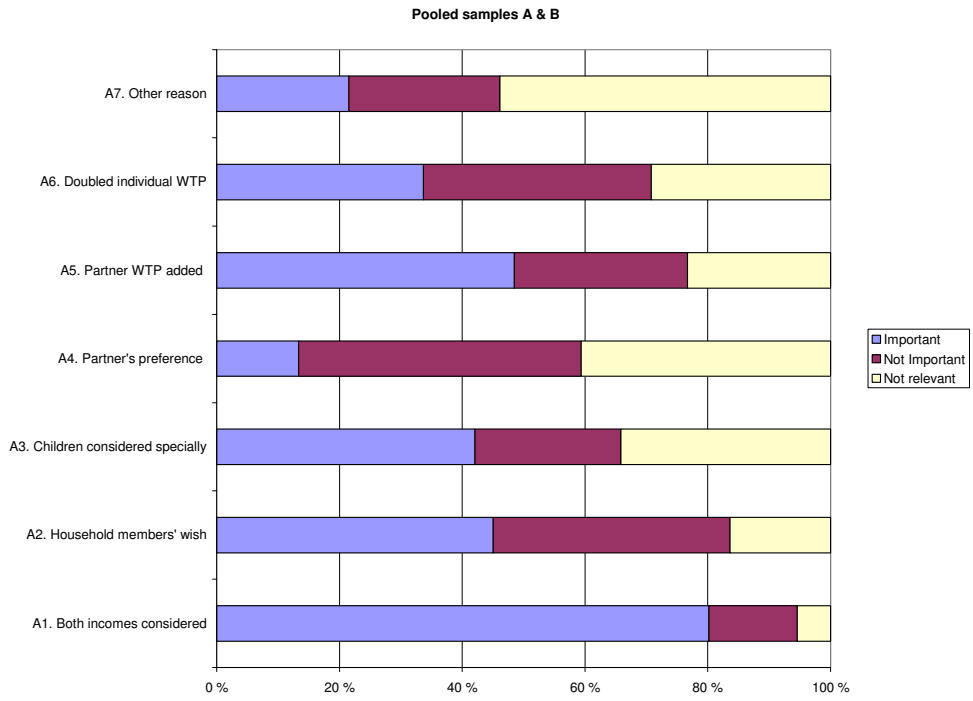
	Within samples	**Test result**	**Between samples**	**Test result**
H1	$\overline{\text{hwtp}_k^i} > \overline{\text{iwtp}_k^i}$	**Supported A&B**	$\overline{\text{hwtp}_A^i} > \overline{\text{iwtp}_B^i}$	Rejected
H2a	$\overline{\text{hwtp}_k^i} = \overline{m_k} \times \overline{\text{iwtp}_k^i}$	Rejected A&B	$\overline{\text{hwtp}_A^i} = \overline{m_B} \times \overline{\text{iwtp}_B^i}$	Rejected
H2b	$\overline{\text{hwtp}_k^i} = \frac{1}{n_k}\sum_{i=1}^{n_k} m_k^i \times \text{iwtp}_k^i$	Rejected A&B	$\overline{\text{hwtp}_A^i} = \frac{1}{n_B}\sum_{i=1}^{n_B} m_B^i \times \text{iwtp}_B^i$	Rejected
H3	$\overline{\text{hwtp}_k^i} = \overline{\text{iwtp}_k^i}$	Rejected A&B	$\overline{\text{hwtp}_A^i} = \overline{\text{iwtp}_B^i}$	**Supported**
H4	$\overline{\text{hwtp}_k^i} < \overline{\text{iwtp}_k^i}$	Rejected A&B	$\overline{\text{hwtp}_A^i} < \overline{\text{iwtp}_B^i}$	Rejected

Rejection of H1 and H2 between samples follows from the support to hypothesis H3. However, household WTP is significantly higher than individual WTP within each sample (i.e. H1 supported), where rejection of H3 and H4 (but not H2) within samples logically follows.

Explaining the relationship between individual and household WTP

We now turn to trying to explain the observed relationship between individual and household WTP within the two samples. Some explanations are given by the respondents themselves, when stating in the follow-up question for each proposed reason whether it was important, not important or not relevant to their choice. Figures 1 and 2 sum up the results for the pooled samples, for $hwtp^i > iwtp^i$ and $hwtp^i = iwtp^i$, respectively. Full versions of statements respondents considered are given in the Appendix.

Figure 1 Percentage of respondents rating given reasons for $hwtp^i > iwtp^i$ (n=202)



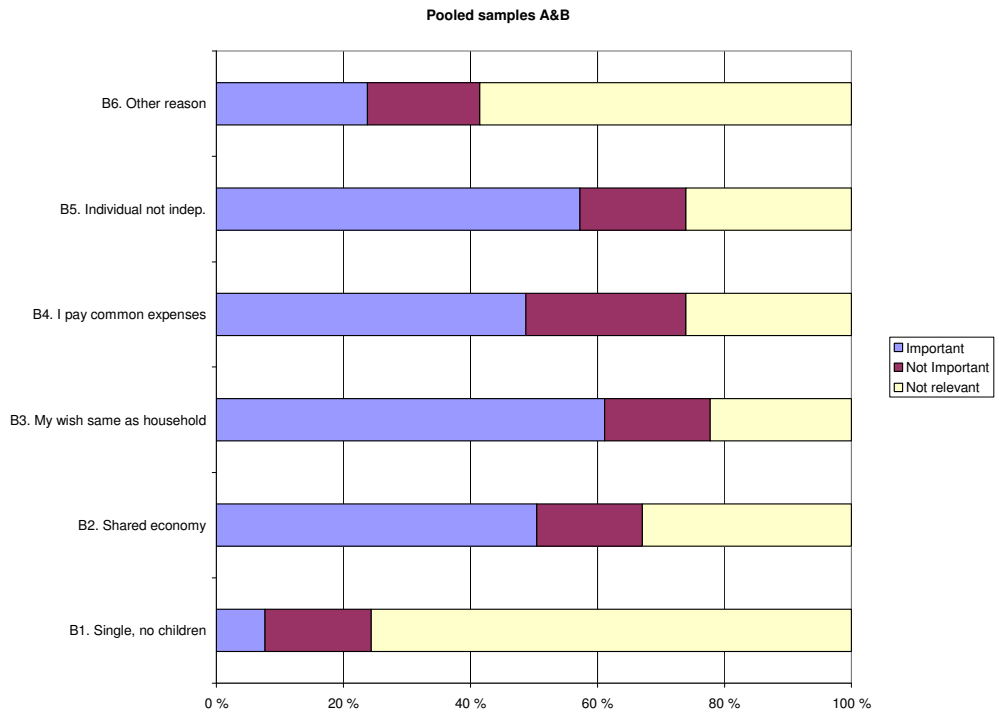
The by far most important reason why people state higher household WTP is that they have a larger budget at their disposal and therefore can pay more (80% for reason A1 in

Figure 1). This means that individuals do not seem to consider the income of adult co-members as part of their own budget constraint, i.e. income is not pooled. The second most important reason (49%) is that the estimated WTP of a partner is added (A5), which may be consistent with both a separate and shared economy in practice. The third reason (A2) is that respondents think about the household also when answering individually (i.e. no generous individual "mental account" distorts the expected relationship between $hwtp^i$ and $iwtp^i$). The fourth most important reason is that respondents consider children especially when answering the household WTP question (A3). This is an indication of altruistic preferences, which is the traditional view of why household WTP may be higher (but as discussed not a necessary condition in Strand's (2007) model). Only 33% state that they have just doubled the individual amount since they are from a two-adult household (A6). Finally, it is interesting to note that very few respondents have answered higher household WTP because their partner has a stronger preference (higher marginal valuation) for forest conservation than themselves (A4). There were no substantial differences in answers to this follow-up question between samples A and B. However, reasons A1 and A5 seemed to be more important for sample B, and A6 for sample A (all by ca 10 percentage points). Some of the open answers (A7) pointed to the number of household members (with or without reference to use of forests) as important, that individual WTP was calculated as a percentage, that assumptions had been made about other members' WTP, and generally that a larger budget is available (supporting A1).

A similar battery of reasons where offered for $hwtp^i=iwtp^i$ -respondents (see Figure 2). The most important reason is that the respondent's wish concurs with what the household would collectively have decided (61%, reason B3 in Figure 2). This is an indication of a unitary household model (as judged by the respondent), as is the reason almost as many states as important: taking household members into account even when

answering as an individual (57%, B5). About 50% indicate as important that they have a shared economy with their partner (B2), 48% that they are responsible for paying household expenses and therefore that it does not matter for their WTP which response unit they are asked (B4). Reason B3 was indicated as more important for sample A than B (by 12 percentage points), while other reasons had no big difference across samples. In their open statements, some respondents had noted that the amount they decided on the first question was "an appropriate amount" or "enough", i.e. that they saw no reason to increase or decrease from this amount. This is a reason related to the embedding and scope insensitivity debate discussed above, however, in this case perhaps more a reflection that a "moral dump" – a suitable donation to a good cause – has been made. Hence, in our dataset there may be a few such responses, where "stickiness" ($hwtp^i$=$iwtp^i$) is not due to reasons related to household decision-making.

Figure 2 Percentage of respondents rating given reasons for $hwtp^i$ =$iwtp^i$ (n=234)[1]



[1]One-person households without children were taken out. Still, 7% had indicated that being single and having no children (B1) was important. This may be due to the fact that the CV data generally are more updated than the Internet panel information. Further, a few responses may be due to misunderstanding, in any case a low number giving us confidence in people's responses.

Some respondents also indicated that they made the decisions in their household, i.e. similar to the Mitchell and Carson's "household head", and therefore $hwtp^i=iwtp^i$. However, this stated reason may also be interpreted as an indication of high bargaining power. Only 7.9% in sample A and 2.5% in sample B (total of 25 respondents) chose $hwtp^i<iwtp^i$ (figure of stated reasons not displayed here). Around 50% stated as important that their personal budget was higher (reason C1 in Appendix), i.e. indicating "mental accounting" (or possibly separate finances). One respondent mentioned separate finances as important, another that it was easier to answer the individual question than assuming WTP for the other members.

We also posed the question of whether household and respondent characteristics, defined in Table 6, can explain the relationship between individual and household WTP. We do not rule out a priori that a range of respondent variables (e.g. sex, age, education, use, attitudes, etc) often included in CV bid functions may also be important to explain the relationship between household and individual WTP. These variables may be considered explorative. Of household variables we included number of household members, presence of children, altruistic attitudes for WTP>0 (latter two crude proxies for altruism), if children (>15 years) answer the survey, type of residence, whether grocery purchases are jointly planned, marital status (latter two crude proxies for economic integration), and the respondent's share of household income (common proxy for bargaining strength). The third and fourth columns in Table 6 indicate mean values and standard deviation, which are generally very similar between samples.

Table 6 Explanatory variables and sample means (st. dev.) samples A and B

Variables	Definition	A	B
Respondent characteristics:			
Gender*	Dummy: 1 if male, 0 if woman	.504	.512
		(.032)	(.032)
Age*	Continuous: >15 years	41.2	41.7
		(.91)	(.96)
Incomeind	Individual income 2006, Norwegian Kroner 25000 intervals	316912	312948
		(11903)	(13597)
Eduhigh*	Dummy: 1 if > 4 years university education; 0 if mid-education	.100	0.119
		(.019)	(.021)
Edulow*	Dummy: 1 if only primary education; 0 if middle education	.075	.085
		(.017)	(.018)
Owner	Dummy: 1 if forest owner; 0 if not	.306	.235
		(.029)	(.027)
Member	Dummy: 1 if member of nature organisation; 0 if otherwise	.025	.038
		(.010)	(.012)
Use	Dummy: 1 if forest used for recreation last 12 months; 0 if not	.924	.935
		(.017)	(.016)
Highuse	Interaction variable: 1 if >15 times in forest last month and	.063	.136
	"Use"=1; 0 otherwise	(.015)	(.022)
Nouse	Dummy: 1 if sure not to use proposed forest reserves, 0 if otherwise	.172	.179
		(.024)	(.025)
Attax*	Dummy: 1 if agree that high taxes ensure public goods; 0 if otherw.	.138	0.16
		(0.02)	(0.02)
Altruism	Dummy: 1 if respondent indicated as reason for WTP>0 that other	.277	.238
	people can enjoy old growth forests; 0 if otherwise	(.029)	(.027)
Household characteristics:			
Relinc	Individual income as share of household income	.570	.545
		(.015)	(.017)
Childdum*	Dummy: 1 if children <15 years of age in household; 0 if otherwise	.231	.227
		(.027)	(.028)
Childresp*	Dummy: 1 if child (> 15 years) answered survey; 0 otherwise	.077	.080
		(.017)	(.018)
Married*	Dummy: 1 if married; 0 if previously married/single	.596	.607
		(.032)	(.032)
Cohabit*	Dummy: 1 if cohabitants; 0 if previously married/single	.236	.209
		(.027)	(.027)
Grocery*	Dummy: 1if divided responsibility, grocery purchase; 0 if otherwise	.454	.446
		(.032)	(.033)
House*	Dummy: 1 if detached house; 0 if otherwise	.592	.638
		(.032)	(.032)
Hhldmem*	Number of adults and children (1-4, 5 or more)	2.98	3.03
		(.071)	(.071)
N**		239	234

Note: * Variable information taken from Internet panel of respondents. Other variables are from the CV survey. ** Some averages based on reduced sample. No weighting was conducted between samples.

We chose a simple regression approach with a binary dependent variable of 1 if $hwtp^i > iwtp^i$ and 0 if $hwtp^i = iwtp^i$ estimated using a standard probit model, similar to the approach in Delaney and O'Toole (2004). The few respondents answering $hwtp^i < iwtp^i$ were excluded for simplicity. Models using the WTP ratio ($hwtp^i/iwtp^i$) or difference ($hwtp^i - iwtp^i$) as dependent variables instead of the binary variable, were specified and tested, but gave generally lower explanatory power. Being unfamiliar with the task, it is

likely that respondents had a clearer idea about the direction than the exact magnitude of the difference between $hwtp^i$ and $iwtp^i$. Using a regression model we can control for the different characteristics that are underlying people's responses and hidden in Figures 1 and 2. Results for the separate and pooled samples are displayed in Table 7. The models show reasonable fit to the data, but coefficient estimates should be interpreted with caution. For sample A, older people have significantly higher probability to state equality, indicating perhaps both for long relationships and for the older generation, the difference between the individual and the household gets increasingly blurred.

Table 7 Probit models on $hwtp^i > iwtp^i$ (Y=1) or $hwtp^i = iwtp^i$ (Y=0) for separate and pooled samples

Independent variables	**Sample A**		**Sample B**		**Pooled sample (A+B)**	
	Coefficient	**Z-score**	**Coefficient**	**Z-score**	**Coefficient**	**Z-score**
Dummy for sample (WTP question order)					.482***	3.69
Respondent variables:						
Gender	-.158	-0.73	.387*	1.73	.126	0.85
Age	-.025**	-2.34	.004	0.44	-.006	-0.94
Incomeind	0.000	1.48	0.000**	1.96	0.000***	2.59
Eduhigh	.166	0.55	.265	0.89	.193	0.96
Edulow	.412	0.96	.670	1.36	.534*	1.76
Owner	-.370	-1.62	.127	0.55	-.013	-0.09
Member	-.439	-0.51	.249	0.44	.214	0.51
Use	.521	1.44	-.040	-0.10	.259	0.99
Highuse	-.404	-0.97	-.120	-0.43	-.145	-0.67
Nouse	-.073	-0.29	-.622**	-2.38	-.405**	-2.34
Altruism	.163	0.71	.354*	1.66	.198	1.32
Attax	-.095	-0.34	-.503*	-1.90	-.375**	-2.00
Household variables:						
Relinc	-1.362***	-2.16	-2.209***	-3.68	-1.653***	-4.01
Childdum	.453	1.27	-.251	-0.81	-.064	-0.29
Childresp	1.150*	1.66	.253	0.39	.611	1.38
Married	.842	1.59	-.200	-0.48	.202	0.65
Cohab	.945*	1.86	-.151	-0.36	.348	1.13
Grocery	-.173	-0.84	.005	0.03	-.048	-0.36
House	.054	0.26	-.242	-1.04	-.103	-0.71
Hhldmem	-.374**	-2.50	-.022	-0.18	-.104	-1.14
Constant	.948	1.11	.944	1.11	.273	0.48
Log Likelihood	-120.19		-129.82		-260.84	
Pseudo R^2	0.1329		0.1419		0.1228	
N	214		219		433	

Note: ***, **, * Indicates significance at 1%, 5%, and 10% levels, respectively

The other respondent variables are not significant for sample A. In sample B, men have a significantly higher probability than women of answering $hwtp^i > iwtp^i$, i.e. women

may see income pooling as more natural than men. Individual income level has almost no effect on the probability. Interestingly, people who are certain not to visit the future forest reserves (variable "Nouse") have lower probability of separating between household and individual WTP (not significant for sample A). Non-users may be more likely to see the good in a broader family context (e.g. for bequest reasons) and therefore (mis)interpret the $iwtp^i$ question as a $hwtp^i$ question than users, in which case the WTP difference will be smaller (see also Delaney and O'Toole 2008). Another explanation, if indeed respondents have clearly understood the response unit, is that a "moral dump" or donation has been made, which is less sensitive to unit of response (and, as is often found, to other key dimension of the survey instrument, such as scope of the good). People who favour a tax to pay for public goods ("Attax") also display smaller WTP differences.

For the household characteristics, only relative income is significantly negative through all three models. A higher share of household income reduces the probability of stating $hwtp^i > iwtp^i$, as expected. This result is consistent with Strand's (2007) model of bargaining strength, but can simply also be interpreted as an indication of separate finances as people's WTP is strongly correlated with their personal budget constraint. The variables on personal status ("Cohab" and "Married") do not pick up any consistent patterns across models. Increasing number of household members (i.e. more than 2) reduces the probability of answering $hwtp^i > iwtp^i$ through all models (only significant for A)[16]. This suggests that once children are involved, the household is more tightly integrated, resulting in smaller differences between household and individual WTP. This result runs contrary to the common argument that altruism drives a wedge between

[16] Mere presence of children in the household (i.e. "Childdum") did, however, not have a consistent and significant effect on response probability.

individual and household WTP. If the alleged effect of altruism is present, it may be outweighed by the higher degree of income pooling that emerges once relationships mature. A few children (>15 years) answered the survey, and these generally had a higher probability of answering $hwtp^i > iwtp^i$ ("Childresp") as expected since they have lower income than their parents. A final point to note is that the dummy on sample in the pooled model is significantly positive indicating a higher probability of $hwtp^i > iwtp^i$ in sample B, confirming our earlier results. The results of the models give us some degree of confidence in the validity of the data, and supplement the insights provided by respondents in their stated reasons for differences in household and individual WTP.

Discussion and conclusions

The practical implications for aggregate welfare estimates of the choice of response unit for WTP – household or individual – in CV surveys has been largely ignored in the literature to date. We demonstrate that the empirical consequence may be substantial noise or bias in welfare estimates. In our CV survey of forest protection in Norway, we find that people do not state a significantly different WTP when asked on behalf of the household than as individuals between two samples. Aggregating WTP over individuals in this case more than doubles the total welfare change compared to mean stated household WTP. This means that scaling individual WTP values with mean household size to get household WTP, as is commonly done, inflates welfare estimates. This result runs contrary to Strand's (2007) collective household decision model, which predicts equality between mean household WTP and scaled-up individual WTP in large samples. Since we exclude single-person households and true zero responses, the demonstrated distortion in welfare estimates is somewhat higher than in a full sample.

When people are prompted in the second WTP question to answer for the other response unit, an average of 43% decide to state higher household WTP than individual

WTP, while 52% state the same WTP. More people state higher household WTP if they have been asked individual WTP first, i.e. people tend more easily to increase their bids than reduce them. Mean household WTP within the same samples is found to be significantly higher than individual WTP on the 1% level. 80% of respondents state as an important reason for this result that they have a larger budget at their disposal when asked household WTP. There are few indications that altruism, though imperfectly measured in this study, may be important in explaining that household WTP is higher than individual WTP within samples – the commonly held view in the literature. Instead, degree of financial integration and relevant budget constraints seem to be more important.

Our study is a first attempt to investigate the empirical differences between individual and household WTP for one type of environmental good in a particular CV setting – where both types of questions could meaningfully be asked. The degree to which our results can be generalised to other CV studies, or stated preference research more generally, types of goods, response formats, survey modes etc. is uncertain. For other environmental goods of a more quasi-private nature or where use values dominate, individual WTP questions may be the appropriate choice, as this may be what resonates best with respondents' interpretation. However, more empirical research is undoubtedly necessary within stated preference valuation, to advance the theory of intra-household resource allocation and to test it empirically. Recent research interviewing partners and households together in choice experiment settings (such as in Bateman and Munro (2005, 2006), Beharry and Scarpa (2006)) are important contributions. However, since this approach will never really be a practical option due to excessive costs, empirical work should inform stated preference design, where random individuals typically are asked, with the aim to reduce response unit distortion in welfare estimates as much as possible. An important point made by Delaney and O'Toole (2006, 2008) is that

people's self perceived agency – i.e. their interpretation of the unit of the WTP question notwithstanding explicit reference to "household" or "individual" – may vary depending on household and respondent characteristics. We think the risk of such misunderstandings to some extent may be alleviated by carefully designing the survey to be consistent with the chosen response unit. Not only wording of the actual WTP question, but the type of good (e.g. extent of non-use values), the payment vehicle (e.g. household tax vs. income tax), budget reminders and scenario descriptions, and even the survey mode[17], may give conflicting cues as to the intended agency of the respondent. Understanding respondent agency more broadly in the CV context, it is clear from the literature that when non-use values and altruistic concerns are part of the valuation context – as is the case in our survey – individuals may also respond in accordance with moral or social norms or as citizens (Brekke et al. 2003, Nyborg 2000), rather than as neo-classical consumers (Sagoff 1988). Understanding how the individual and household roles are influenced by and influence these other roles of respondents, beyond the scope of this paper, would be a fruitful avenue for further research.

Our results indicate that people may need more information to state their WTP reliably for the household or as individuals. We think that our approach would have to be improved in different directions and thoroughly tested, before a clear recommendation on survey design is given. Some avenues of improvement are clear. Since there are parallels to the embedding debate in CV, some sort of advance disclosure of the fact the both individual and household questions will be asked (which we did not include) may help respondents think, improve consistency and reduce "surprise" effects (as recommended in scope tests – see e.g. Bateman et al. (2004)). People may also be given

[17] People may for example view their agency differently depending on whether they are asked during an intercept at a forest site or in a shopping mall compared to filling in a paper questionnaire on their own, family kicthen table.

a chance to revise WTP ex post. Since our findings show that people seem not to have a clear idea about how they should interpret the individual and household questions, "cheap talk" (e.g. explaining why there may be differences) and definition of "household" may be useful in clarifying the intended response unit. Further, it may prove useful to investigate whether our results are invariant to the use of a dichotomous response format rather than payment card (for an early test in this context see Bateman and Brouwer (2006)). These suggested approaches will have to be carefully tested not to introduce other, unintended biases, a common experience in the CV history. However, our results suggest that response unit distortions may be sufficiently problematic to need fixing. Though we have not uncovered the "true" (actual) household WTP in our survey and more research is needed, asking household WTP of random individuals for environmental goods seem to be the most conservative approach and should be followed, even though it may lead to underestimation of welfare change in some situations.

Appendix

Table A: Given reasons in survey for why respondents chose higher, the same or lower household or individual WTP[1]

How important were the following reasons for you stating a higher/same/lower amount on behalf of your household than/as for yourself? **Answers: Cross "Important, Not Important, or Not Relevant"**		
Higher	**Same**	**Lower**
A1. I took both incomes into account when I was asked on behalf of the household	B1. I am single and have no children, so there is no difference	C1. I thought about my individual budget and can pay more than if I have to take my household into consideration
A2. I take the household members' wishes regarding increased forest conservation into account even if I consider willingness to pay for myself alone[2]	B2. My partner and I have a shared economy, so it does not matter if I am asked personally or on behalf of my household	C2. My partner is against more forest conservation, so I adjusted for that
A3. I especially consider the children when asked on behalf of the household	B3. What the household collectively would have decided concur with my wish	C3. I am normally not the one paying for our household expenses, so I chose a lower amount on behalf of my household
A4. My partner is more interested in forest conservation than I am, so I adjusted for that	B4. I am normally the one paying our household expenses, so in practice there is no difference if I am asked personally or behalf of my household	C4. We have a tight budget for household expenses, but my personal budget is more generous
A5. I added what I think my partner would be willing to pay	B5. I take my household members into account even if I consider willingness to pay for myself alone	
A6. I doubled my individual amount since we are two adults in the household		
Other reasons that were important? Specify:_____		

Note: 1. Respondents would get automatically directed to one of these item batteries in the web-survey depending on their answers to the hwtp and iwtp questions. For brevity all three are compiled in one table here. 2. There was some ambiguity in the interpretation of this reason. The intended meaning is that the respondent does not focus on a more generous individual budget "mental account" for $iwtp^i$, but thinks about the whole household and therefore goes up from $iwtp^i$ to $hwtp^i$.

Acknowledgements

We would like to thank Jon Strand, Olvar Bergland, Anna Bartczak, Jette Bredahl Jacobsen, Mark Morrison and Laura O. Taylor for constructive comments. Funding from the Norwegian Research Council AREAL program grant 173230/I10 is gratefully acknowledged.

References

Arrow K J, Solow R, Leamer E, Portney P, Radner R and Schuman H (1993) Report of the NOAA Panel on Contingent Valuation. Federal Register 58: 4601-4614.

Bateman I, Cole M, Cooper P, Georgiou S, Hadley D and Poe G L (2004) On visible choice sets and scope sensitivity. Journal of Environmental Economics and Management 47: 71-93.

Bateman I J and Brouwer R (2006) Consistency and construction in stated WTP for health risk reductions: A novel scope-sensitivity test. Resource and Energy Economics 28:199-214.

Bateman I and Munro A (2003) Non-cooperative decision-making and measures of household surplus. CSERGE Working Paper EDM 03-12

Bateman I and Munro A (2005) An experiment on risky choice amongst households. The Economic Journal 115: C176-C189.

Bateman I and Munro A (2006) Household versus individual valuation: what's the difference? Royal Holloway, University of London: Discussion Papers in Economics number 06/02.

Bateman I J, Carson R T, Day B, Hanemann W M, Hanley N, Hett T, Jones-Lee M, Loomes G, Mourato S, Ozdemiroglu E, Pearce D W, Sugden R and Swanson T (2002) Economic Valuation with Stated Preference Techniques: A Manual. Edward Elgar Publishing, Cheltenham, 480pp.

Becker G S (1973) A theory of marriage: Part I. Journal of Political Economy 81: 813-846.

Becker G S (1981) A Treatise on the Family (Enlarged edition). Harvard University Press.

Beharry N and Scarpa R (2006) Joint vs. separate decisions by couples in choice experiments: The case of coastal water quality in Tobago. 3rd World Congress of Environmental and Resource Economists, Kyoto, Japan, July 2006.

Bergstrom T C (2003), Benefit Cost Analysis and the Entanglements of Love. Proceedings of session II: Household decision making, USEPA Workshop, October 20-21. Washington DC.

Boyle K J (2003) Contingent valuation in practice. In: P. A. Champ, K. J. Boyle and T. C. Brown, eds, A primer on nonmarket valuation. Kluwer Academic Publishers.

Brekke, K A, Kverndokk S and Nyborg K (2003) An economic model of moral motivation. Journal of Public Economics 87: 1967-2003.

Cameron T A and Huppert D D (1989) OLS Versus ML Estimation Of Non-Market Resource Values With Payment Card Interval Data. Journal of Environmental Economics and Management 17(3): 230-246.

Carson R T, Flores N E and Meade N F (2001) Contingent valuation: Controversies and evidence. Environmental and Resource Economics 19(2): 173-210.

Clark J and Friesen L (2008) The causes of order effects in contingent valuation surveys: An experimental investigation. Journal of Environmental Economics and Management 56: 195-206.

Delaney L and O'Toole F (2004) Irish Public Service Broadcasting: A Contingent Valuation Analysis. The Economic and Social Review 35: 321-350.

Delaney L and O'Toole F (2006) Willingness to pay: individual or household? Journal of Cultural Economics 30: 305-309.

Delaney L and O'Toole F (2008) Individual, household and gender preferences for social transfers. Journal of Economic Psychology 29(3): 348-359.

Dosman D and Adamowicz W (2006) Combining stated and revealed preference data to construct an empirical examination of intrahousehold bargaining. Review of Economics of the Household 4: 15-34.

Efron B (1997) Bootstrap methods: Another look at the jackknife. Annals of Statistics 7: 1-26.

Hasler B, Jacobsen J B, Lundhede T H, Martinsen L and Thorsen B J (2008) Household versus Individual Willlingness to Pay: Evidence from a Choice Experiment on Environmental Valuation. Working Paper, University of Aarhus.

Li H, Berrens R P, Bohara A K, Jenkins-Smith H C, Silva C L and Weimer D L (2005) Testing for budget constraint effects in a national advisory referendum survey on the Kyoto protocol. Journal of Agricultural and Resource Economics 30(2): 350-366.

Lindhjem H (2007) 20 Years of stated preference valuation of non-timber benefits from Fennoscandian forests: A meta-analysis. Journal of Forest Economics 12: 251-277.

Mitchell R C and Carson R T (1989) Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future, Washington DC.

Munro A (2005) Household willingness to pay equals individual willingness to pay if and only if the household income pools. Economics Letters 88(2): 227-230.

Nyborg K (2000) Homo economicus and homo politicus: Interpretation and aggregation of environmental values. Journal of Economic Behavior and Organization 42: 305-322.

Pahl J (1995) His money, her money: Recent research on financial organisation in marriage. Journal of Economic Psychology 16: 361-376.

Powe N A and Bateman I J (2003) Ordering effects in nested 'top-down' and 'bottom-up' contingent valuation designs. Ecological Economics 45: 255-270.

Presser, H. B (1998) Decapitating the US Census Bureau's "head of household": Feminist mobilization in the 1970s. Feminist Economics 4(3): 145-158.

Quiggin J (1998) Individual and household willingness to pay for public goods. American Journal of Agricultural Economics 80: 58-63.

Samuelson P A (1956) Social Indifference Curves. The Quarterly Journal of Economics 70(1): 1-22.

Sagoff M (1988) The Economy of the Earth. Cambridge University Press, Cambridge.

SEPA (2006) An instrument for assessing the quality of environmental valuation studies. Swedish Environmental Protection Agency.

Smith V K and Van Houtven G (1998) Non-Market Valuation and the Household, RFF Discussion Paper 98-31.

Smith V K and Van Houtven G (2004) Recovering Hicksian consumer surplus within a collective model: Hausman's method for the household. Environmental and Resource Economics 28(2): 153-167.

Strand J (2005) Individual and household values of mortality reductions with intrahousehold bargaining. Journal of Risk and Uncertainty 31(2): 217-236.

Strand J (2007) Public-good valuation and intrafamily allocation. Environmental and Resource Economics 38(4): 527-543.

Thaler R H (1999) Mental accounting matters. Journal of Behavioral Decision Making 12(3): 183-206.

Vermeulen F (2002) Collective household models: principles and main results. Journal of Economic Surveys 16(4): 533-64.

Webley P (1995) Accounts of accounts: En route to an economic psychology of personal finance. Journal of Economic Psychology 16: 469-475.

Winnett A and Lewis A (1995) Household accounts, mental accounts, and savings behaviour: Some old economics rediscovered? Journal of Economic Psychology 16: 431-448.