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Relative income and the WTP for public goods

- A case study of forest conservation in Sweden

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Abstract

The main objective with this paper is to test the hypothesis that peoples stated WTP for an environmental public good (old growth forest in Sweden) are sensitive to the respondents' relative income. To do that I use an experimental valuation question in a split-sample setting, conditioning the respondents on hypothetical changes in their absolute and relative income. The results indicate that the relevant income measure may not only be the income level per se, but also the income level relative to others. People with green attitudes and males react more strongly to changes in their relative position than others. The results stress that growth in incomes may not be a guaranty for growth in WTP, the distribution of growth also matter.

Keywords*: contingent valuation; income-effect; social responsibility; relative income.*

JEL-Codes: C81, D12, D31, D64, Q20

1. Introduction

In contingent valuation (CV) studies income is often included as a covariate in the estimated WTP-function. A fairly simple justification test of estimates of WTP for environmental goods is to check their consistency with economic theory and *a priori* expectations. *E*xpectations concerning the relationship between WTP and income may be founded in expectations about how the marginal utility of money (private consumption) varies over income levels (Haab and McConnell, 2002). If the marginal utility of money is decreasing with the income level, rich people are expected to state a higher WTP compared to poor people. The income level is also one of the main factors that determines a person's budget constraint, and hence, her ability to pay. The importance of the ability to pay has been manifested in suggestions and practises to (1) remind respondents about budget constraints and substitutes (Arrow et al., 1993), (2) model assumptions that constrain WTP by the respondent's income level (Hanemann and Kanninen, 1999; Haab and McConnell, 2002) and (3) remove outlier responses where the stated WTP constitutes a large fraction of the respondent's income (Freeman, 2003).

In the previous literature income, independent of other individuals' incomes and consumption patterns, has been judged as the relevant variable to study (Schläpfer, 2006). It has also been shown that the statistical relevance of including income in the WTP-function is sensitive to the income measure used (Broberg, 2010). This paper contributes to the previous literature on the empirical relationship between WTP and income by studying the relevance of the relative income. The *a priori* hypothesis is that not only the absolute level of income matters to an individual when she is asked to state her WTP for an environmental public good, but also her income relative to other individuals'. Significant support for the hypothesis would stress that an increase in ability to pay not automatically transforms into an increase in WTP and that the income distribution may be relevant to consider in non-market valuation.

The relative income has historically received little attention in mainstream economics where consumption and savings are independent of context. However, social comparison has gained some attention in the field of happiness research. Some argue that social comparison is a potential explanation of the Easterlin paradox of unchanged happiness in developed countries despite substantial growth in real income levels (see a throughout review of the literature in Clark et al., 2008). The relative income level has also received some attention in the field of public economics. The assumption of context independence was challenged already in Duesenbury (1949) who analyzed the implications of demonstration and habitation effects on consumption and saving rates. Hirsh (1976) and

Frank (1985) extended the theory by defining positional and nonpositional goods. The term positional refers to the goods ability to signal social status. The latter study showed theoretically that if preferences are interdependent, i.e. individuals' consumption depends on other individuals' consumption, then the demand for nonpositional goods will be lower if individuals act independently than if they act co-operatively. In the co-operative case they realize that their consumption give rise to externalities that affect other individuals' consumption decisions and hence consume less of the positional good.

Few studies exist in the field of environmental economics that study the relevance of taking the relative income into consideration. One exception is Magnani (1999) who analyzes whether or not the demand for environmental quality is affected by relative-income effects on an aggregate level. The starting point for her study was the observation of differences in environmental degradation across high-income countries (with majority voting systems). After examining cross-country data she concluded that economic growth has two effects on environmental preferences: 1) an absolute income effect 2) a relative-income effect. The first effect is due to the individual's ability to pay and is strictly positive. The second effect is due to the individual's willingness to pay and is not necessarily positive, it can be negative. As a consequence, economic growth in itself is not a sufficient condition for environmental improvement, also income distribution matters. To be sure that economic growth has positive effects on the environment the increasing income has to be equally distributed. However, other studies using aggregated household data have found that equality may increase emissions (Brännlund and Ghalwash, 2008).

In this paper the relevance of relative income is analyzed on the micro level. To study the importance of relative income, I examine CV data concerning preservation of old-growth forest in Sweden. Specifically, I adopt a spilt-sample approach to study how individuals believe that they would change their WTP as their absolute and relative income changes. As the valuation concerns provision of a public good in fixed quantity, WTP rather than demand is in focus of this study. The relative income may influence WTP for public goods through individuals' perceptions about social responsibilities and "fair-payments" and their propensity to free-ride on other tax-payers. In a recent study Brännlund and Persson (2012) apply the stated choice experiment approach to elicit WTP for different aspects of climate policy measure and find that Swedes have preferences for climate policy instrument having a distribution of costs that is progressive in income. One possible interpretation of this result is that relative income does matter when people decide on their WTP for environmental goods.

The paper is structured as follows. Section 2 provides a brief presentation of a conceptual theoretical framework including a moral context. Section 3 describes the survey and presents descriptive statistics. The econometric model is presented in Section 4 and the results in Section 5. Finally, Section 6 concludes the paper.

2. Theory and description of the experiment

The present analysis of relative income is based on the broader hypothesis that morality plays a significant role in the decision of how much to pay for environmental public goods. In the split-sample experiment presented in this paper people are asked to state their WTP for an environmental public good, namely preservation of old-growth forests.

Following Levitt and List (2007) the moral context can be described by the following conceptual utility function:

$$U_i(a, v, n, s) = W_i(a, v) + M_i(a, v, n, s) \quad (1)$$

This function says that individual *i* derive utility from a single choice of action (*a*) through both a wealth effect (*W*) and a moral effect (*M)*. In the present case (*a)* is the decision on how much to pay for preserving virgin forests. The moral effect is a function of the stakes (v) and how the individual imagines that her action will be scrutinized (*S*). For example, it can be assumed that more attention is given to the wealth effect as the stakes get larger and that individuals are more likely to comply with social norms if they believe that their behavior is being observed and judged. The moral effect is also a function of social norms (*n*) that in turn may be a function of relative income. People may, e.g., feel a social responsibility and an obligation to pay for conserving virgin nature and the perceived obligation to pay may be a function of *relative* income, such that, when their relative position worsens their sense of obligation weakens.

In order to test the hypothesis regarding relative income and WTP, I designed a simple split-sample experiment. The respondents were divided into two groups where one group was contingent on an income increase that kept their relative income unchanged, while the second group was contingent on a higher absolute income, but a lower relative income. Throughout this paper the groups will be referred to as ”neutral” and ” discouraged”.

3. The survey and descriptive statistics

The dataset concerns Swedes' WTP for preservation of old-growth forests. Sweden's total land area is approximately 41 million hectares, with fifty percent covered by boreal forests dominated by Scots pine (*Pinus Sylvestris*) and Norway spruce (*Picea Abies*). According to the *Swedish Forestry Agency*, about 18 percent of the forest area is owned by the State. Almost all of the old-growth forests in Sweden belong to the state and are mainly concentrated in the sparsely populated sub-mountainous area in Northwestern Sweden (shaded area in Figure 1). A rather large part, 43% or 660,000 hectares, of the old-growth forests in sub-mountainous area was already protected in 2002. In 2002 the *Swedish Environmental Protection Agency* was commissioned by the government to assess the environmental value of the State's forests, with a focus on old-growth forests. The results from the forest assessment was published in 2004 and concluded that there were an additional 126,000 hectares (8 percent) of productive old-growth forest in the sub-mountainous region worthy of additional preservation.

A survey was sent out in the fall of 2005 with the main objective to study attitudes toward forest preservation among the Swedish population and ultimately to estimate the mean WTP for implementing the preservation program described above. The sample included 2,000 individuals between the ages of 18 and 84. The study relied on stratification to assure selection of individuals living in municipalities near the studied forest areas. In total the response rate was 49 percent, including 2.5 percent blank survey responses. The dataset includes 922 consistent responses. [1]

Figure 1: Sub-mountainous area of Sweden

(Source: The Swedish environmental protection agency)

[1] Two weeks after the first mail-out a remainder was sent out. Non-respondents were contacted via telephone and asked for their reasons for not answering the mail survey. Laziness and time-constraints were the most common reasons.

Broberg (2007) used the same dataset, as used in this study, and estimated the mean WTP for implementing the forest preservation program. The mean WTP based on estimation of a spike model, which allowed for zero WTP, was approximately SEK 300 (approximately €33). The study found that the WTP was significantly correlated with income and environmental awareness.

In addition to an ordinary WTP question the respondents were also asked to state how they would change their WTP if their monthly income after tax would increase by SEK 1,000 (approximately €110). A split-sample approach including two samples was adopted. Both groups (samples) were given the same information about the change of their personal income, but different information about the change in average income in Sweden. The average income were said to increase with SEK 1000 in one of the sub-samples and with SEK 2000 in the other. Hence, the relative income was unchanged for the first group whereas it decreased for the second group.

This paper analyzes the answer to the follow-up question concerning how the respondents would change their WTP given a hypothetical income change. The follow-up question was directed to respondents who stated a positive WTP, given their current budget constraint, and respondents who had zero WTP but said they were willing to pay if their budget allowed for it. Table 1 presents descriptive statistics for the variables used in the empirical analysis.

The follow-up question was divided into three stages. First, the respondents were asked if they would pay anything at all given their new hypothetical budget constraint. The respondents who answered "yes" got to answer how they would change their WTP (stated earlier in the survey): "increase" "decrease" or "not change". Respondents indicating that they would change their WTP were asked to mark the highest change they would accept on a pre-specified payment card including 16 different amounts, ranging between SEK 10 and SEK 2,500.

Table 1: Descriptive statistics for the aggregated sample and specific samples. Mean values (standard deviation)

Variables	Whole sample (922 obs.)	"Neutral" (448 obs.)	"Discouraged" (474 obs.)
Age	52.87 (16.81)	53.08 (16.95)	52.68 (16.70)
Male (Yes=1)	0.50 (0.50)	0.50 (0.50)	0.49 (0.50)
Income (16 categories)	5.40 (3.11)	5.31 (2.92)	5.48 (3.28)
"Green"[a] (Yes=1)	0.33 (0.47)	0.34 (0.47)	0.34 (0.47)
Lower WTP bound (Given WTP>0)	569.34 (643.42)	546.19 (555.02)	590.52 (715.48)

[a]If = 1: Respondent wants the government to increase its environmental expenditures

Table 2 presents descriptive statistics for the two groups concerning their responses to the follow-up question. As shown a high percentage of the respondents that stated a positive WTP given their current budget answered that they would continue to have a positive WTP if their income would increase. However, the numbers of "no" responses are higher within the "discouraged" group. One reason why respondents "leave the market" when their relative economic status worsens could be that they believe that those getting relatively richer should pay more, i.e. individuals may feel that there is a relationship between social responsibility and relative standing. More difficult to explain is the ten respondents in the "neutral" group that "leave the market" if the income of all citizens in the economy increases with an equal amount. Once again, perceptions about payment responsibility may matter, but also the perceptions about the relative growth of their personal income level. It is also possible that individuals protested against the hypothetical setting by giving seemingly strange answers.

Concerning the individuals that said they were not willing to pay in the first valuation question, only a small fraction of them increase their WTP when given the hypothetical increase in income. The fraction is smaller within the "discouraged" group. The result is interesting for two reasons. First, the relative income seems, again, to matter. Secondly, the majority of the respondents referring to their tight budget constraint when answering "no" to the valuation question did not change their answer when they were given a relatively large hypothetical income increase. One explanation for this may be that some people found it easier to refer to their budget constraint than to simply say "I don't care", i.e. they gave answers that were socially comfortable to them.

In Table 3 we see that many respondents would increase their WTP if their income was about to increase as described in the valuation scenario. However, a larger fraction of the

respondents within the ”discouraged” group stated that they would leave their WTP unchanged, or even decrease it, compared to the ”neutral” group. Table 3 further indicates that respondents do react on changes in their relative standing.

Table 4 presents descriptive statistics for the payment card question concerning the highest change in WTP that the respondents would accept given the income increase. The value presented is the mean of the lower bound of the indicated change-categories. A comparison of the two groups further indicates that relative income matters to the respondents. The average increase is smaller within the ”discouraged” group compared to the “neutral”.

Table 2: Descriptive statistics for responses to the first step of the follow-up WTP question concerning if WTP>0 contingent on the increase in income. Responses are categorized in terms of whether respondents had a positive WTP prior to the hypothetical change in income.

	All	**”Neutral”**	**”Discouraged”**
Sample size	2,000	1,000	1,000
Responses	922	448	474
Respondents with positive WTP given the initial scenario			
“Yes”	315	156	159
“No”	39	10	29
Missing	59	30	29
Total	413	196	217
Respondents with Zero WTP given the initial scenario			
“Yes”	33	20	13
“No”	228	113	120
Missing	8	6	2
Total	279	139	135

Table 3: Change in WTP in case of an increased income level. Number of observations.

	All	"Neutral"	"Discouraged"
Increase	128	78	50
Decrease	13	2	11
Not change	176	73	103
Missing	31	23	8
Total	348	176	172

Table 4: Lower bound of the change in WTP contingent on an increased income level. Mean values (standard deviations).

	All	"Neutral"	"Discouraged"
Increase	428.33 (435.94)	442.50 (427.82)	406.80 (451.53)
Decrease	-326.15 (340.14)	--*	-305.45 (358.54)
Total	157.87 (364.83)	216.89 (382.66)	103.54 (339.78)
Missing	2	2	0

*Only two observations

4. The econometric model

To analyse the change in WTP following the hypothetical income change, an interval estimation approach (Cameron and Huppert, 1989) is applied. The change in WTP is modelled as a linear combination of personal characteristics, *X*, a dummy for the hypothetical change in average income, DY_A (equals one if respondents belong to the "discouraged" group and zero otherwise) and an additive stochastic term, υ:

$$\Delta \mathrm{WTP_i}\,|_{\Delta Y_i} = \alpha + \theta \cdot X_i + \mu \cdot DY_A + \upsilon_i \qquad (2)$$

An individual will reject paying more for the environmental good if the cost (in our case a tax increase), ΔA_i, is larger than the change in WTP following the change in income. Hence;

$$\Pr(\Delta \mathrm{WTP_i}\,|_{\Delta Y_i} < \Delta \mathrm{A_i}) = \Pr(\alpha + \theta \cdot X_i + \mu \cdot DY_A + \upsilon_i < \Delta \mathrm{A_i}) \qquad (3)$$

Denoting the cumulative distribution of the change in WTP with F(υ), Eq.(3) can be written as:

$$\Pr(\Delta \mathrm{WTP_i} \mid_{\Delta \mathrm{Y_i}} < \Delta \mathrm{A_i}) = \mathrm{F}(\upsilon_i) \qquad (4)$$

Hence, the probability of accepting a tax change is $1 - \mathrm{F}(\upsilon_i)$. The probability that $(\Delta WTP_i|_{\Delta Yi})$ lies between the bounds given by the double-bounded data $(\Delta A_{Li}$ and $\Delta A_{Lu})$ can be written as:

$$\Pr(\Delta WTP_i \mid_{\Delta Y i} \subseteq (\Delta \mathrm{A_{Li}}, \Delta \mathrm{A_{Ui}})) = F(\eta_{Ui}) - F(\eta_{Li}) \qquad (5)$$

where η is the standardized error term (υ/σ).

When specifying the log-likelihood function it should be considered that individuals may not want to change their WTP given the hypothetical income change and, therefore, a spike at zero WTP change is introduced that allows such answers.

The interval spike model is given by[2]:

$$L = \sum_{i=1}^{N} \left[k_i \cdot \ln\left[F(\eta_{Ui}) - F(\eta_{Li}) \right] + (1 - k_i) \cdot \ln(F(0)) \right] \qquad (6)$$

where k_i equals one if the individual stated a positive change in WTP and zero for "no change" responses.[3]

5. Results

Table 5 presents results derived from estimation of the spike model given by Eq. (6), explaining the size of the change in WTP conditioned on the hypothetical income change. The regression model is applied on all the respondents who answered the split-sample question and also separately on those who said they were willing to pay given their current income. Note that this model excludes respondents that would decrease their WTP

[2] Spike models applied on WTP data allowing for zero WTP can be found in Kriström (1997) and Nahuelhual-Munoz et al. (2004). Yoo & Kwak (2002) extend the DC spike model in Kriström (1997) to the case with double bounded DC.

[3] The small number of "decrease" answers have been excluded from the analysis. This will bias the estimate of the change upwards. If the data had allowed for it, an extended spike model including such answers could have been estimated.

given the new scenario. The results in Table 5 are based on a model including only one covariate, the "discouraged" dummy. The results for both the whole sample and the sub-sample consisting of respondents with a positive WTP show that people react significantly to the social context presented in the valuation scenario. The "discouraged" dummy is negative and highly significant. Table 6 presents estimates of the change in WTP contingent on the hypothetical income change, based on the estimates of Model 1 in Table 5. As can be seen, the increase in WTP is smaller within the "discouraged" group. However, the differences between the split-sample groups are statistically significant (on the five percent level) only for those who had stated a positive WTP (in the initial scenario).

Table 5: Spike model on the change of WTP contingent on the hypothetical income change. Parameter estimates (standard deviations)

	WTP ≥ 0 initial scenario	**WTP > 0 initial scenario**
Variables	Model 1a ΔWTP	Model 1b ΔWTP
Constant	-0.899***	-0.204
	(0.135)	(0.170)
"Discouraged"	-0.605***	-0.794***
	(0.206)	(0.252)
Bid	-0.002***	-0.002***
	(0.000)	(0.000)
X^2	1,265***	883.26***
NOBS	535	272

*, **, *** indicates if the estimates are significant on the 10, 5 and 1 percent level

Table 6: Mean ΔWTP contingent on the hypothetical income change (Standard deviations)

	ΔWTP unchanged relative income (in SEK)	**ΔWTP decreased relative income (in SEK)**
Whole sample	144 (19)	85 (13)
Part sample (WTP > 0)	248 (34)	130 (23)

The results from more detailed models including several covariates are presented in Table 7. To study whether different types of individuals react differently to the hypothetical change in their relative income, interaction terms are also included. The difference between Model 2 and Model 3 is the inclusion of the respondents' WTP (in the initial scenario without any change in income), which to some degree is determined by other covariates in the model (e.g. age, gender and income). However, this covariate is relevant to study because it also captures factors unobservable to the researcher, e.g. attitudes and perceptions about social responsibility and "fair payments".[4]

[4] There seems not to be any serious co-linearity problem in the model. The highest correlation coefficient is 0.16 and concerns the correlation between the variables WTP and "green".

In Table 7 it can be seen that the increase in WTP is positively correlated with respondents' attitudes toward public expenditures on the environment ("green") and their WTP (in the initial scenario), with the corresponding interaction terms being negative. These findings indicate that the effects are smaller within the "discouraged" group. This supports the notion that the "unobservable characteristics of respondents", captured by the WTP variable, also covers perceptions about "fair payments". The results also show that males within the "discouraged" group tend to state smaller increases compared to females, which would indicate that males react stronger to the social context manifested in the relative income change. The estimates of Model 2b and Model 3b show that the results remain stable when the same model is regressed only on those who stated a strictly positive WTP (in the initial scenario). The only estimate that changes substantially is the estimates of the age parameter which in that case is statistically significant.

Table 7: Spike model on the change of WTP contingent on the hypothetical income change.

Parameter estimates (standard deviations)

	WTP ≥ 0 initial scenario		**WTP > 0 initial scenario**	
Variables	Model 2a ΔWTP	Model 3a ΔWTP	Model 2b ΔWTP	Model 3b ΔWTP
Constant	-2.256***	-2.702**	-1.863**	-2.660***
	(0.549)	(0.583)	(0.751)	(0.797)
Age	0.004	0.009	0.021*	0.025**
	(0.009)	(0.009)	(0.012)	(0.012)
Male	0.474	0.399	0.680	0.548
	(0.291)	(0.295)	(0.371)	(0.371)
Income	0.053	0.049	-0.031	-0.013
	(0.050)	(0.052)	(0.060)	(0.062)
"Green"	1.305***	0.941***	0.775**	0.635*
	(0.296)	(0.302)	(0.383)	(0.376)
WTP	--	0.002***	--	0.001***
		(0.000)		(0.000)
"Discouraged"	0.266	0.574	-0.18	0.750
	(0.829)	(0.851)	(1.087)	(1.144)
Discouraged ·Age	0.000	-0.003	-0.003	-0.007
	(0.013)	(0.014)	(0.017)	(0.018)
Discouraged ·Male	-0.951**	-0.881*	-1.398**	-1.283**
	(0.475)	(0.472)	(0.602)	(0.600)
Discouraged ·Income	0.010	0.013	0.140	0.122
	(0.076)	(0.077)	(0.090)	(0.091)
Discouraged ·Green	-0.977**	-0.736	-1.124**	-0.969*
	(0.437)	(0.449)	(0.555)	(0.563)
Discouraged ·WTP	--	-0.001**	--	-0.0015***
		(0.000)		(0.0006)
Bid	-0.002***	-0.003***	-0.002***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
$\mathbf{X^2}$	1,170***	1,140***	814.21***	1,050***
LL	584.751	570.057	407.103	400.794
AIC	-2.302	-2.244	-3.193	-3.143
NOBS	508	508	255	255

*, **, *** indicates if the estimates are significant on the 10, 5 and 1 percent level

6. Discussion and Concluding remarks

The analysis in this paper focuses on the relevance of considering social context aspects of the valuation scenario when studying the relationship between WTP and income. Specifically, the paper analyzes the relevance of respondents' relative income level.

To study the relevance of relative income, this paper applies a split-sample approach, using survey data concerning preservation of old-growth forest in Sweden. An experimental CV question asked respondents how they would change their WTP (stated earlier in the survey) if their absolute income and the average income in Sweden were to increase by a specific amount. Two samples were compared, both conditioned on the same increase in personal income, but on different information about the change in average income.

The results from the analysis indicate that respondents react on the social context given in the valuation scenario, with 'greens' and males having a stronger reaction than others. Respondents who were asked to consider a decrease in their relative income stated a lower increase in WTP (on average) compared to those whose relative income remained unchanged, all else equal. The estimated models included the respondents' WTP (in the initial scenario) as a covariate. Respondents who stated a high WTP also stated a high increase in their WTP given that their hypothetical income increased. However, when their hypothetical *relative* income decreased, they stated a smaller increase in WTP.

From the analysis in this paper it is not possible to study why some respondents react stronger than others to the hypothetical income change. However, the results indicate that respondents react to information (change in the average income in Sweden) which according to the conventional CV literature should be irrelevant to them. Even though an individual's income level is an important determinant of WTP, it is not independent of the social context. In other words, people seem to have perceptions about who should pay for public goods, which implies that an increase in income does not necessarily imply an increase in WTP. This paper asked about WTP for a good that many respondents conceive as a genuine public good: the preservation of biodiversity within a virgin forest that provides value almost exclusively from its nonuse attributes. Many respondents stated that their main motive for valuing the preservation program was their desire to conserve virgin nature for future generations. One interpretation of the results is that peoples' perceived obligation to pay for conserving virgin nature is a function of their *relative* income, such that, when their relative position worsens their sense of obligation weakens. This implies that the income-effect on the WTP for public goods is more

complicated than suggested in the conventional CV literature. It also implies that valuation of public goods is not independent of the social context described to respondents in the valuation scenario. The results are in line with the findings in Brännlund and Persson (2012) that Swedes have preferences for environmental policy instrument that have a distribution of costs that is progressive in income.

Contingent valuation estimates of WTP have been found to suffer from hypothetical bias (see Ready et al., 2010 for a review of literature). While the exact numbers of WTP may be biased, I believe that the differences between the sub-samples and groups of respondents are more reliable and reveal information from which we can draw some cautious conclusions. The results have relevance for benefit transfers across regions and over time as they suggest that growth in incomes may not be a guaranty for growth in WTP, the distribution of growth also matter.

In the future, studies examining the income-effect on WTP should more carefully describe their choices of income measure and modelling assumptions and further study the influence of the social context, i.e. in what degree an individual's WTP is influenced by the income levels and contributions of other individuals. Also, studies experimenting with the social context need to address design issues of CV questions and obtain a better understanding of the workings behind the responses.

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