# The effects of current and expected future income on stated preferences for environmental improvements

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## Abstract

We formulate and test the hypothesis that expectations regarding changes in future income influences the WTP for environmental goods. For valuation of environmental goods in forests and other habitats in Denmark, we find that both current income and expected changes in future income are significant determinants for preferences. The effect of income on WTP seems to be caused by changes in preferences for environmental attributes rather than by marginal utility of income. The results suggest that to evaluate the distributional impacts of environmental improvements, researchers need a better measure of expected future consumption options than current income.

**Keywords:** Choice Experiment, income sensitivity of WTP, environmental valuation, wildlife, recreational access, forests, wetlands, fields.

# The effects of current income and expected change in future income on stated preferences for environmental improvements

## 1. Introduction

It is widely believed that people's emphasis on environmental goods and services increase with increasing income, and should be reflected in an increased marginal willingness to pay (WTP) for improvements in such goods. Therefore income sensitivity of WTP-measures has long been considered an indicator of the validity and reliability (Mitchell and Carson 1989) of stated preference studies, as it may indicate whether respondents take the budget constraint seriously. However, many studies fail to find such a relationship between WTP and current income (see Jacobsen and Hanley 2009), and even where found, the estimated - often small - sensitivity has caused debate on how sensitive WTP is to respondent income (Bateman et al. 2002). This is an issue of considerable policy relevance as it has clear implications for distributional effects of the environmental policies (Flores and Carson 1997), and distribution of relative gains or losses across income classes is a core concern in everyday politics. Because of the fact that environmental goods are often quantity rationed, the income sensitivity of WTP for environmental goods may take on a range of values. Arguments have been given for WTP for the environmental goods to be progressively distributed, i.e. the income elasticity of WTP is larger than one. But more often WTP seems to be regressively distributed (Broberg 2010; Kriström and Riera 1996), implying that WTP increases less than proportional to income.

In this paper, we investigate the hypothesis that the mixed evidence may be a result of the commonly applied measure of income, being current income, is not fully adequate;

specifically that it ignores the role of expected changes in future income for respondents. Economic theory suggests that current income may be a less than perfect measure of consumption options. The general life cycle income hypothesis (Modigliani 1949) and the permanent income hypothesis (Friedman 1957) both suggest that we may expect respondents to take their wealth and future income into account when answering hypothetical WTP questions. Often the payment vehicle used suggests that payments will continue either for a specified number of years (Amigues et al. 2002) or be permanent in recurrence (Jacobsen et al. 2011). Such framing makes it likely that respondents include more than current income in their considerations of future consumption possibilities and WTP than in cases where once-and-for-all payments are asked for. In addition, environmental goods often have a very long time provision perspective, especially for non-use values such as existence and bequest values. Thus, not only the payment but also the good has a long time perspective.

In choice experiments (CE) the marginal WTP measure for each attribute is derived as the ratio of the attribute parameter to the price variable. Thus, when estimating how income affect WTP two ways must be considered: The effect could be through the price parameter, which is the expected effect on the marginal utility of income (e.g. Brown et al. 1999); or through a systematic change in preferences for the different environmental attributes across income groups. These considerations lead to the main hypotheses tested in this paper, namely that respondents' expectations regarding changes in future income, relative to current income, matter for their preferences for the environmental attributes and hence for WTP, and furthermore also matter for their marginal utility of money and hence for WTP.

To investigate if WTP, or more broadly stated preferences, is sensitive not only to current income but also to expected changes in future income, we collected a simple piece of

information: In addition to asking respondents about their current household income, we asked them to indicate if they think their future household income would be lower than, similar to or higher than their current income.

## 2 Theory and evidence

### *2.1 The income sensitivity of WTP estimates*

As pointed out by Kriström and Riera (1996), it is sometimes casually argued that environmental quality is a luxury good, with an income elasticity of demand larger than one. This implies that demand for environmental goods, e.g. organic produce, should grow disproportionately fast as incomes rise. Addressing the value of non-marketed environmental goods, this aspect of income effects does not translate easily. Kriström and Riera (1996) note that because changes in environmental quality tend to be public goods and, from the perspective of the individual, come in rationed quantities so the quantity provided cannot be chosen individually, one cannot derive an analogous measure. Hence, they define and investigate instead the income elasticity of WTP for environmental improvements, an approach also used by later studies (Flores and Carson 1997; Hökby and Söderqvist 2003). Specifically, they define $s = WTP(y)/y$ where $y$ is income of the individual, and stress that when $s$ is regressed on income $y$ (and a constant) a significantly positive parameter implies an income elasticity of *WTP* larger than one. For non-use values derived from public goods, this framework seems particularly compelling, but also use-based recreational values limited by, e.g. access rights, cannot be freely varied on the demand side. The environmental improvements in many valuation studies, including the present, largely have these characteristics. It should be noted, however, that the characteristics of environmental goods, in particular the aspect of quantity rationing, imply that even if they are luxury goods, it does not follow that income elasticity of WTP will be larger than one (Flores and Carson 1997).

Nevertheless, due to the distributional issue, the income sensitivity of WTP of course remains an interesting policy question and focus of empirical research.

Turning to the empirical WTP, Kriström and Riera (1996) and later also Hökby and Söderqvist (2003) and Broberg (2010) question the allegation that environmental improvements should be considered as luxury goods, and indeed they all find regressive distributions.

More widely, it is commonplace in stated preference studies to test whether WTP or choice patterns are sensitive to respondents' current income. Evidence is mixed regardless of whether there is corrected for other factors. To, mention a few, examples of studies finding significant income parameters include Riera et al. (2008), Bandera and Tisdell (2004), and Sattout et al. (2007), whereas insignificant parameters were reported by e.g. Holmes et al. (2004). In a meta-analysis Schläpfer et al. (2006) found that 63% of the studies reporting income effects found them to be positive. In another meta-analysis Jacobsen and Hanley (2009) found that in 39% of the observations, income was a significant explanatory factor for WTP, whilst 27% reported insignificant effects. Looking at the data behind the Jacobsen and Hanley (2009) study, 52% of the studies using a one-time payment had significant income effects whereas this was only the case for 38% of the studies with repeated payment. This indicates that insignificant income effects may be more likely for one-time payments. All the other studies mentioned here use repeated payments with varying time horizon and there is no clear relationship between income effect and payment period. This is to expect given that current income is a good measure of current consumption possibilities.

While income effects may be expected when the ability to pay is constrained by income, as in WTP studies, this is not so for willingness to accept (WTA) (Brown et al. 1999). Indeed, Grutters et al. (2008) found that the cost coefficient in a CE was significantly higher in the WTP-format than in the WTA-format, but the disparity between WTP and WTA did not differ across income groups. In the present study, one of the attributes was a reduction in recreational access, and thus implicitly a WTA-measure was obtained, which may then react differently to income variation.

Broberg (2010) studied the income effect on contingent valuation (CV) results and applied various specifications of income, e.g. personal vs. household income. He argued that better measures of respondents' disposable income are called for. By people's consumption pattern they can affect net and disposable income in the long run (e.g. tax deductions due to debt, mortgage, etc.), so while disposable income may matter for a one-time payment, we suggest that the reason for the mixed evidence of income effects, in particular for perpetual or long-term annual payments, may be that current income, regardless of whether gross or net is an imprecise measure of the respondents' consumption options. Based on the life cycle income hypothesis and the permanent income hypothesis we would expect it to be present regardless of the time horizon of the payment. To our knowledge, this is the first study to address the question empirically, and we do that with a study using perpetual payments. Furthermore, apart from Grutters et al. (2008), all the above studies analysed income effects in a CV context, whereas our use of the CE method better allows us to see if income effects on preferences vary across attributes.

One may argue that there is no theoretical argument for expecting income changes to drive preferences changes as such. Changes in lifestyle, social context and network, education,

profession, etc., which correlate with income, seem more likely actual drivers of preference changes. While that may be true, income effects remain of great policy interest due to their role in the discussion of distributional effects of environmental policy.

*2.2 Why expectations of future income may matter*

The general economic literature on consumption, savings, and income, suggests that consumption propensities are rarely dependent only on current income levels. This literature takes its theoretical starting points in Modigliani's (1949) hypothesis of life cycle income being important to the consumption and saving decisions of individuals, and in Friedman's (1957) permanent income hypothesis. When put forward, these hypotheses were tested and disputed (Houthakker 1958a,b; Eisner 1958; Friedman 1958; Modigliani and Ando 1963). Since then, this framework has been extended and put to several more tests (Hall 1978; Campbell 1987; Gourinchas and Parker 2002, to mention a few), and is now widely acknowledged as a theoretical cornerstone in understanding consumption choices. Both hypotheses assume that consumers form expectations of their ability to consume in the long run, and then set their current consumption to what they think is the appropriate fraction of their long-run consumption options. Empirical tests have obviously struggled with the definition of variables capturing consumers' long-run expectations, and the hypotheses are still contested on their predictive power.

It seems reasonable that stated WTP for environmental services could reflect similar considerations about long-run consumption options. If both current and future income are considered by respondents, it could explain at least part of the observed weak or lacking sensitivity of WTP to income found in the environmental valuation literature. Current income is for some groups an especially poor predictor of long-run consumption options. In the low-

income brackets, we find young people, e.g. university students, who have a low current income but may expect future income to be much higher. Thus, their WTP may be relatively higher than their current income and wealth would suggest. Similarly, in the high-income brackets we may find people who are reaching retirement age and focusing on adding to their pension funds. Their WTP may be relatively lower than their present high income and wealth would indicate. Such systematic variations could hide a potential income sensitivity of WTP.

*2.3 Specific hypotheses of this study*

In the multinomial logit model, $WTP_x$, for a change in an attribute, $x$, of an alternative can be derived as the ratio of the estimated choice probability parameters, $\beta_x$ and $\beta_P$, the latter being the parameter of the price variable (Train, 2003):

$$WTP_x = -\frac{\beta_x}{\beta_P} \quad (1)$$

If we want to incorporate income variables directly in the estimation of WTP, and hence the implicit utility functions underlying the choice probability function, we see that income may affect WTP in more than one way. Firstly, as people's income grows, we expect their marginal utility of income to decrease, which is the typical interpretation of $\beta_P$. Thus, we may estimate different marginal utility of income parameters for different income groups, $z$, e.g. as $\beta_{Pz} = \beta_P + \gamma_{Pz}$, where $\gamma_z$ is the coefficient of a variable describing the price variable and a measure of current income. We expected increased WTP for a discrete change in the environmental good as income increases. Furthermore, if the income effect on $WTP_x$ only occurs through $\beta_P$, then the relative effect would be the same for all attributes of the environmental improvement. In order to distinguish such possible effects, we worked in preference space rather than in WTP-space (see Train and Weeks (2005) for a description of WTP-space).

The second possibility is that people's preferences for the various environmental attributes vary systematically across income levels, as many social factors (education, social class, etc.) vary systematically with income. Such variation could be captured using the parameter $\beta_x$ and estimated, e.g. as $\beta_{xz} = \beta_x + \lambda_{xz}$, where $\lambda_{xz}$ is the coefficient of an interaction term involving the level of attribute *x* and the current income group *z*.

Both these pathways should ideally be investigated simultaneously, but this proved infeasible due to multicollinearity and the large number of variables in the present case. Instead we used the above observations to formulate two hypotheses:

*Hypothesis 1: Expectations of changes in future income matter for marginal utility of income and hence WTP*

To test this, we estimate a model where the choice parameter for price is modelled as:

$$\beta_{Pzf} = \beta_P + \gamma_{Pz} + \phi_{Pf}, \quad (2)$$

where $\varphi_{Pf}$ is the coefficient of an interaction term involving the price *P* and the stated expectation concerning change in future income, *f*. The remaining parameters are as above. Under the null of no effect of change in future income, an insignificant parameter $\varphi_{Pf}$ implies rejection of Hypothesis 1 for preferences. Applying the coefficient $\beta_{Pz} = \beta_P + \gamma_{Pz}$ in calculating WTP-estimates and CI-intervals, we assess if Hypothesis 1 can be supported or rejected for WTP-measures.

*Hypothesis 2: Expectations regarding change in future income matter for people's preferences for the different environmental attributes and hence for WTP.*

To test this, we estimate a model where the choice parameter for an attribute is modelled as:

$$\beta_{xzf} = \beta_x + \lambda_{xz} + \gamma_{xf} \quad (3)$$

Here $\gamma_{xf}$ is the coefficient of an interaction term involving the attribute, *x*, and the expectation, *f*, concerning change in future income. The remaining parameters are as above. Under the hypothesis of no effect of change in future income, an insignificant parameter $\gamma_{xf}$ implies rejection of Hypothesis 2 for preferences. Applying equation (2) in calculating WTP-estimates and CI-intervals, we assessed if Hypothesis 2 can be supported or rejected for WTP-measures too.

## 3. Econometric Model

The CE method was originally developed for market analysis (Louviere 2000) and it relies on McFadden's (1974) random utility model, where the utility of a good is described as a function of its attributes, and people choose among complex goods by evaluating their attributes and subject to their budget constraints. The random utility model is the base for estimation and can formally be described as:

$$U_{ij} = V_{ij}\left(y_i - t_j, x_j, z_i\right) + \varepsilon_{ij} \quad (4)$$

The term $U_{ij}$ is the *i*'th individual's utility of paying $t_j$ out of individual income $y_i$ for the good described by alternative *j*. $V_{ij}$ is the deterministic part of utility depending on the alternatives' attributes $x_j$, and the individual's characteristics, $z_i$. Here we assume that $V_{ij} = \beta' x_{ij} + z_i' x_{ij}$, where $\beta$ is a vector of parameters for the attributes $x_{ij}$ and $z_i$' is a vector of parameters for income level and change in future income affecting linearly the preference for $x_{ij}$. The term $\varepsilon_{ij}$ is the i.i.d. error term, here assumed *iid* Gumbel.

Allowing for heterogeneity among respondents, we apply a random parameter approach taking into account the panel structure of repeated choices. Here the probability that a respondent *i* will choose an alternative *j* over *k* in a set of choices *n* is:

$$P_{ijn} = \int \frac{\exp(\beta' x_{ijn} + z_i x_{ijn})}{\sum_k^K \exp(\beta' x_{ikn} + z_i x_{ikn})} f(\beta) d\beta \ , \qquad (6)$$

where $f(\beta)$ is the density function, here assumed normal distributed with mean b and covariance W, i.e. $f(\beta) = \Phi(\beta|b,W)$. We apply this model to test our hypotheses formulated in Section 2.3.

## 4. Survey design

The survey used a postal questionnaire regarding access to nature and initiatives for improving conditions for wildlife in three widespread Danish habitats: forests, open fields, and along lakes and streams. Along with the questionnaire, respondents were supplied with an information sheet describing the current status of wildlife and access. The questionnaire was designed on the basis of discussions with experts in wildlife and tested in focus groups as well as in individual interviews. The first part of the questionnaire concerned the respondents' attitude to nature and wildlife and their level of recreational use and wildlife experiences. This was followed by the CE part, and the third and final part of the questions concerned debriefing and the respondents' socioeconomic characteristics[1].

The CE included 2 × 6 choice sets, where respondents were distributed to two out of three habitats. Across blocks, the combination and order of habitats were systematically distributed to avoid order effects and ensure equal representation. Each choice set consisted of three

[1] A translated version of the questionnaire can be obtained from the authors upon request and is attached for review purposes.

alternatives, the first alternative always representing the status quo. The content of the CE was discussed with focus groups and experts and was selected to address several relevant discussions in the public environmental policy debate at the time, notably recreational access rights to different private land and if nature protection efforts should focus on specific target species and habitats in need or benefit nature and wildlife in general. This resulted in three attributesincluding: *i*) initiatives to increase population size of wildlife in general, *ii*) initiatives to increase population size of endangered wildlife, and *iii*) various reductions in access to the habitats for the public in order to improve living conditions for wildlife.

In Denmark, there is fairly open access to most habitats for ordinary recreational activities like walking and biking on paths. Therefore, we expect respondents to react with demands of compensation for reductions in their access to habitats, even if explicitly motivated by concerns for wildlife protection, like moderate reductions during the breeding season. Such reductions in access are commonly implemented in specific localities, and this ads plausibility to the overall case description. We expect preferences for the wildlife attributes to be non-negative and in particular to be positive for endangered wildlife (Jacobsen et al 2008, 2012).

Respondents were explained that the annual costs of securing the environmental improvements would be financed by income taxes, and thus would be affecting the household's annual budget for all future relevant time periods. Similar public actions are typically not from specific funds and therefore financed through the overall state budget. While that is made up of numerous tax sources, the income tax remains the main tax component for the household. Furthermore, smaller income tax changes are often implemented in the Danish Parliament, e.g. in relation to the annual budget law negotiations,

whereas e.g. property taxes are much more rarely changed. The payment vehicle therefore is credible for this specific context. The full set of attributes and levels is described in Table 1.

The environmental attributes had each three levels of provision and the price attribute had six levels. A complete factorial design would involve 162 combinations of alternatives for each habitat. From this potential set we generated a design where d-efficiency was searched for a multinomial logit model by the use of a modified Fedorov candidate set search algorithm (Kuhfeld 2004) and then blocked into groups of six[2]. The same design was used for the three habitats, but allocated to respondents by a cyclic design to even out order and combination effects. The design included a limited number of potentially dominating alternatives, e.g. with no restrictions on access combined with positive gains for wildlife at no or lower cost than worse alternatives.

Some respondents received an 'iconised' description, showing specific species as an example of general wildlife (cf. Jacobsen et al. 2008) and others a more general description of the types of species. The order of attributes in the choice sets was varied, to even out any order effects. The endangered species used for the questionnaire was Dormouse (*Muscardinus avellanarius* L.) for the forest, Barn owl (*Tyto alba* Scopoli) for the field, and Otter (*Lutra lutra* L.) for the lakes and streams. The iconised representatives of general wildlife were Hare (*Lepus capensis* L.), Great Crested Grebe (*Podiceps cristatus* L.) and Great Spotted Woodpecker (*Dendrocopos major* L.). Results from the two versions are merged in the following as the slight differences in their design did not affect our analyses and results here.

[Insert Table 1 about here]

[2] The ex-ante d-error for this design was 0.00317 evaluated as a MNL-model with main effects only and without the status quo and 0.002726 with status quo. When evaluated ex post, the d-error was 0.0003 based on the determinant of the variance-covariance matrix from Table 4, and that of Table 5 was 0.0050. When evaluated as a multinomial logit model without any interaction effects, the ex post d-error was 0.0008.

After completing the CE part of the questionnaire, respondents were asked to answer a number of socio-demographic questions including their present gross household income level by ticking quantitative brackets in steps of DKK[3] 100,000 in the range from below DKK 100,000 to above DKK 900,000. Because people can regulate their net taxable income (e.g. through tax deductions, debt management, asset changes etc.), we found gross income a better measure of total current and future consumption options. This is also in accordance with the existing literature on the life cycle income and permanent income hypothesis. Respondents were asked to indicate if they expected their household income before tax in ten years' time to be either lower than, equal to or higher than the household's current income level.

The mail administered questionnaire was sent to a representative sample of 1,800 people in May 2005, and 862 questionnaires were completed and returned, which equals an overall response rate of almost 48%. Postal questionnaires are frequently used in Denmark. The response rate of 48% is common for similar studies (e.g. Jacobsen et al. 2008; Jacobsen and Thorsen 2010). A total of 116 answers dealt with an external scope test and are excluded from the present analysis. The full sample consists of 746 respondents answering 8,447 choice questions, as not all respondents completed all 12 choices.

## 5. Results

The results presented below are based on pooled data from all habitats. Analyses of data from each habitat showed similar results, although some of the parameters were insignificant due to fewer observations. No systematic difference was seen across the habitats for the patterns

[3] € 1 ≈ DKK 7.5

analysed. For a presentation and discussion of the main effect results, see Jacobsen et al. (2012).

To correct for the income difference between single adult and two adult household, we calculated income as per adult member by dividing the later by two. This current household income per person[4] was modelled both on a semi-continuous scale where the income groups ranged from (all figures in DKK) 0 to above 900,000, with intervals of 50,000, and in three groups using group dummy variables: one below 200,000 (low), one ranging from 200,000 to 299,999 (medium) and one from 300,000 and above (high). These groups were made in order to have three groups of reasonably equal size. Other group boundaries were tested and results remain robust to these variations. The median personal income in Denmark is 250,000. Only results for the group dummy variables model are reported in the following, as this allows for possible non-linearity but using the semi-continuous scale gave similar results. Expected changes in future income were dummy-coded, using two dummies; on for expecting higher future income than today and one for expecting a lower income than today. In Table 2 we cross-tabulate the respondent's according to their current income group and their expectations on future income. Compared to the Danish population, the sample is a bit overrepresented for the middle income group and a bit underrepresented for the low income group and slightly for the high income group.

[Insert Table 2 around here]

[4] Notice that it is not the same as a personal income as it tends to even out differences caused by one household member earning more than the other. Households with more than two adults are normally due to home-living children above 18 who do not contribute to the household income. We therefore neglect the few cases where it may not be so.

Respondents that differ in their expectations of changes in future income may differ in various other manners too. In Table 3 we report the average of gender, age and education level across current and expected changes future income. The results in Table 3 indicate not surprisingly that age is a significant factor influencing expectations about future income: the younger you are the higher expectations of a future income increase.

[Insert Table 3 around here]

If income groups differ in scale we could get biased results of the differences, A random parameter logit model was estimated using the software Biogeme 2.0 (Bierlaire, 2003). No significant scale difference between income groups or future income groups were found and therefore groups are analysed jointly.

Table 4 shows the results of a model including interaction terms between the attributes and the income measures, where we have excluded the medium current income group and the group expecting no changes as references. Because we are specifically interested in the heterogeneity explained by income, we do not include unexplained heterogeneity for the price parameter, Income differences and thereby marginal utility of money would be the main argument for expectations of heterogeneity in the beta-parameter for price. For the main effects of the other variables we do include normally-distributed standard deviations. The parameter for price interaction with current high income is statistically significant and positive, whereas the parameter for lower current income is not statistically significant from the middle income group. The parameter for expected lower future income than today interacted with price is not statistically significant from not expecting a change in income,

whereas the interaction with expectation of higher future income is significantly different from zero at the 5% level. Estimated parameters from interactions with the price parameter are all very small, even when significant, compared to parameter on price and thus have hardly any influence on WTP.

Looking at environmental preference parameters, the group with high current income does not differ significantly from the middle current income group whereas the low income group does, being significant at the 10%% level for the wildlife attributes. For the access attributes which is the only attribute with a utility loss, there are no differences between current income groups. The effect of expected changes in future income interacted with the attribute representing endangered wildlife and the 50% population increase is significant, whereas expectation of lower future income does not affect preferences relative to not expecting a change in income.

[Insert Table 4 about here]

Turning from preference parameters to the WTP estimates, we show in Table 5 WTP for illustrative combinations of current income and expectations about changes in future income. Because the interaction terms of current income with price have almost no impact on WTP (less than 0.2%, cf. Table 4) we show only results where the parameter values for the environmental attributes differ significantly. Respondents in the lower current income group expecting no change in future income have a somewhat lower WTP, especially for the attribute representing common wildlife. The group expecting a higher future income has a higher WTP on both common and endangered wildlife. Similarly, results from other combinations can be derived.

[Insert Table 5 about here]

*Some further considerations*

Our measure of expectations regarding future income is qualitative and we are not able to derive a 'future income elasticity of WTP'. However, we could evaluate the current income elasticity of WTP at attribute level for three types of expectations regarding future income. Based on a main effect model with normal distributed standard deviation for the environmental attributes and a lognormal for the price, we used the mean and standard error of estimations of the respondent specific posterior betas to obtain mean individual WTP. For each environmental attribute and price we simulated 15,000 drawsand eliminated the upper and lower 3,000 draws in order to exclude extreme values, e.g. caused by a price beta estimate very close to zero[5]. We used these individual WTP marginal estimates, as well as medians, and the household income data per person, and follow Kriström and Riera (1996) in estimating $s = a + by$ (cf. section 2.1). We found that in none of the cases was *b* significantly different from zero and hence the data cannot support the hypothesis that as people's income increases, they allocate an increasing share of their income for environmental goods. Rather, the results suggest that the proportion is constant at least with respect to current income within each of the future income expectation groups[6] .

[5] This high amount of removed estimates is due to a large proportion of the sample looking only little at price. While that may be a general problem, it is only a problem for the analysis here if this attribute-non-attendance is related to the income level. We have not found that to be the case here.

[6] Results can be obtained from authors upon request.

## 6. Discussion

The literature's empirical evidence of the income sensitivity of WTP focuses on current income, and evidence is mixed. The main contribution of this study is a formulation and test of the general hypothesis that expectations regarding changes in future income will matter for the preferences and WTP for environmental goods. We refined the hypothesis to two specific versions, and distinguish between effects on the marginal utility of income, and income effects on preferences across attributes. The measure used to evaluate future income expectations is rough – changes in 10 years, and results might depend on the measure used. However, even with this rough measure we find some interesting results.

### *6.1 Effects of expected future income*

Evaluating Hypothesis 1, that expectations regarding change in future income matter for the marginal utility of income, we find results inconclusive. Respondents expecting a higher future income have a significantly higher marginal disutility of parting with money compared to the other groups. However, the size of the parameter is very small compared to the direct price parameter (-0.0308 compared to -22.) and hence has hardly any effect on WTP. The group expecting a lower future income showed no significant difference for the interaction with price compared to the omitted group of respondents expecting no change. These results imply that Hypothesis 1 cannot be rejected, though the actual differences on WTP are very small and not statistically significant.

Turning to Hypothesis 2, i.e. expected future income matters for preferences for environmental attributes, we find a much clearer signal. Respondents expecting a higher future income have significantly higher preferences for the endangered wildlife attributes and for one of the common wildlife attributes. These higher preferences translate into a higher

WTP for this group of up to 83%. There was no difference for the lower income group relative to the omitted middle group. The results imply that Hypothesis 2 cannot be rejected for the non-use attributes. This also implies that ignoring this aspect of income and consumption choices and omitting expectations of future income may lead to omitted variable bias. The use oriented access attribute, which is a utility loss, shows no significant differences across income expectations. This corresponds neatly to the argument that income effects should be less pronounced for WTA (see section 2.1)

The implications of these findings are important. First, they suggest that the difficulties in identifying a significant current income effect may in many valuations studies simply reflect that current income is a too poor measure of the respondents' perceived consumption options. Accounting for expectations of future changes may have an impact of equal size. Secondly, the results raise the question of which income or consumption possibility measure is to replace current income if better estimates of income effects are to be obtained. The current study has used a qualitative assessment of expectations about future income changes, which respondents could answer with ease, but better ones could be developed, cf. below.

Finally, the finding here adds needed nuances and complexity to the analyses of distributional impacts of various environmental improvements, as we see that effects on preferences vary across attribute types. We found that the more non-use related wildlife values appear significantly more important for people expecting a higher future income than for others.

*6.2 Effects of current income*

As described in Section 2.3, the effects of current income could, analogous to the two hypotheses regarding changes in future income effects on preferences and WTP, travel in two

ways. In Table 4, we see the effects of current income on marginal utility of money. Respondents with high current income have a significantly lower marginal disutility of the price parameter, and hence a higher WTP for the environmental improvement, *ceteris paribus*. However, again we find the difference to very small (0.0407) compared to the direct price parameter (-22.1). The lower current income group does not differ from the middle current income group with respect to marginal utility of income.

For the environmental attributes we see most notably, the parameters for the wildlife attributes are significantly lower for the low current income group, a relative to the middle group, where as there is no significant difference for the high current income group. As seen in Table 5, this reduces WTP significantly for the lower current income group. For access, there is no significant difference between the low income group and the middle, or between the high and the middle.

As opposed to many of the existing studies estimating income effects on WTP measures, by focusing on income effects for the different attributes, we find significant, intuitively appealing and non-trivial effects of current income on several attributes of the environmental improvement in focus. While we on purpose chose to work in preference space to allow for a distinction between an effect of change in attribute preference and a change in marginal utility of money, we cannot directly address the issue of the income elasticity of WTP. But we evaluated this in a series of additional regressions of individual mean and median WTP on individual income. We found that these results are largely in line with Kriström and Riera (1996), as for all wildlife attributes, the WTP increases less than proportionally with income.

*6.4 Caveats and future work*

The effect of expectations on future income may depend on the payment period – the longer the more likely it is to be important. In this study we were not able to test this, we only had a perpetual payment period. However, the reasoning behind the permanent income hypothesis and the life cycle income hypothesis would suggest that it would matter also for a more limited time period as is used in most valuation studies.

One may argue that income in itself does not seem the obvious driver of preference variation. Indeed many aspects likely underlie variations in income, e.g. education, social back ground, gender, career stage and many others. While these may very well affect preferences, it remains important to stress that income effects have particular policy relevance as a measure of distribution effects. Furthermore, increases in income directly affect peoples' life style, leisure opportunities etc., which in turn could cause them to adopt different preferences and tastes. While it would indeed be interesting to model all potential parameters driving preferences in one single model, our purpose have been to evaluate the possible current income effects along with expectations of future income changes.

A clear potential for improvement lies in the measure of income used. Here we have used current household income, adjusted for possible single adult households, in combination with an easy to answer question on qualitative expectations about future income[7]. Clearly, a more quantitative measure of the expected future income level could add new understandings; even if such measures may be reported with considerable uncertainty. Furthermore, different reasons underlying expectations could be accounted for, e.g. retirement, change in household

[7] One could question if expectations of increases infuture income simply reflect normal drift in nominal wages, i.e. wage inflation. We cannot exclude the possibility that some people have understood just this, but as Table 2 shows this is not a widespread problem.

size, etc. Finally, one may consider uncovering other measures of income, including disposable income, relative income, e.g. to peers, and also to include the effects of net worth or wealth of the household.

An issue which we have not addressed is the importance of the individuals' time horizon of consumption, individual discount rates, etc. which are important when discussing future income and welfare distribution. From a policy perspective these issues would be of relevance to investigate further.

It is well known that wealth accumulation can, e.g. through increasing house prices, greatly affect consumption patterns (Miles 1992). It is difficult for respondents to answer detailed questions of net worth, e.g. value of property and pension funds less debt, etc., and we abstained from that in this study. Instead we attempted to approximate wealth by assigning each respondent a measure corresponding to the average wealth for the municipality and age group using data from Statistics Denmark (statistikbanken.dk). Effects of this variable on stated preference patterns were, however, not convincing, and hence obtaining improved measure of wealth would also be a task for future research.

## 7. Concluding remarks

The empirical evidence regarding the income sensitivity of WTP in the environmental valuation literature is mixed. We raise the question if the weak evidence may be caused in part by current income being an imperfect measure of the respondent's assessment of her future consumption options. We formulate and test the general hypothesis that expectations regarding future income will matter to the preferences and WTP for environmental goods. We refined the hypothesis to two specific versions, distinguishing between effects on the

marginal utility of income, and systematic income effects on preferences across attributes. We found ample support for the hypotheses. In particular the differences in preferences for environmental attributes have a much higher impact than the difference in marginal utility of money.

The implications of our findings are significant. They suggest that to evaluate fully and accurately the distributional impacts of environmental improvements, researchers need to develop a better measure of income and wealth effects than currently applied in most of the literature. The results furthermore raise the question of which income measure is to complement current income. This question is not fully explored in this study, but should represent a fruitful future research avenue.

## 8. References


Amigues, J.P., Boulatoff, C., Desaigues, B., Gauthier, C., Keith, J.E., 2002. The benefits and costs of riparian analysis habitat preservation: a willingness to accept/willingness to pay contingent valuation approach, Ecol Econ 43, 17-31.

Bandera, R., Tisdell, C., 2004. The net benefit of saving the Asian elephant: a policy and contingent valuation study', Ecol Econ 48, 93-107.

Bateman, I.J., Carson, R.T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M. Loomes, G., Mourato, S., Sugden, R., Swanson, J., 2002. Economic Valuation with Stated Preference Techniques, A Manual. Edward Elgar, Cheltenham, UK, 458 pp.

Bierlaire, M., 2003. BIOGEME: A free package for the estimation of discrete choice models , Proceedings of the 3rd Swiss Transportation Research Conference, Ascona, Switzerland.

Broberg, T., 2010. Income Treatment Effects in Contingent Valuation: The Case of the Swedish Predator Policy, Environ Resour Econ. 46, 1-17.

Brown, T.C., Gregory, R., 1999. Why the WTA-WTP disparity matters, Ecol Econ 28, 323-335.

Campbell, J.Y., 1987. Does Saving Anticipate Declining Labour Income? An Alternative Test of the Permanent Income Hypothesis, Econometrica 55, 1249-1273.

Eisner, R., 1958. The Permanent Income Hypothesis: Comment, Amer Econom Rev 48, 972-990.

Flores, N.E., Carson, R.T., 1997. The Relationship between the Income Elasticities of Demand and Willingness to Pay, J Environ Econom Management 33, 287-295.

Friedman, M., 1957. A Theory of the Consumption Function, NBER, Princeton, New Jersey.

Friedman, M., 1958. The Permanent Income Hypothesis: Comment, Amer Econom Rev 48, 990-991.

Gourinchas, P.O., Parker, J.A., 2002. Consumption over the Life Cycle, Econometrica 70, 47-89.

Grutters, J.P.C., Kessels, A.G.H., Dirksen, C.D., van Helvoort-Postulart, D, Anteunis, L.J.C., Joore, M.A., 2008. Willingness to Accept versus Willingness to Pay in a Discrete Choice Experiment, Value in Health 11, 1110-1119.

Hall, R.E., 1978. Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence, J Political Economy 86, 971-987.

Hökby, S., Söderqvist, T., 2003. Elasticities of Demand and Willingness to Pay for Environmental Services in Sweden, Environ Resour Econ 26, 361-383.

Holmes, T.P., Bergstrom, J.C., Huszar, E., Kask, S.B. and Orr, F., 2004 Contingent valuation, net marginal benefits, and the scale of riparian ecosystem restoration, Ecol Econ 49, 19-30.

Houthakker, H.S., 1958a. The Permanent Income Hypothesis, Amer Econom Rev 48, 396-404.

Houthakker, H.S., 1958b. The Permanent Income Hypothesis: Reply, Amer Econom Rev 48, 991-993.

Jacobsen, J.B., Boiesen, J.H., Thorsen, B.J., Strange, N., 2008. What's in a name? The use of quantitative measures versus 'Iconised' species when valuing biodiversity, Environ Resour Econ 39, 247-263.

Jacobsen, J.B., Hanley, N., 2009. Are there income effects on global willingness to pay for biodiversity conservation? Environ Resour Econ 43, 137-60.

Jacobsen, J.B., Lundhede, T.H., Martinsen, L., Hasler, B., Thorsen, B.J., 2011. Embedding effects in choice experiment valuation of environmental preservation projects. Ecological Economics 70, 1170-1177.

Jacobsen, J.B., Lundhede, T.H., Thorsen, B.J., 2012. Valuation of wildlife populations above survival. Biodiversity and Conservation 21, 543-563.

Jacobsen J.B., Thorsen B.J., 2010. Preferences for site and environmental functions when selecting forthcoming national parks. Ecol Econ 69, 1532-1544.

Kaae, B.C., Madsen, L.M., 2003. Holdninger og ønsker til Danmarks natur' [Opinions and wishes for the nature of Denmark], By og Landskabsserien 21, Forskningscentret for Skov & Landskab, Hørsholm, Denmark, 128 pp.

Kriström, B., Riera, P., 1996. Is the Income Elasticity of Environmental Improvements Less Than One?, Environ Resour Econ 7, 45-55.

Kuhfeld, W.F., 2004. Marketing Research Methods in SAS. Experimental Design, Choice, Conjoint, and Graphical Techniques'. SAS 9.1. Edition. TS-694. SAS Institute Inc., Cary, NC, USA, 782 pp.

Louviere, J.J., Hensher, D.A., Swait, J.D., 2000. Stated Choice Methods: Analysis and Application, Cambridge University Press.

McFadden, D., 1974. Conditional logit analysis of qualitative choice behaviour, In: P. Zarembka, Front. in Econometrics. Academic Press Inc., New York, pp. 105-142.

Miles, D., 1992. Housing markets, consumption and financial liberalisation in the major economies, Eur Econom Rev 36, 1093-1136.

Mitchell, R.C., Carson, R.T., 1989. Using surveys to value public goods, The contingent valuation method, Resources for the Future, Washington DC, 463 pp.

Modigliani, F., 1949. Fluctuations in the saving-income ratio: A problem in economic forecasting, Stud in Income and Wealth, No. 11. New York: National Bureau of Economic Research.

Modigliani, F. Ando, A., 1963. The life cycle hypothesis of saving: Aggregated implications and tests, Amer Econom Rev 53, 55-84.

Riera, P., Mogas, J., Bennett, J., 2008. Forest value inference using contingent valuation and choice experiments, in "Choice Experiments Informing European Environmental Policy" (E. Biroland and P. Koundouri, Eds.), Edward–Elgar Publishing, Wally Oates and Henk Folmer's 'New Horizons in Environmental Economics' Series, Cheltenham, UK.

Sattout, E.J., Talhouk, S.N., Caligari, P.D.S., 2007. Economic value of cedar relics in Lebanon: An application of contingent valuation method for conservation, Ecol Econ 61, 315-322.

Schläpfer, F. 2006. Survey protocol and income effects in the contingent valuation of public goods: A meta-analysis, Ecol Econ 57, 415-429.

Train, K.E., 2003. Discrete Choice Methods with Simulation, Cambridge University Press, 346 pp.

Train, K., Weeks, M., 2005. Discrete Choice Models in Preference Space and Willing-to-Pay space. In R. Scarpa and A. Alberini, eds. Applications of Simulation Methods in Environmental and Resource Economics. Dordrecht, Springer Publisher, Chapter 1, pp. 1–16.

# TABLES

**Table 1 Attributes and levels in the CE questionnaire**

| ATTRIBUTE | LEVEL |
|---|---|
| ACCESS:<br>Access to habitat | Unrestricted access (status quo)<br>Reduced access (No access in 25% of all of the specific habitat from April to November)<br>No access (No access in 25% of all of the specific habitat all year) |
| ENDANGERED:<br>Increases in population levels of an endangered species related to the habitat | Threatened with extinction (status quo)<br>Rare, but not threatened with extinction<br>Common |
| GENERAL WILDLIFE:<br>Increases in population levels of general wildlife in the specific habitat | Population size as of today (status quo)<br>Population increase by 25%<br>Population increase by 50% |
| PRICE:<br>Annual tax increase | DKK 0 (status quo)<br>DKK 100<br>DKK 250<br>DKK 500<br>DKK 1,000<br>DKK 2,000 |

*(DKK 100 equate approx.€ 13)*

**Table 2. Distribution of 678 respondents to current income and change in future income groups**

| | | Expected change in future income | | | |
|---|---|---|---|---|---|
| | | **Lower** | **As now** | **Higher** | **Total** |
| **Stated current income** | **Low** | 14% | 9% | 12% | 35% |
| | **Medium** | 15% | 11% | 10% | 36% |
| | **High** | 11% | 11% | 7% | 29% |
| | **Total** | 40% | 32% | 29% | 100% |

**Table 3 Average of gender, age and education level distributed on present and expected income.**

| Current Income Level | | Expected Future Income Change | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Lower* | | *As now* | | *Higher* | |
| | | Average | St. error | Average | St. error | Average | St. error |
| *Low* | Gender (share of men) | 0.48 | 0.50 | 0.51 | 0.50 | 0.47 | 0.50 |
| | Age in years | 61.77 | 9.30 | 58.09 | 15.07 | 33.64 | 14.08 |
| | Education level | 2.58 | 1.66 | 2.22 | 1.37 | 2.76 | 1.70 |
| *Medium* | Gender (share of men) | 0.47 | 0.50 | 0.41 | 0.50 | 0.50 | 0.50 |
| | Age in years | 53.62 | 10.81 | 45.61 | 13.29 | 37.57 | 8.70 |
| | Education level | 3.49 | 1.80 | 3.59 | 1.58 | 3.26 | 1.55 |
| *High* | Gender (share of men) | 0.52 | 0.50 | 0.45 | 0.50 | 0.61 | 0.49 |
| | Age in years | 54.78 | 9.41 | 46.20 | 10.24 | 38.54 | 9.18 |
| | Education level | 4.43 | 1.49 | 3.77 | 1.77 | 4.21 | 1.65 |

Note: Education level ranges from 1 (lowest) to 6 (highest)

**Table 4. Results of a random parameter logit model, where income and expected change in future income are interacted with the attributes. 1000 halton draws were used.**

| | Parameter | Std. Err | t-value | p-value |
|---|---|---|---|---|
| ASC | -0.406 | 0.0924 | -4.40 | 0.00 |
| Price*100 DKK | -22.2 | 1.21 | -18.42 | 0.00 |
| Red. Access whole year | -1.10 | 0.206 | -5.31 | 0.00 |
| -heterogeneity | -1.40 | 0.102 | -13.66 | 0.00 |
| Red. Access summer | -0.564 | 0.203 | -2.78 | 0.01 |
| -heterogeneity | 1.55 | 0.0929 | 16.63 | 0.00 |
| End. Wildlife common | 1.26 | 0.241 | 5.25 | 0.00 |
| -heterogeneity | 1.96 | 0.115 | 17.11 | 0.00 |
| End. Wildlife rare | 1.64 | 0.219 | 7.50 | 0.00 |
| -heterogeneity | 1.67 | 0.101 | 16.50 | 0.00 |
| Common wildlife + 25% | 1.10 | 0.201 | 5.45 | 0.00 |
| -heterogeneity | -1.59 | 0.0964 | -16.48 | 0.00 |
| Common wildlife + 50% | 0.554 | 0.221 | 2.51 | 0.01 |
| -heterogeneity | -1.85 | 0.0907 | -20.44 | 0.00 |
| **High income interacted with** | | | | |
| Red. Access whole year | 0.0889 | 0.219 | 0.41 | 0.68 |
| Red. Access summer | -0.203 | 0.213 | -0.95 | 0.34 |
| End. Wildlife common | 0.0342 | 0.245 | 0.14 | 0.89 |
| End. Wildlife rare | 0.0946 | 0.229 | 0.41 | 0.68 |
| Common wildlife + 25% | 0.231 | 0.208 | 1.11 | 0.27 |
| Common wildlife + 50% | 0.128 | 0.226 | 0.56 | 0.57 |
| Price*100 | 0.0407 | 0.0124 | 3.29 | 0.00 |
| **Low income interacted with** | | | | |
| Red. Access whole year | 0.263 | 0.215 | 1.23 | 0.22 |
| Red. Access summer | -0.221 | 0.209 | -1.05 | 0.29 |
| End. Wildlife common | -0.436 | 0.240 | -1.81 | 0.07 |
| End. Wildlife rare | -0.545 | 0.228 | -2.39 | 0.02 |
| Common wildlife + 25% | -0.705 | 0.206 | -3.42 | 0.00 |
| Common wildlife + 50% | -0.700 | 0.223 | -3.14 | 0.00 |
| Price*100 | 0.0140 | 0.0130 | 1.08 | 0.28 |
| **Higher future income interacted with** | | | | |
| Red. Access whole year | -0.143 | 0.217 | -0.66 | 0.51 |
| Red. Access summer | 0.0356 | 0.214 | 0.17 | 0.87 |
| End. Wildlife common | 0.533 | 0.244 | 2.18 | 0.03 |
| End. Wildlife rare | 0.500 | 0.229 | 2.19 | 0.03 |
| Common wildlife + 25% | 0.128 | 0.207 | 0.62 | 0.54 |
| Common wildlife + 50% | 0.454 | 0.226 | 2.01 | 0.04 |

| | | | | |
|---|---|---|---|---|
| Price*100 | -0.0308 | 0.0123 | -2.49 | 0.01 |
| **Lower future income intaracted with** | | | | |
| Red. Access whole year | 0.0571 | 0.232 | 0.25 | 0.81 |
| Red. Access summer | 0.0378 | 0.226 | 0.17 | 0.87 |
| End. Wildlife common | -0.188 | 0.263 | -0.71 | 0.48 |
| End. Wildlife rare | -0.350 | 0.243 | -1.44 | 0.15 |
| Common wildlife + 25% | -0.0472 | 0.222 | -0.21 | 0.83 |
| Common wildlife + 50% | 0.0740 | 0.241 | 0.31 | 0.76 |
| Price*100 | -0.0205 | 0.0134 | -1.52 | 0.13 |
| N Choices/respondents | 7979/678 | | | |
| LL/ Adj. R2 | -6228/0.285 | | | |

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**Table 5. WTP and 95% confidence intervals for selected groups. Confidence intervals are calculated using the Krinsky-Robb method.**

| | Medium current income and no expected income change | | | Low current income and no expected income change | | | Medium current income and expects higher income | | |
|---|---|---|---|---|---|---|---|---|---|
| | WTP | Lower bound 95% | Upper bound 95% | WTP | Lower bound 95% | Upper bound 95% | WTP | Lower bound 95% | Upper bound 95% |
| ASC | -183 | -262 | -103 | | | | | | |
| Red. Access whole year | -495 | -674 | -316 | | | | | | |
| Red. Access summer | -252 | -434 | -70 | | | | | | |
| End. Wildlife common | 562 | 347 | 776 | 367 | 165 | 569 | 805 | 608 | 1002 |
| End. Wildlife rare | 739 | 555 | 924 | 496 | 307 | 684 | 960 | 769 | 1151 |
| Common wildlife + 25% | 493 | 318 | 669 | 175 | -3 | 353 | | | |
| Common wildlife + 50% | 249 | 60 | 438 | -66 | -250 | 119 | 456 | 276 | 637 |