Who cares about the income of others?

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Abstract

This paper examines how sensitive one's happiness is to the income of those they are said to compare themselves to. The primary purpose is to investigate whether this sensitivity differs according to observable characteristics. An ordered probit model is used to examine the relationship between a measure of subjective well-being and interactions among income, reference income and various demographic variables. Using data from the British Household Panel Survey it is found that males, those younger than 50 years old, those without a child and those on low incomes are most negatively affected, in terms of happiness, when the income of others rises. However, the results are suggestive at best. Various diagnostic tests reveal shortcomings in the empirical strategy. As such, this paper acts only as a first step in a movement to study heterogeneity in attitudes to comparison income. It is advised that substituting semi-parametric and nonparametric estimators for the one presented here would be an appropriate next step.

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1. Introduction

Classical economists touched on the idea that individuals compare their income or wealth to that of others. Richard Whately (1831, p. 157) asserted that "As wealth increased, the continued stimulus of emulation would make each man strive to surpass, or at least not fall below, his neighbours."

Certainly, it seems natural to assume that whilst one seeks more income to obtain the intrinsic pleasure that comes from consumption, there also exists a "desire of everyone to excel everyone else in the accumulation of goods" (Veblen, 1899, p. 39). It is surprising then that the mainstream model of utility has a single argument, absolute income.[1] One would think that the relative income hypothesis of Duesenberry (1949), which added 'relative' income as an argument, would be favoured. For various reasons this has not been the case.[2]

It is appreciated that the mainstream model is useful in making problems more tractable. It also produces clear results. Nevertheless, it is not always appropriate to disregard relative income concerns. Labour economists should note that Keynes (1936) saw real wage rigidity and unemployment as being caused partly by workers keen to maintain their 'relative' wages. On the issue of optimal taxation, Boskin and Sheshinski (1978) argue that a more progressive taxation system is required when individuals are concerned about relative position. Indeed, if one's life satisfaction deteriorates when their income growth lags behind that of others, then this implies poverty lines should be based on relative rather than absolute income.

Clearly then there is need for research which examines how important relative income concerns are. If they are found not to be significant then economists are justified in their use of the mainstream model. Fortunately such research has started to be delivered in abundance.[3] This paper is complementary to such research, though goes beyond much of the existing literature by looking more deeply at 'who cares' about relative income. That is, this paper seeks to determine whether one's demographic characteristics shape their attitude to the income of others. Identification of those groups most negatively affected by a decreased relative income is in itself interesting, though can also be beneficial. For instance, we may worry that individuals from these groups are more likely to overwork themselves.[4]

To examine how demographic characteristics affect one's attitude to others' income, the present study, using data from the British Household Panel Survey (BHPS), has undertaken econometric regressions of a subjective, self-reported measure of life satisfaction. This paper presents an estimated ordered probit model of this life satisfaction measure, which shows that males, those younger than 50 years old, those without a child and those on low incomes are most negatively affected, in terms of happiness, when the income of others rises. Regrettably, in addition to this, the paper

[1] In fact the argument is consumption, though this is a function of income.
[2] Drakopoulos (2011) provides an excellent perspective on why economists are reluctant to accept the role of relative income.
[3] Clark *et al*. (2008) review the evidence from the subjective well-being literature.
[4] See Pérez-Asenjo (2011) for evidence which suggests this.

shows that such results may be spurious, owing to the unsuitability of the ordered probit model.

2. A review of the literature

In this paper one's utility, U, is defined as a function of one's own income, Y, and the income of others, Y^*. That is:

$$U = f(Y, Y^*)$$

It is assumed that utility is increasing in income and decreasing in the income of others. The former effect is conventionally assumed and is found in the mainstream model of utility. The latter effect, omitted from the mainstream model, can be rationalised by Festinger's (1954) social comparison theory and the notion of relative deprivation (see Runciman 1966). Perhaps the reader is also able to rationalise it by considering their own experiences.

An important theoretical question regards the 'others' whose income affects our utility. Social comparison theory says that people form 'reference groups', which are groups of individuals like oneself to which meaningful comparisons are made. Hence, we take these 'others' to be one's reference group and can redefine Y^* as the average income of this group, called 'reference income'.

Unfortunately, what defines one's reference group is not known. Pérez-Asenjo (2011) finds evidence that individuals compare themselves mainly to those of the same age. In addition, the author finds that the reference group is also determined by race, sex and religion. More research is certainly warranted in this area. In its absence, most authors intuitively define the reference group by assumption and this approach is adopted in the present study.

As suggested in the introduction, the decision to use the mainstream utility model can be inappropriate if the Y^* term is an important argument in the utility function. Given this, the seminal work of Easterlin (1974), which provided suggestive evidence that the term is important, will make uncomfortable reading for many economists. Easterlin finds that within a country self-reported happiness is increasing with one's income, though a country's average level of happiness does not increase over time as it becomes richer. The 'Easterlin Paradox' was interpreted by Easterlin as highlighting that relative income rather than absolute income determines happiness.

Studies at the individual level have been supportive of Easterlin's interpretation. Using self-reported happiness as a proxy for utility, McBride (2001), Ferrer-i-Carbonell (2005) and Luttmer (2005) all show with micro-data that one becomes unhappier when the income of 'relevant others' increases. Considering the related topic of job satisfaction, Clark and Oswald (1996) find evidence that the utility of workers increases (decreases) when their income is higher (lower) than a comparison level.

Of course the evidence is not all one sided. Senik (2004) finds that in the 'volatile' Russian environment life satisfaction is increasing in reference group income. The

finding is rationalised by Hirschman's (1973) 'tunnel-effect': people can derive utility from others' income where it raises their expected future income.

The research that has been conducted is encouraging for those, who like this author; believe that the income of others does play a role in the utility function. Nonetheless, there are shortcomings in the literature. Firstly, from the few studies that explore heterogeneity in attitudes to others' income, a bewildering picture is presented. Luttmer (2005) considers the idea that different demographic groups have different attitudes, though only finds one significant result: those who socialise more frequently with their neighbours incur a larger loss of happiness when their neighbour's earnings rise. In contrast, Pérez-Asenjo (2011) shows that for males, white people and people living in rural areas the positive relation between relative income and happiness is greater. Being critical, one would say that the use by Luttmer of OLS regressions on a discrete, 7 category self-reported happiness variable, is inappropriate. With regard to the paper by Pérez-Asenjo, one would question why after having shown the relevance of multiple characteristics in defining one's reference group, the author elects to use models where males compare themselves to all other males, white people compare themselves to all other white people and so on.

Duesenberry (1949) hypothesised that only 'upward' income comparisons are made. That is, poorer people are negatively affected by the high incomes of the rich, though the rich do not derive benefit from being above the poor. McBride (2001) and Ferrer-i-Carbonell (2005) have considered this suggestion and both have come to opposite conclusions. Whilst Ferrer-i-Carbonell finds evidence in favour of the idea, McBride found that relative income effects are much stronger at higher income levels.

This paper, which investigates how one's characteristics shape their sensitivity to others' income, makes a contribution to clarifying the bewildering 'picture'. Not only this, the paper illustrates a second shortcoming of the literature. By conducting diagnostic tests, which are either not commented on or are overlooked in many other papers, it is shown that the ordered probit model, favoured by many (see, for example, McBride 2001), is a less than suitable tool for describing well-being.

3. Methodology

In this study the main outcome variable, y_i (later referred to as $life\ satisfaction_i$), is a subjective, self-reported measure of life satisfaction. It is the answer to the following question posed in the BHPS: "How dissatisfied or satisfied are you with your life overall?" Answers take discrete values from 1 to 7 where 1 is defined as "not satisfied at all", 4 is "not satisfied or dissatisfied" and 7 is "completely satisfied". The other values do not have explicit labels, though fit into the scale such that a higher value corresponds to greater satisfaction.

Given the outcome variable is ordered and discrete, it is estimated by using an ordered probit model. This model is based on an underlying latent variable, y_i^*, which reflects one's true, unobserved feeling of satisfaction with life. This latent variable is

taken to be a function of a vector of explanatory variables, x_i, which includes, amongst other things, one's own income, their reference income and interactions between these and demographic variables. Hence we write,

$$y_i^* = x_i'\beta + \varepsilon_i$$

where ε_i is independently and identically distributed as a standard normal. The latent variable is matched to the observed one, y_i, as follows:

$$\begin{aligned} y_i = 1 \quad & \text{if} \quad y_i^* \leq \gamma_1 \\ = 2 \quad & \text{if} \quad \gamma_1 < y_i^* \leq \gamma_2 \\ = 3 \quad & \text{if} \quad \gamma_2 < y_i^* \leq \gamma_3 \\ = 4 \quad & \text{if} \quad \gamma_3 < y_i^* \leq \gamma_4 \\ = 5 \quad & \text{if} \quad \gamma_4 < y_i^* \leq \gamma_5 \\ = 6 \quad & \text{if} \quad \gamma_5 < y_i^* \leq \gamma_6 \\ = 7 \quad & \text{if} \quad y_i^* > \gamma_6 \end{aligned}$$

where γ_j $(j = 1, \dots, 6)$, are parameters to be estimated jointly with β.

The parameters are estimated using maximum likelihood estimation. To make statements regarding the impact that changes in the regressors have on y_i, we focus attention on the signs of the β coefficients and changes in the probability of observing y_i in excess of 5. The former area of attention will be used to make comments on the variables which are not of primary interest. The latter area of attention will be used to examine heterogeneity in attitudes to income and reference income. Use is made of the fact that:

$$P(y_i > 5) = 1 - \Phi(\gamma_5 - x_i'\beta)$$

and,

$$\frac{\partial P(y_i > 5)}{\partial x_i} = \phi(\gamma_5 - x_i'\beta)\beta$$

where $\phi(.)$ and $\Phi(.)$ denote the standard normal density and distribution functions, respectively.

As mentioned above an open question in the literature is what constitutes the reference income level for an individual? The present study assumes that one takes the reference income level to be the average income of those who live in the same country, are of the same gender and are in the same age group. The three countries in the sample used are England, Scotland and Wales. The age groups are: 16-24, 25-34, 35-44, 45-64,

and 65 or older. Thus, 30 different reference groups are generated. It is acknowledged that such an arbitrary definition is not ideal. However, age and gender have been identified as characteristics defining one's reference group (see Pérez-Asenjo 2011) so the definition does have some merit.

Another important choice which had to be made in the analysis was what measure of income to use. It was decided that "equivalised" monthly household income was the most appropriate measure. The measure is defined in Appendix A where a short explanation of why the measure was chosen is also given. Hereafter, equivalised monthly household income is referred to simply as 'income'.

With regard to the selection of this paper's 'headline' model of life satisfaction, a 'general-to-specific' approach was adopted. Wald tests were used to test the individual significance of explanatory variables, whilst the likelihood-ratio test was used to test joint significance and the appropriateness of imposing non-zero restrictions on parameters.

4. Data

The headline model of this paper is based on a sample of 10,049 individuals from the 2007-2008 wave of the British Household Panel Survey (BHPS). The BHPS is a longitudinal survey consisting of a representative sample of British households and has been conducted every year since 1991.[5] From 2001 a sample of 2000 households from Northern Ireland have been included in the BHPS, though they are excluded from the present analysis, which focuses solely on Britain.

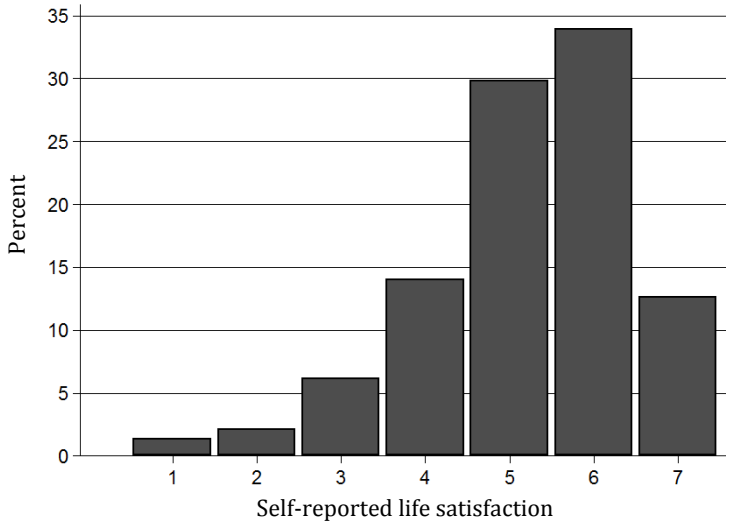
In addition to the 2007-2008 wave, samples from all other waves of the BHPS from 1997 to 2009 (excluding the 2001-2002 wave) are used in order to undertake robustness checks of the estimated model. The size of each sample and the mean of the outcome variable, $life\ satisfaction$, for each is reported in Table 6 of Appendix C.

Concentrating on the main sample from the 2007-2008 wave, Figure 1 shows the distribution of answers to the earlier described life satisfaction question. The mean value of life satisfaction is 5.21 and as can be seen the distribution is asymmetric around this. Responses are negatively skewed (skewness $= -0.862$) with only about 24% of respondents declaring a life satisfaction value below 5. The most commonly chosen value is 6. As would be expected, relatively few individuals decide to declare themselves completely satisfied, which corresponds to choosing value 7.

In Appendix B, Tables 4 and 5 list and define all the variables which were considered as explanatory variables in the ordered probit model for life satisfaction. Table 4 lists those variables which are in the 'headline' specification of this paper, whilst Table 5 lists the dropped regressors from the 'general' specification. Appendix C, Table 7 provides summary statistics for these variables, including correlations with the outcome variable.

[5] Detailed information on all aspects of the BHPS is provided on the Institute for Social and Economic Research website: http://www.iser.essex.ac.uk/bhps

Figure 1. Distribution of self-reported life satisfaction (2007-2008)



5. Estimation results

Table 1 presents the estimated headline ordered probit model for life satisfaction. All regressors presented hold individual significance at the 10% level, or hold joint significance with other 'related' regressors at the 5% level.

As a robustness check, the model was estimated using each of the 11 waves of BHPS data from 1997 to 2009 (excluding the 2001-2002 wave). Table 1 records the "mark" of each regressor, which is the proportion of times it was significant at the 5% level and shared the same coefficient sign as in Table 1. Thus, one can use this mark to help determine the relevance of the regressors.

5.1. Comments on the effects of the control variables

The estimated coefficients provide support for some relationships regularly documented in the subjective well-being literature. Those of better health and those living as part of a couple are more satisfied with life, ceteris paribus. Those who meet friends or relatives, not living with them, at least once a week (indicated by the dummy variable *social*) are also more likely to report a higher satisfaction level. It is found that life satisfaction is u-shaped against age, with the minimum occurring at around 55 years. Having controlled for income, the non-pecuniary cost of unemployment is demonstrated by the negative coefficient on the variable *unemployed*.[6] Notice that the marks for the variables corresponding to these relationships are all above 0.9. This reaffirms their relevance, as do the complementary works of Blanchflower and Oswald (2004), Clark and Oswald (2002), Frey and Stutzer (2000) and Leyden *et al*. (2011).

[6] The variable '*usual working hours*' has been demeaned. Therefore, the dummy variables for the unemployed, the retired and those out of the labour force are relative to an employed person working the average number of hours and full-time students.

Table 1
Ordered probit model for life satisfaction (2007–2008)

	Coefficient	Standard error	P-value	Mark across 11 waves
Life satisfaction				
$\log(age)$	-1.384	0.777	0.075	0.91
$\log(age)^2$	0.173	0.112	0.122	0.91
$Female$	-2.024	0.846	0.017	0.36
$Asian$	1.895	0.686	0.006	0.27
$Excellent\ health$	0.403	0.027	0.000	1.00
$Fair\ health$	-0.440	0.028	0.000	1.00
$Poor\ health$	-0.947	0.040	0.000	1.00
$Wales$	3.361	1.306	0.010	0.09
$Scotland$	2.052	1.026	0.046	0.64
$Couple$	0.264	0.028	0.000	1.00
$Lone\ parent$	-0.113	0.058	0.052	0.09
$Sociable$	0.203	0.032	0.000	1.00
$Child$	-3.407	1.307	0.009	0.55
$Above\ GCSE$	-0.080	0.023	0.001	1.00
$Unemployed$	-0.396	0.069	0.000	1.00
$Retired$	0.353	0.052	0.000	1.00
$Out\ of\ labour\ force$	-0.140	0.040	0.000	0.55
$Duration^2$	0.0002	0.0001	0.000	0.91
$Unemployed \times duration^2$	0.0013	0.0006	0.050	0.45
$Retired \times duration^2$	-0.0003	0.0001	0.000	0.82
$Usual\ working\ hours$	-0.0038	0.0012	0.002	0.64
$\log(income)$	-3.111	0.777	0.000	0.73
$\log(ref.income)$	-3.432	0.755	0.000	0.82
$\log(income) \times \log(ref.income)$	0.401	0.098	0.000	0.73
$Female \times \log(income)$	0.072	0.035	0.040	0.18
$(Age \geq 50) \times \log(income)$	-0.042	0.039	0.276	0.36
$Asian \times \log(income)$	-0.266	0.091	0.003	0.27
$Female \times \log(ref.income)$	0.186	0.112	0.097	0.18
$(Age \geq 50) \times \log(ref.income)$	0.058	0.039	0.133	0.36
$Child \times \log(ref.income)$	0.432	0.165	0.009	0.45
$Wales \times \log(ref.income)$	-0.434	0.169	0.011	0.09
$Scotland \times \log(ref.income)$	-0.254	0.130	0.051	0.64
$Boundary\ point\ 1$	-31.516	5.999	–	–
$Boundary\ point\ 2$	-31.061	5.999	–	–
$Boundary\ point\ 3$	-30.467	5.999	–	–
$Boundary\ point\ 4$	-29.797	5.998	–	–
$Boundary\ point\ 5$	-28.895	5.998	–	–
$Boundary\ point\ 6$	-27.735	5.998	–	–

Number of observations: 10,049
Log-likelihood: $-14{,}825.587$
Pseudo-R^2: 0.064

In fact, some results obtained differ from those of existing work. It is predicted that individuals who have attained an academic qualification above the level of GCSE are less satisfied, ceteris paribus. This contradicts the conclusion of Gerdtham and Johannesson (2001) that more education increases one's happiness. A possible reason for the discrepancy is the use by Gerdtham and Johannesson of a categorical variable for income with four categories. By not using a continuous measure, as in the present case, the 'income effect' may somewhat by captured by the variable for education.

The results provide evidence that the unemployed 'adapt' to their situation and partially recover happiness with time. This finding is indicated by the positive coefficient on the multiplicative dummy variable, $unemployed \times duration^2$. The work of Clark and Oswald (1994), who also use BHPS data, reaches the same conclusion. However, Winkelmann and Winklemann (1998), who use a German panel data set, find no such effect. Noting the mark of only 0.45 for the variable $unemployed \times duration^2$, it is not surprising that this discrepancy exists.

The remaining control variables provide some interesting insights, though are not discussed here. One should note that the presence of the interaction terms adds greater complexity to the interpretation of coefficients. For instance, whilst the coefficient on the dummy variable for females is -2.024, when evaluated at the mean values of $\log(income)$ and $\log(ref.income)$, the effect (on the underlying latent variable) of being female is only -0.012 compared with being male. Note that Table 7 in Appendix C can be used for such calculations.

5.2. The effects of income and reference income

Due to the inclusion of interaction terms the impact on life satisfaction of income and reference income depends on where we evaluate it. Evaluated at the sample means, the effect of a one unit rise in $\log(income)$ on the underlying 'latent satisfaction' variable is 0.051. The corresponding effect of a one unit rise in $\log(ref.income)$ is -0.228. Thus, for the 'representative' individual, it is estimated that the drop in 'underlying satisfaction' from a 1% increase in reference income, is over 4 times the magnitude of the gain when their income rises by 1%. Having said this, the hypothesis that the effects are equal in size, though opposite in sign, cannot be rejected. The appropriate Wald test produced a statistic of 1.96. Asymptotically distributed as a chi-squared with one degree of freedom, the corresponding p-value was 0.162.

Hence, the results do not provide evidence that the 'reference income effect' dominates the 'income effect' (or vice versa). Nevertheless, they do show, in line with the literature, that relative income rather than just absolute income determines happiness. The representative individual would like to have more income, though would also like to avoid 'relevant' others getting more.

As far as this author is aware, use of the interactive variable $\log(income) \times \log(ref.income)$ represents a first in the literature. Previous studies have looked at the effect of reference income across a maximum of two income groups, characterised as the high and low income groups (see, for example, McBride 2001). The interactive variable allows the effect of reference income to differ across all income levels, and the effect of

income to differ across all reference income levels. With regard to the second effect, what the estimated positive coefficient shows is that a 1% rise in income becomes 'more' pleasurable the higher the income of your reference group. With regard to the first effect, it shows that a 1% rise in reference income becomes 'less' painful the higher your income. Thus, the reference income effect is estimated to be asymmetric between the relatively poor and the relatively rich. This is supportive of Duesenberry's (1949) hypothesis that income comparisons are 'upwards', though even suggests we go a step further. Notice that for those with an income high enough it is predicted that an increase in reference income will make them happier. Perhaps this can be justified through the emergence of a sense of caring for those worse off. Of course, it is worth noting that the variables $\log(income)$, $\log(ref.income)$ and $\log(income) \times \log(ref.income)$ all have a decent mark. In almost 3 out of 4 regressions the variables are significant at the 5% level with the stated signs.

In order to determine for whom the reference income effect is more important, and to aid interpretation, attention now shifts to the probability of one declaring themselves as 'very satisfied', $P(very\ satisfied = 1)$, and the marginal effects on this.[7] It is supposed that categories 6 and 7 of the life satisfaction variable correspond to one being very satisfied.

The estimated ordered probit model shows that the 'happiness loss' from a rise in reference income varies with gender, age, whether one has a child, country of residence and one's own income. Table 2 reports the estimated marginal effects of $\log(ref.income)$ on $P(very\ satisfied = 1)$ across groups defined by these characteristics. For each group two marginal effects are reported. First, a "descriptive" marginal effect is given. This is the answer to the question:

> *For the representative individual 'of this group', when $\log(ref.income)$ increases by 1 unit, what is the change in the probability that the individual declares themselves very satisfied?*

Second, a "controlled" marginal effect is given. This is the answer to the question:

> *For an individual of this group who otherwise has the same characteristics as the representative individual 'in the sample', when $\log(ref.income)$ increases by 1 unit, what is the change in the probability that the individual declares themselves very satisfied?*

Thus, if one is interested in knowing how much a 1% rise in reference income affects the average female then one is interested in the "descriptive" marginal effect. If one instead is interested in knowing how the effect of a 1% rise in reference income differs between males and females, all else the same, then one is interested in the "controlled" marginal effects. From a policy perspective, the "descriptive" marginal effects are perhaps more relevant, as they "describe" what actually happens when average incomes/ reference

[7] For the interested reader, Appendix D presents a similar analysis to determine for whom the income effect is more important.

Table 2
Marginal effects of $\log(ref.income)$ on $P(very\ satisfied = 1)$ evaluated for different groups

	"Descriptive" marginal effect	"Controlled" marginal effect
Group		
All individuals	-0.090	-0.090
Males	-0.128	-0.132
Females	-0.061	-0.058
Those aged 16-49	-0.051	-0.100
Those aged 50 or older	-0.144	-0.077
Those with no children	-0.140	-0.144
Those with children	0.016	0.027
English	-0.029	-0.034
Welsh	-0.224	-0.204
Scottish	-0.130	-0.135
Those with an income in 1st quarter	-0.211	-0.195
Those with an income in 2nd quarter	-0.115	-0.114
Those with an income in 3rd quarter	-0.058	-0.057
Those with an income in 4th quarter	0.025	0.027

incomes are raised. The "controlled" marginal effects pinpoint the change in attitude towards reference income resulting from a certain characteristic. Consequently, the controlled marginal effects are used to determine who cares most about the income of others.

For the representative individual who reference income is about £2,558, a 10% rise in this (extra £256) is estimated to reduce their probability of being very satisfied by 0.9%. With regard to the descriptive marginal effects, it is rather astonishingly estimated that those from Wales and those in the bottom 25 percentile range of the income distribution (1st quarter), incur a sizeable loss of over 2% in their respective probabilities when reference income rises by 10%.

Focusing on the controlled marginal effects, we would conclude that the groups that 'care' most, or are hurt most, when reference income rises are males, those younger than 50 years old, those without children, the Welsh and those on low incomes. Notice the result that those with children and those in the top 25 percentile range of the income distribution (4th quarter) are not hurt when the income of others rises. The idea for the latter was that perhaps they develop a sense of altruism for the poorer. The idea for the

Table 3
Diagnostic tests for estimated ordered probit model

	Null hypothesis (H_0)	Test statistic $\xi \sim_a \chi^2(k)$	k	P-value
Heteroskedasticity	Errors are homoskedastic	192.53	3	0.000 (Reject H_0)
Normality	Errors are normally distributed	69.46	2	0.000 (Reject H_0)
Boundary heterogeneity	Boundaries are constant over observations	25.95	6	0.000 (Reject H_0)
Functional form	Relevant variables are not omitted	9.52	2	0.009 (Reject H_0)
Parallel regression	Same relationship between each pair of outcome groups	871.37	160	0.000 (Reject H_0)

Note: k is the number of restrictions imposed under the null hypothesis.

former may be that having and raising children delivers a feeling of contentment, and an appreciation that money is not everything.

In addition to the diagnostic tests below, which show that the marginal effects of Table 2 may be spurious, one may also want to reflect on the marks of the interactive variables on which the results are based. Only 1 of the 5 interactive variables between $\log(ref.income)$ and the demographic group dummy variables has a mark above 0.5. As a result, we cannot say with any great confidence that the conclusions are reflective of the truth.

5.3 Diagnostic tests

Table 3 presents the outcomes of diagnostic tests that were conducted on the estimated ordered probit model. Each was a Lagrange multiplier (LM)/ score test, except for the test of the parallel regression assumption, which was an approximate likelihoood-ratio test. An excellent description of how to conduct the LM tests for an ordered probit model, using an auxiliary regression, is given in the appendix to Machin and Stewart (1990). The approximate likelihood-ratio test is due to Wolfe and Gould (1998). Faced with this barrage of tests, the ordered probit model could not have fared much worse.

Against the alternative of heteroskedasticity with respect to the variables $\log(age)$, $female$, and $\log(income)$, the null hypothesis that the error term was homoscedastic was unambiguously rejected.[8] Additionally, the error term was found not to be normally distributed. The LM test for the heterogeneity of boundaries, allowing them in the

[8] Note that the use of robust standard errors for the ordered probit model of Table 1 had only a marginal effect on the statistical significance of regressors. It is likely that the heteroskedasticity test is illustrating a problem that cannot be solved by the use of robust standard errors.

alternative to differ between males and females, led to a rejection that they are homogenous. The modified LM version of the RESET test, where omission of the squared and cubed terms of the predicted latent variable, $life\ satisfaction^*$, was tested, led to the conclusion that the model was mis-specified.[9] Finally, the approximate likelihood-ratio test of the parallel regression assumption led to its rejection, thereby sealing the ordered probit model's fate as an inappropriate specification.

5.4. Can the results be salvaged?

In its current form the model presented is inappropriate. As a result, all conclusions drawn above need to be viewed in light of this. Much research is warranted to refine the model, and indeed likely models found elsewhere in the literature, to see if the results can be salvaged. An appropriate direction to take would be to generalise the functional form of the model to accommodate heteroskedasticity and non-normality. For this, the semi-parametric and nonparametric estimators proposed by Chen and Khan (2003) and Stewart (2004) would be suitable.

Another equally important question to ask is whether 'these results' are the ones that need salvaging. One may worry that the presented ordered probit model suffers from unobserved heterogeneity bias. As a robustness check, a fixed effects logit model was estimated using the 11 waves of BHPS data from 1997 to 2009 (excluding the 2001-2002 wave). The results are presented in Appendix E, Table 9. The dummy dependent variable is $very\ satisfied$ (corresponding to categories 6 and 7 of the life satisfaction variable), and the regressors are the same as those from Table 1.

A cursory glance at Table 9 places further doubt on the above analysis of who cares most about others' income. Only the conclusions that males and those on low incomes care more about the income of others are upheld. However, it is at least encouraging that the three variables $\log(income)$, $\log(ref.income)$ and $\log(income) \times \log(ref.income)$ all remain very significant.

6. Conclusion

The aim of this paper was to determine whether certain individuals display a greater sensitivity to increases in the income of others. Estimation of an ordered probit model for self-reported life satisfaction has yielded insights on this. By calculating how the probability that one reports themselves as very satisfied changed as reference income changed, clear results have been provided. In particular, special emphasis is given to two of these: males care more about the income of others than do females, and the poorer in society care more than the richer.

Regrettably the chosen path for the analysis was not fit for purpose. Diagnostic tests have revealed that the ordered probit model that was used was not suitable for explaining variations in life satisfaction. Herein, it is hoped, lays the main contribution of

[9] The most general model with the addition of squared terms for $\log(income)$ and $\log(ref.income)$ still failed the functional form test at the 5% significance level.

this paper. Many studies on subjective well-being have used ordered response models. For example, Clark and Oswald (1996), McBride (2001) and more recently, Kroll (2011). Such specifications are not dissimilar to the one presented in this paper. This paper's contribution is not to discredit these works. It is merely to show the importance of conducting diagnostic tests to check the appropriateness of one's model. It seems that such tests are regularly overlooked and this is undesirable. A model is only as good as its assumptions.

Appendix A. "Equivalised" monthly household income

In conducting the analysis of who cares most about others' income it was necessary to find an income measure that satisfied two conditions:

(i) The measure was reflective of the income one has access to and can derive benefit from.
(ii) The measure was reflective of the income level used by individuals to compare their standard of living with that of others.

Because those who are part of a couple or have children have to share their income, using a measure like usual gross pay per month would not be suitable since it does not satisfy the first condition. Similarly, household income fails the first condition because of the different sizes and compositions of households.

"Equivalising" household income means adjusting it to account for the different sizes and compositions of households. In this presented analysis, the McClements scale (see McClements 1977), which was provided as a variable in the BHPS data set, was used to make the adjustment. The household income of single person households was scaled up and that of multi-person households was scaled down. In this way all incomes were made comparable to that of an adult couple.

It is felt that equivalised household income is the best available measure of income that satisfies the above two conditions.

Appendix B. Variable definitions

Table 4 gives the definitions of those variables present in the headline ordered probit model of Table 1. In addition to this, Table 5 gives definitions of dropped regressors, which were present in the general model from which the headline specification was generated.

Table 4
Variable definitions for the headline ordered probit model

Variable name	Definition
$Life\ satisfaction$	Self-reported satisfaction with life overall, where values 1, 4 and 7 correspond to "not satisfied at all", "not satisfied or dissatisfied" and "completely satisfied", respectively. Other values do not have explicit labels.
$\log(age)$	Natural logarithm of age.
$\log(age)^2$	Squared natural logarithm of age.
$Female$	Dummy variable for females.
$Asian$	Dummy variable for Asians.
$Excellent\ health$ $Fair\ health$ $Poor\ health$	Dummy variables corresponding to self-reported health status, compared with people of one's age, over the 12 months preceding the questionnaire. Note that $poor\ health$ includes those that declared their health "very poor", and those that declared their health was "good" are the default (omitted) category.
$Wales$ $Scotland$	Dummy variables for country of residence. Those living in England are the default category.
$Couple$	Dummy variable for those living as part of a couple.
$Lone\ parent$	Dummy variable for lone parents.
$Sociable$	Dummy variable for those who usually meet friends or relatives, not living with them, at least once a week.
$Child$	Dummy variable for those with a child in their household.
$Above\ GCSE$	Dummy variable for those whose highest academic qualification is above that corresponding to GSCE level. Note that O-level and CSE qualifications were taken to correspond to GCSEs.
$Unemployed$ $Retired$ $Out\ of\ labour\ force$	Dummy variables indicating one's self-reported labour force status. Note that $out\ of\ labour\ force$ includes everyone who did not say they were employed, unemployed or a full-time student. The default (omitted) category is those in employment or full-time education.
$Duration^2$	Squared duration, in years, of current labour force status.
$Unemployed \times duration^2$ $Retired \times duration^2$	Multiplicative dummies between variables already defined.
$Usual\ working\ hours$	Usual number of hours worked in a week, which includes overtime. Note this variable has been demeaned.
$\log(income)$	Natural logarithm of equivalised monthly household income (in pounds). (See also Appendix A)
$\log(ref.income)$	Natural logarithm of 'reference' equivalised monthly household income (in pounds). (See also Appendix A)
$\log(income) \times \log(ref.income)$	Interactive variable between variables already defined.
$Female \times \log(income)$	Multiplicative dummy between variables already defined.

Variable name	Definition
$(Age \geq 50) \times \log(income)$	Multiplicative dummy. $\log(income)$ is already defined, whilst $(age \geq 50)$ is a dummy variable for those whose age is 50 years or over.
$Asian \times \log(income)$ $Female \times \log(ref.income)$ $(Age \geq 50) \times \log(ref.income)$ $Child \times \log(ref.income)$ $Wales \times \log(ref.income)$ $Scotland \times \log(ref.income)$	Multiplicative dummies between variables already defined.
$Boundary\ point\ x$	If the underlying 'latent' satisfaction variable, $life\ satisfaction^{*}$, is below this boundary then the dependent variable $life\ satisfaction$ takes a value of x or below.

Table 5
Variable definitions for regressors dropped from the general ordered probit model

Variable name	Definition
$Other\ ethnicity$	Dummy variable for those whose ethnicity was not white or Asian.
$One\ child$ $Two\ children$ $Three\ children$ $Four\ or\ more\ children$	Dummy variables for the number of children in the household.
$Higher\ degree$ $First\ degree$ $Higher\ ed.\ diploma$ $A-level$ $No\ qualification$	Dummy variables for one's highest academic qualification. Those with a qualification corresponding to GCSE level were the default category in the general model.
$Student$	Dummy variable for full-time students.
$Duration$	Duration, in years, of current labour force status.
$Unemployed \times duration$ $Retired \times duration$ $Student \times duration$ $Out\ of\ labour\ force \times duration$ $Student \times duration^2$ $Out\ of\ labour\ force \times duration^2$	Multiplicative dummies between variables already defined.
$Usual\ working\ hours^2$	Squared usual number of hours worked in a week (demeaned), which includes overtime.
$Sociable \times \log(income)$	Multiplicative dummy between variables already defined.
$(16 \leq age < 30) \times \log(income)$ $(30 \leq age < 50) \times \log(income)$	Multiplicative dummies. $\log(income)$ is already defined, whilst $(16 \leq age < 30)$ and $(30 \leq age < 50)$ are dummy variables for those whose age satisfies the constraint.

Variable name	Definition
$Sociable \times \log(income)$	Multiplicative dummies between variables already defined.
$Higher\ degree \times \log(income)$	
$First\ degree \times \log(income)$	
$Higher\ ed.\ diploma \times \log(income)$	
$A - level \times \log(income)$	
$No\ qualification \times \log(income)$	
$Child \times \log(income)$	
$Other\ ethnicity \times \log(income)$	
$Wales \times \log(income)$	
$Scotland \times \log(income)$	
$Sociable \times \log(ref.income)$	
$(16 \leq Age < 30) \times \log(ref.income)$	
$(30 \leq Age < 50) \times \log(ref.income)$	
$Couple \times \log(ref.income)$	
$Higher\ degree \times \log(ref.income)$	
$First\ degree \times \log(ref.income)$	
$Higher\ ed.\ diploma \times \log(ref.income)$	
$A - level \times \log(ref.income)$	
$No\ qualification \times \log(ref.income)$	
$Asian \times \log(ref.income)$	
$Other\ ethnicity \times \log(ref.income)$	

Appendix C. Summary statistics

Table 6
Sample sizes and the mean of $life\ satisfaction$ for each wave of the BHPS used in this paper

	Sample size	Mean of $life\ satisfaction$
1997-1998	9,314	5.229
1998-1999	9,084	5.309
1999-2000	13,012	5.209
2000-2001	12,985	5.171
2002-2003	11,220	5.223
2003-2004	10,902	5.259
2004-2005	10,578	5.210
2005-2006	10,486	5.136
2006-2007	10,421	5.191
2007-2008	10,049	5.210
2008-2009	9,613	5.214

Table 7
Summary statistics (2007-2008)

Variable	Mean	Standard deviation	Correlation with $life\ satisfaction$	P-value
$Life\ satisfaction$	5.210	1.262	–	–
Explanatory variables from the 'headline' ordered probit model				
$\log(age)$	3.748	0.452	0.035	0.000
$\log(age)^2$	14.255	3.303	0.041	0.000
$Female$	0.564	0.496	−0.016	0.114
$Asian$	0.016	0.127	−0.040	0.000
$Excellent\ health$	0.237	0.426	0.216	0.000
$Fair\ health$	0.210	0.408	−0.152	0.000
$Poor\ health$	0.092	0.289	−0.272	0.000
$Wales$	0.207	0.406	−0.003	0.806
$Scotland$	0.207	0.405	0.008	0.398
$Couple$	0.729	0.445	0.128	0.000
$Lone\ parent$	0.047	0.212	−0.085	0.000
$Sociable$	0.879	0.326	0.069	0.000
$Child$	0.315	0.465	−0.030	0.003
$Above\ GCSE$	0.430	0.495	0.006	0.555
$Unemployed$	0.027	0.163	−0.095	0.000
$Retired$	0.240	0.427	0.115	0.000
$Out\ of\ labour\ force$	0.107	0.309	−0.176	0.000
$Duration^2$	139.231	343.662	0.019	0.055
$Usual\ working\ hours$	−0.147	9.630	−0.024	0.017
$\log(income)$	7.691	0.646	0.080	0.000
$\log(ref.income)$	7.847	0.212	−0.095	0.000
Dropped explanatory variables from the general ordered probit model				
$Other\ ethnicity$	0.014	0.116	−0.005	0.642
$One\ child$	0.153	0.360	−0.013	0.183
$Two\ children$	0.121	0.326	−0.016	0.109
$Three\ children$	0.032	0.176	−0.013	0.179
$Four\ or\ more\ children$	0.010	0.098	−0.015	0.137
$Higher\ degree$	0.029	0.167	−0.002	0.858
$First\ degree$	0.122	0.327	0.013	0.198
$Higher\ ed.diploma$	0.074	0.262	0.029	0.004
$A-level$	0.206	0.405	−0.021	0.035
$No\ qualification$	0.257	0.437	−0.009	0.390
$Student$	0.063	0.242	0.029	0.003
$Duration$	7.737	8.910	0.021	0.032
$Usual\ working\ hours^2$	92.740	250.505	0.013	0.201

Number of observations: 10,049
Note: "P-value" is the probability of observing the sample correlation under the null hypothesis that the true correlation is zero. It is obtained from a t-test of the null hypothesis and represents the significance of a correlation.

Appendix D. For whom is the income effect more important?

The estimated headline ordered probit model shows that the 'happiness gain' from additional income varies with gender, age, ethnicity and reference income level. Table 8 reports the estimated marginal effects of $\log(income)$ on $P(very\ satisfied = 1)$ across groups defined by these characteristics. As was done in the analysis of relative income effects, two marginal effects are reported for each group, the "descriptive" marginal effect and the "controlled" marginal effect.

Table 8
Marginal effects of $\log(income)$ on $P(very\ satisfied = 1)$ evaluated for different groups

	"Descriptive" marginal effect	"Controlled" marginal effect
Group		
All individuals	0.020	0.020
Males	0.012	0.0041
Females	0.027	0.033
Those aged 16-49	0.039	0.027
Those aged 50 or older	−0.0063	0.011
Non-Asians	0.022	0.022
Asians	−0.064	−0.081
Those with a reference income in 1st quarter	−0.034	−0.0050
Those with a reference income in 2nd quarter	0.020	0.010
Those with a reference income in 3rd quarter	0.055	0.0071
Those with a reference income in 4th quarter	0.041	0.049

The first point to note upon looking at Table 8 is that for all groups, the effect of an income increase on the probability of being very satisfied is extremely small. Indeed, for the representative individual whose income is about £2,188, a 10% rise in this (extra £219) increases the probability by just 0.2%.

From the descriptive marginal effects it can be seen that the representative female, individual aged 16-49 years old and non-Asian are those who experience the larger increases in the probability of being very satisfied. Dividing sample reference incomes into 25 percentile ranges (stated as quarters in Table 2) we again see that the 'return' to income rises with reference income.

The controlled marginal effects tell a similar story, though notice that the marginal effect for those aged 50 or older has switched sign from the descriptive effect. On the basis of these results, it is concluded that with respect to income, the groups that 'care'

most are females, those younger than 50 years old, those who are not Asian and those who have a high reference income.

Appendix E. Estimation results for the fixed effects logit model

Table 9
Fixed effects logit model for declaring oneself very satisfied (1997-2009)*

	Coefficient	Standard error	P-value
Very satisfied			
Year dummies (10)	–	–	–
$\log(age)$	−7.247	2.442	0.003
$\log(age)^2$	1.340	0.468	0.004
$Female$	–	–	–
$Asian$	–	–	–
$Excellent\ health$	0.381	0.027	0.000
$Fair\ health$	−0.520	0.026	0.000
$Poor\ health$	−0.971	0.043	0.000
$Wales$	1.292	1.517	0.394
$Scotland$	0.180	1.309	0.891
$Couple$	0.423	0.042	0.000
$Lone\ parent$	0.030	0.070	0.664
$Sociable$	0.113	0.030	0.000
$Child$	2.370	1.136	0.037
$Above\ GCSE$	0.036	0.076	0.635
$Unemployed$	−0.404	0.061	0.000
$Retired$	0.323	0.062	0.000
$Out\ of\ labour\ force$	−0.078	0.047	0.101
$Duration^2$	0.0001	0.0001	0.449
$Unemployed \times duration^2$	0.0010	0.0005	0.041
$Retired \times duration^2$	−0.0002	0.0001	0.002
$Usual\ working\ hours$	−0.0053	0.0013	0.000
$\log(income)$	−2.662	0.609	0.000
$\log(ref.income)$	−2.722	0.609	0.000
$\log(income) \times \log(ref.income)$	0.358	0.079	0.000
$Female \times \log(income)$	−0.011	0.042	0.787
$(Age \geq 50) \times \log(income)$	−0.010	0.041	0.809
$Asian \times \log(income)$	−0.192	0.123	0.120
$Female \times \log(ref.income)$	0.379	0.136	0.005
$(Age \geq 50) \times \log(ref.income)$	0.032	0.042	0.449
$Child \times \log(ref.income)$	−0.305	0.146	0.037
$Wales \times \log(ref.income)$	−0.184	0.198	0.353
$Scotland \times \log(ref.income)$	−0.078	0.167	0.640

Number of observations: 75,477 Excluding the 2001-2002 wave*
Number of individuals: 10,309
Log-likelihood: −29,676.354
Pseudo-R^2: 0.029

References

Blanchflower, D.G. and Oswald, A.J. (2004). 'Well-being over time in Britain and the USA', *Journal of Public Economics*, vol. 88(7-8), pp. 1359-86.

Boskin, M. J. and Sheshinski, E. (1978). 'Optimal redistributive taxation when individual welfare depends upon relative income', *The Quarterly Journal of Economics*, vol. 92(4), pp. 589-601.

Chen, S. and Khan, S. (2003). 'Rates of convergence for estimating regression coefficients in heteroskedastic discrete response models', *Journal of Econometrics*, vol. 117(2), pp. 245-78.

Clark, A.E., Frijters, P. and Shields, M.A. (2008). 'Relative income, happiness, and utility: an explanation for the Easterlin paradox and other puzzles', *Journal of Economic Literature*, vol. 46(1), pp. 95-144.

Clark, A.E. and Oswald, A.J. (1994). 'Unhappiness and unemployment', *The Economic Journal*, vol. 104(424), pp. 648-59.

Clark, A.E. and Oswald, A.J. (1996). 'Satisfaction and comparison income', *Journal of Public Economics*, vol. 61(3), pp. 359-81.

Clark, A.E. and Oswald, A.J. (2002). 'A simple statistical method for measuring how life events affect happiness', *International Journal of Epidemiology*, vol. 31(6), pp. 1139-44.

Drakopoulos, S.A. (2011). 'The neglect of comparison income: an historical perspective', *The European Journal of the History of Economic Thought*, vol. 18(3), pp. 441-64.

Duesenberry, J.S. (1949). *Income, Savings and the Theory of Consumer Behavior*, Cambridge, MA: Harvard University Press.

Easterlin, R.A. (1974). 'Does economic growth improve the human lot? Some empirical evidence', in (P.A. David and M.W. Reder, eds.), *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*, pp. 89-125, New York and London: Academic Press.

Ferrer-i-Carbonell, A. (2005). 'Income and well-being: an empirical analysis of the comparison income effect', *Journal of Public Economics*, vol. 89(5-6), pp. 997-1019.

Festinger, L. (1954). 'A theory of social comparison processes', *Human Relations*, vol. 7(2), pp. 117-40.

Frey, B.S. and Stutzer, A. (2000). 'Happiness, economy and institutions', *The Economic Journal*, vol. 110(466), pp. 918-38.

Gerdtham, U. and Johannesson, M. (2001). 'The relationship between happiness, health, and socio-economic factors: results based on Swedish microdata', *The Journal of Socio-Economics*, vol. 30(6), pp. 553-7.

Hirschman, A.O. and Rothschild, M. (1973). 'The changing tolerance for income inequality in the course of economic development', *The Quartely Journal of Economics*, vol. 87(4), pp. 544-66.

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. London: Macmillan.

Kroll, C. (2011). 'Different things make different people happy: examining social capital and subjective well-being by gender and parental status', *Social Indicators Research*, vol. 104(1), pp. 157-77.

Leyden, K.M., Goldberg, A. and Michelbach, P. (2011). 'Understanding the pursuit of happiness in ten major cities', vol. 47(6), pp. 861-88.

Luttmer, E.F.P. (2005). 'Neighbors as negatives: relative earnings and well-being', *The Quartely Journal of Economics*, vol. 120(3), pp. 963-1002.

Machin, S.J. and Stewart, M.B. (1990). 'Unions and the financial performance of British private sector establishments', *Journal of Applied Econometrics*, vol. 5(4), pp. 327-50.

McBride, M. (2001). 'Relative-income effects on subjective well-being in the cross-section', *Journal of Economic Behaviour and Organisation*, vol. 45(3), pp. 251-78.

McClements, L.D. (1977). 'Equivalence scales for children', *Journal of Public Economics*, vol. 8(2), pp. 191-210.

Pérez-Asenjo, E. (2011). 'If happiness is relative, against whom do we compare ourselves? Implications for labour supply', *Journal of Population Economics*, vol. 24(4), pp. 1411-42.

Runciman, W.G. (1966). *Relative Deprivation and Social Justice*, London: Routledge & Kegan Paul.

Senik, C. (2004). 'When information dominates comparison: learning from Russian subjective panel data', *Journal of Public Economics*, vol. 88(9-10), pp. 2099-123.

Stewart, M.B. (2004). 'Semi-nonparametric estimation of extended ordered probit models', *The Stata Journal*, vol. 4(1), pp. 27-39.

Veblen, T. (1899). *The Theory of the Leisure Class*, New York: Macmillan.

Whately, R. (1831). *Introductory Lectures on Political-Economy: Being Part of a Course Delivered in Easter Term, MDCCCXXXI*, London: B. Fellowes.

Winkelmann, L. and Winkelmann, R. (1998). 'Why are the unemployed so unhappy? Evidence from panel data', *Economica*, vol. 65(257), pp. 1-15.

Wolfe, R. and Gould, W. (1998). 'An approximate likelihood-ratio test for ordinal response models', *Stata Technical Bulletin*, vol. 7(42), pp. 24-27.