Income Rank and Upward Comparisons

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Abstract

Many studies have argued that relative income predicts individual well-being. More recently, it has been suggested that the relative rank of an individual's income, rather than how that income compares to a mean or reference income, is important. Here the relative rank hypothesis is examined along with the additional hypothesis that individuals compare their incomes predominantly with those of slightly higher earners. A study of over 12,000 British adults using the British Household Panel Survey (a) confirms the importance of rank and (b) finds evidence that individuals compare upwards and to those most similar. This paper appears to be the first to show in fixed effect well-being equations that the influence of rank is more important than the influence of relative pay.

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Developed countries have achieved substantial increases in national income over the last 50 years, yet this increased wealth has not generally been accompanied by corresponding increases in average well-being. Within these countries, however, an individual's income and well-being are positively correlated (Easterlin, 1974, 1995). This observation suggests that well-being is influenced not by an individual's absolute level of income but instead by their level of income compared to that of their peers (Duesenberry, 1949). Discussion within economics of the individual's concern with their relative standing can be traced as far back as Veblen (1899), Marx (1952) and Smith (1976).

Comparing oneself to others is a complex process. Comparison might take place in order to gain information about how well one is doing in life (Festinger, 1954), or to learn how one's performance can be improved (Wilson & Benner, 1971). Comparisons undertaken for either reason can be both beneficial and detrimental to the individual's life (Buunk et al., 1990). The investigation into relative effects and comparison in economics has largely been guided by the use of subjective well-being data. Such data act as a proxy for an individual's utility and have been used to show that the presence of high earning individuals, either in the workplace or neighbourhood, is harmful to well-being (Blanchflower & Oswald, 2004; Clark & Oswald, 1996; Ferrer-i-Carbonell, 2005; Luttmer, 2005). Almost all studies have used what is termed the mean reference group income approach. In this approach the average income of a reference group, those that the individual might typically compare to, is used as a proxy for the level of consumption that the individual evaluates their own consumption against. This average income, used as an explanatory variable, negatively and significantly predicts a variety of subjective well-being variables. The coefficient on the average income variable is typically

found to be equal in magnitude but opposite in sign to the coefficient on the individual's own income. Such results appear consistent with the relative income hypothesis.

However, the general pattern of results to date is consistent with a number of different types of comparison. First, upward and downward comparisons may have different effects. It is commonly suggested that comparison is asymmetric, being made mostly to those above oneself (Duesenberry, 1949). Upward comparison appears detrimental to the individual's well-being but may also bring benefits by demonstrating ways in which the individual could improve their life (Buunk et al., 1990). It has been suggested, however, that upward comparison can take place to indicate how to improve life without necessarily damaging the individual's well-being (Taylor & Lobel, 1989). Two studies have found evidence for upward comparison within the mean reference group framework. Instead of using the mean income of an individual's reference group Blanchflower & Oswald (2004) use the reference group quintile incomes as comparison income levels. They find that the strongest explanation of life satisfaction comes when the highest quintile income level is used in estimation. Ferrer-i-Carbonell (2005) finds that poorer than average individuals in West Germany are adversely affected by the incomes of those around them, whilst richer than average individuals are not. However, neither approach reveals the precise nature of the individual's upward comparisons.

A second issue concerns the nature of the relative comparison that takes place, whether upwards or downwards. Alternatives to the mean reference group approach, which has been predominant within economics, can be seen by consideration of parallel theoretical developments within psychology. The mean reference group income approach is closely related to Helson's (1964) Adaptation Level Theory

(ALT). ALT was proposed to model how individuals subjectively assess an objective stimulus within the context of a set of other stimuli. A typical experiment scenario might require an individual to assess how subjectively heavy a weight feels in comparison to other weights, where 1 = "very light" and 10 = "very heavy". The model is simple and proposes that an assessment is made by intuitively making a comparison with a weighted mean of the background stimuli; in the example above, an average weight in the context of the other weights might be given a 5 or a 6. If the set of stimuli and mean were to increase so should the comparison level to which an assessment would be made to. The previously average weight would perhaps now be given a 3 or 4. ALT predicts that the individual's evaluation of a given stimulus will therefore adapt to the context of comparison. There are clear parallels with the methodology employed in the relative income studies: The stimulus under evaluation is analogous to income and the subjective assessment is analogous to rated satisfaction with pay or life.

However within psychology the data better support an alternative model of how individuals make subjective assessments: Range-Frequency Theory (RFT) (e.g. Parducci, 1965; 1995). RFT suggests that an assessment is given by a weighting of the stimulus' rank (frequency) and cardinal position relative to the highest and lowest values (range) within the set of stimuli. One issue with ALT is that two differently distributed sets of stimuli can have identical means. The distribution is not considered. An assessment under RFT, however, is modelled on a uniformly distributed rank but anchored by distribution extremes. RFT has been useful in modelling subjective assessments in an array of stimuli but importantly for economics it has been found to help model assessments of both prices (Niedrich et al., 2001; Qian & Brown, 2007) and incomes (Brown et al., 2008; Mellers, 1986). RFT has also been shown to be

applicable to social comparisons (R. H. Smith et al., 1989). Outside of experimental conditions the range and skew of an income distribution, as predicted by RFT, affect the average happiness level across communities (Hagerty, 2000). Thus RFT motivates the hypothesis that the ranked position of an income may independently contribute to the judgements of satisfaction associated with it.

A further theoretical problem with relative income studies is the explicit assumption of reference groups. The assumption is necessary since it allows the comparison variable to vary across individuals but this assumption, however, is not guided by any theory. A more plausible approach is that comparison is made to those most similar to an individual and to some extent, though much less, with those dissimilar (Brown et al., 2008; Law & Wong, 1998). We approach this issue below with a model that allows the degree of similarity-bias in the comparisons to be parameterised and estimated.

This paper focuses solely on the rank (frequency) aspect of RFT. There are fixed amounts of rank in society – only one individual can be the highest earner. Relative income studies suggest that if an individual's own income and comparison level increase in equal proportions the individual is no more satisfied. Similarly, if the individual's income rises at the same rate as others in the same reference group the individual's rank, and therefore satisfaction, will not change. Conceptually the individual's rank can be viewed as the result of a series of binary comparisons. The individual compares to every other person in their reference group and carries out a simple binary assessment of whether each individual is in either a better or worse situation than himself (Stewart et al., 2006). Those assigned "worse than" (i-1) are compared to the total number within the reference group (n-1). The ratio gives the

individual a rank (R_i) normalised between 0 and 1, representing the lowest and highest income earners respectively:

$$(1)\ R_i = \frac{i-1}{n-1}$$

Further, and importantly for examining upward comparison, rank can be meaningfully adapted in a way such that higher ranked others can have greater impact on the individual's assessment of their own income than those below. This can be referred to as the individual's subjective income rank (SR).

$$(2)\ SR_i = 0.5 + \frac{(i-1) - \eta(n-i)}{2\left[(i-1) + \eta(n-i)\right]} \qquad \text{(Qian \& Brown, 2007)}$$

Here, η captures the degree of upward comparison. If η = 1, equation 2 reverts to equation 1. When η > 1, individuals earning more than i influence perception of the individual's rank more than those earning less. If η = 2, for example, the number of individuals that earn more than i matter twice as much as those that earn less.

Moreover income rank has psychological plausibility over and above that of the mean reference group income approach. Individuals are likely to have good idea of where they rank in society, consistent with the multiple binary assessment approach. It is seems less likely that all individuals compare their own income directly to a single reference point, such as the mean. A single reference point comparison would first require an explicit calculation by each individual of their reference group mean; a concern noted by Duesenberry (1949) in a footnote to chapter 3. In any case evidence suggests that people are much better at discerning whether one stimulus is different from another than the actual magnitude that separates them (Stewart et al., 2005). It is also further argued that humans have evolved to think instinctively in terms of natural frequencies (Gigerenzer, 2002) and it also seems clear that rank is important for non-humans, particularly monkeys (Sapolsky, 2004).

Determination of the amount of upward comparison that takes place would have important implications for issues such as wealth distribution. Evidence of upward comparison would cast doubt on the equity-efficiency trade off predicted by utility models that depend solely on the individual's absolute level of income. As discussed by Hollander (2001), evidence for upward comparison would suggests that increasing the wealth of those lower in the income distribution will not have huge negative effects on those that are higher in the distribution. Essentially, wealth redistribution might not reduce individual work incentives to as large an extent as is typically believed.

In this paper a large data set analysis is carried out using income rank in place of the individual's level of income. The possibility that income rank could be a miss-specification of the more commonly used individual's income relative to the mean of their reference group is also checked. This paper, however, does not make the explicit assumption of reference groups in the main analysis. Instead the concept that there is a graded comparison with those most similar to the individual is explored. The subjective income rank variable is then used to investigate an upward graded comparison. The evidence presented suggests that income rank is important and individuals compare upwards and with those most similar.

2. Methodology

The approach used here is based on estimating equation 3, which includes the subjective income rank variable:

(3) $LifeSatisfaction_{it} = \alpha + \mu_i + D_{it} + \beta_1 X_{it} + \beta_2 \log y_{it} + \beta_3 SR_{it} + \varepsilon_{it}$

Here, i refers to the individual and t refers to the time period at which the observation was made. X corresponds to a series of personal characteristics used as controls and D includes time and regional dummies. Equation 3 can be initially estimated by pooling cross-sectional observations and carrying out an OLS regression. However, with multiple observations of individuals across time it is possible to use fixed effects analysis. This allows any unobservable characteristics, μ, that correlate with both income and satisfaction to also be controlled for. It is assumed that μ_i is constant within individuals across time and non-random. Given this assumption, the time variation in life satisfaction within each cross-sectional observation is used in a regression.

By applying appropriate restrictions to estimations based around equation 3 the influence on life satisfaction of both income variables, logarithm of absolute income (log y) and subjective income rank (SR), can be compared using a number of comparative statistics including standardised coefficients, sum of squared residuals and t-statistics.

Construction of the individual's subjective income rank variable is crucial and is constructed for each individual at a given time period by comparing to all other individuals within that time period. This is best described using equation 4:

$$(4)\quad SR_{it} = 0.5 + \frac{\sum_{j=1}^{i-1}(R_{it} - R_{jt})^{\gamma} - \eta \sum_{j=i+1}^{N}(R_{jt} - R_{it})^{\gamma}}{2(\sum_{j=1}^{i-1}(R_{it} - R_{jt})^{\gamma} + \eta \sum_{j=i+1}^{N}(R_{jt} - R_{it})^{\gamma})}$$

Equation 4 is similar to equation 2 but now includes a similarity parameter, γ. This parameter enters in such a way that the individual's subjective rank depends on how close in rank others are to them. The parameter allows for a graded comparison. The use of both upward comparison and similarity parameters ensures that all other j

individuals' can have a differential impact on subjective income rank. The impact depends upon their position in the income distribution relative to the individual's income. For example, when $\gamma = 0$ (and $\eta = 1$) equation 4 reverts to equation 1; all other individuals equally influence each individual's subjective rank. However, when $\gamma < 0$ (or $\gamma > 0$), individuals that are closer to (or further away from) the individual's income have a greater impact on the individual's subjective rank. If $\gamma = 1$, for instance, the actual difference in rank determines the weight given to each individual in the subjective income rank's construction. Here, an individual ten positions away would be weighted ten times more than another who is only one position away from a given individual. Individuals with income furthest away matter the most. If $\gamma = -1$, all other individuals matter according to the reciprocal of the actual difference in rank away from the individual. Now the individual ten positions away matters ten times less than the individual just one position away when subjective income rank is constructed. Incomes furthest away therefore matter the least (Brown et al., 2008).

The use of the similarity parameter not only avoids the problem of explicitly specifying reference groups but also enables a test of the hypothesis that individuals compare to those only slightly better than themselves. The investigation of upward and similarity comparison is made by constructing subjective rank variables using equation 4 for each wave using fixed values of both η and γ. It can then be observed whether specific values for either significantly improve the explanation of life satisfaction.

Data used to test income rank's explanation of life satisfaction comes from the British Household Panel Survey (BHPS), which is a representative longitudinal sample of British households. For the analysis this paper takes adults from seven waves, from 1997 to 2004, that provide an answer to a life satisfaction question. 2001

is excluded as it does not include a life satisfaction question. There are many variables that correlate with both life satisfaction and income, so these are controlled for. The controls used are: age, gender, education, marital status, children, housing ownership, labour force status and disabilities. To allow a comparison across the pooled OLS and fixed effects models individuals that have at least two time period observations are included. This gives a sample size of 86679 with summary statistics displayed in Table 1.

The subjective well-being variable used, as briefly addressed earlier, is life satisfaction. It acts as the dependent variable and proxies for the individual's utility. The validity and reliability of such subjective well-being measures have been discussed extensively (see Fordyce, 1988; Lepper, 1998; Lucas et al., 1996; Sandvik et al., 1993; Veenhoven, 1993). Life satisfaction is the respondent's answer on a 1 to 7 scale of the question: "how dissatisfied or satisfied are you with your life overall?" This satisfaction variable is an assumed cardinal measure with 6 the most commonly given answer and a median of 5, implying some negative skew. Income is the key independent variable. All individuals within the sample year, whether they answer the life satisfaction question or not, are used to construct the subjective rank of a given individual. First, however, all incomes are adjusted to account for the cost of living differences across regions within the United Kingdom and the number of individuals in the household. The income variable is adjusted by dividing total household income by both the regional living costs for 2004 and a weighted household size, where adults count as 1 unit and each child as a half. The use of a regionally deflated household income adjusted for household size makes individuals more comparable. Those with children, or those that may stay at home in the presence of a big income earner, will have comparable spending powers.

3. Results

Table 2 begins by comparing the individual's income (logarithmically transformed) with an income rank variable with no upward or similarity comparison ($\eta = 1, \gamma = 0$). The comparison takes place controlling for observable characteristics and by first pooling the cross-sectional observations (columns 1-3) and then further controlling for unobservable fixed effects (columns 4-6). The coefficients on the control variables are typical of the literature. Children, disabilities and unemployment enter negatively; marriage and living in a house that one owns enter favourably. A less typical, yet interesting finding, is that age enters in the 3rd polynomial. Using the pooled model coefficients (column 3) figure 1 shows how life satisfaction changes over the life cycle. Life satisfaction minimises in the late 30s, but the inclusion of the 3rd polynomial of age shows that satisfaction begins to turn again in later years. The statistical technique used is important and controlling for unobserved heterogeneity influences a number of results. The benefits to being married, for example, reduce to about a third, whilst some variables, such as home ownership and education, now have no effect. This suggests that there exists unobservable heterogeneity across individuals that drive them to be both more satisfied with life and have healthy marriages. All regressions include both year and regional dummies which are jointly significant.

Concentrating solely on the income variables the OLS regressions (Columns 1-3) show that income rank variable enters more robustly than the logarithm of absolute income. Income rank on its own explains significantly more of the overall

variation (R^2) in life satisfaction and when entered alongside the absolute income variable, it completely dominates. Applying the more rigorous fixed effects method (Columns 4-6) the results follow a similar pattern, although perhaps to a lesser degree. Rank dominates with a higher t-statistic and explains more of the time variation (within R-Squared) in life satisfaction.

In all instances the coefficient on income is positive and well defined. This finding adds further to the evidence that those with more money have a greater satisfaction with life. Little discussed in the literature, however, is income's typically low explanatory power. In the pooled regressions the standardised beta is little under 0.07 using the absolute income variable so it explains less than half a percent of the variation in life satisfaction. If income were doubled then life satisfaction is estimated to be approximately 0.13 points higher. In context of some of the controls, income would need to more than quadruple to get the same associated benefits as a healthy marriage or reduce by a factor of at least 60 to achieve the reductions in life satisfaction associated with a disability.

Turning to rank it is observed that the overall explanation improves somewhat. The standardised coefficient is still small (0.08) but in terms of overall explanatory power this makes it 40% higher than that given by absolute income. An increase in earning power from lowest to highest, which in this sample equates to an increase of approximately £485,000, is associated with an increase in life satisfaction of around 0.37 points. Importantly, however, the use of the rank variable also captures the fact that going from say £0 to £100,000 is associated with a very similar life satisfaction increase. In terms of rank there is very little difference between earning £100,000 and being the highest earner, which neatly displays diminishing returns to income. A healthy marriage is associated with approximately the same life satisfaction increase

achieved from going from the lowest earner to the highest. It seems now that no loss in rank equates to the losses in satisfaction from being disabled. Once unobservable fixed effects are considered the standardised coefficients on the income variables diminish by as much as a third. This reduction in coefficient size, however, is most severe for absolute income.

It is possible that income rank is a mis-specification of the individual's income relative to those around him. This alternative, along with the possibility that income rank is non-linear, is tested with fixed effect satisfaction equations in table 3. In column 1 the logarithm of the individual's mean regional income is used in estimation. This income variable does not appear important within this sample. In column 2 the log of absolute income relative to this mean regional income is used. The specification in column 2 tests whether the negative effect from a rise in our neighbours income is equal but opposite to that of a rise in personal income. This hypothesis cannot be rejected but importantly it does not have as strong an explanation as seen for income rank in table 2. According to the data there is a pure relative effect and this is best described using income rank.

The next 2 columns of table 3 test for non-linearities in the rank variable. The logarithm and the quadratic are used respectively. Whilst the logarithm of income rank is significant the overall explanation offered is less than income rank in its non-logarithmic form. The quadratic on the other hand does not enter robustly at all. Both coefficients are positive so the explanatory power and significance of each individually is significantly reduced.

The next aspect to consider is whether there is any improvement to the explanation once upward comparison or similarity effects are accounted for. Tables 4 and 5 give a selection of results that consider different amounts of upward comparison

(η) and similarity (γ) respectively. Across each wave the rank variable is constructed with the same values for η and γ and compared to the income rank variable (η = 1, γ = 0) previously seen. It can then be observed whether an adjustment to the degree of upward comparison or similarity significantly improves the explanation of life satisfaction. Table 4 shows a range of values for η, from 1.25 up to 2.25, rising in 0.25 increments. The greatest improvement occurs at around η = 1.75 under the pooled OLS but slightly higher around η = 2 for the fixed effects. A careful look at the change in sum of squared residuals indicates that their inclusion is warranted. The F-statistic indicates that the change is significant at the 1% level between at least 1.25 and 1.75 for the pooled OLS model. Using the fixed effects model and changes to the sum of squared residuals from the within variation the evidence is not forthcoming. Although showing some improvement the change is not significant. It should be noted that the improvement to the sum of square residuals in all cases is in a generally smooth u-shape, and the minimum, between 1.25 and 2, appears to be a global minimum.

Table 5 shows a range of values for γ, from -0.4 up to -0.1, rising in 0.1 increments. The greatest improvement occurs at around γ = -0.3 under the pooled OLS but less at γ = -0.1 using fixed effects. Examination of the change in sum of squared residuals indicates that its inclusion is again warranted for the pooled OLS model. The F-statistic indicates that the change is significant at the 5% level for -0.3 and -0.2. The explanation of the within variation again shows no significant improvements. The sums of squared residuals are minimised globally for these values of γ.

The results from the pooled model confirm Duesenberry's (1949) original claim that comparison is primarily upwards. People seem to compare to others that are

not only better than themselves but with those that are only slightly better. There is graded comparison. A value for η of 1.75 suggests that people compare to those above themselves one and a three-quarter times more than those below. A value for γ of -0.2 suggests that someone immediately next to an individual in the income distribution is compared to twice as much as someone 30 positions away. As γ becomes more negative those closer are compared to even more. If γ were -0.3 the individual compares to those immediately next to him twice as much as those only 10 positions away. In terms of the controls no income change can fully compensate for a disability but a healthy marriage is equivalent to going from say the lowest earning individual to around the 3rd highest out of ten.

Using the amended income rank variable larger coefficients emerge on the income variable. Income rank seems a preferable variable, but particularly so when incorporating both upward and similarity comparison. One important observation is that the evidence for both upward comparison and similarity is not seen using a fixed effects model. This finding suggests that there are unobservable individual characteristics that cause individuals to make comparisons with slightly better others yet also have a higher satisfaction with life. Falk & Knell's (2004) conclusion that those with greater ability aspire higher is perhaps conducive with this finding.

Income rank is also found to offer a good explanation of life satisfaction across different groups of individuals by gender, education and across most age groups. There is clear evidence that the individual's income rank is important. However, the results so far have not considered simultaneity. It is likely that life satisfaction and income are simultaneously determined. To overcome this problem income rank needs to be instrumented with a variable that correlates with income but not life satisfaction. Oswald & Powdthavee (2008) make use of a variable in the

BHPS that indicates whether the interviewer was shown a payslip to confirm the income stated. This paper similarly makes use of whether the payslip was observed as an instrument for income. The results for the two-stage regression are shown in table 6. The first column gives the results of a pooled OLS regression on income rank. The instrument correlates positively with income. Based on this first regression a predicted value for income rank is constructed and used in both pooled OLS and fixed effect regressions as observed in column 2 and 3 respectively. An instrumented income rank variable is significant. Interestingly the coefficients on income rank nearly treble under both statistical techniques and suggests that more satisfied individuals need to work less to achieve the same level of income as others. Not fully considering simultaneity produces an underestimation of the positive effect money truly has on life satisfaction. The standardised coefficient increases to 0.13 and income rank now explains 1.7% of the overall variation in life satisfaction.

4. Conclusions

Income rank offers an explanation of life satisfaction above and beyond that of the logarithm of income.[1] Rank is also particularly useful for a discussion of upward comparison effects when considering the relative income hypothesis. Duesenberry's (1949) original exposition of relative considerations suggested that comparison was primarily upwards. Upward comparison is not only confirmed here but it is also shown that higher incomes influence the individual's well-being up to twice as much as lower incomes. Evidence that comparison is graded is also offered. Although the individual is likely to compare to a number of other individuals those closest in

[1] Brown and Moore (2007) also found an effect of rank, but did not examine asymmetry between upwards and downward comparisons and did not apply the more conservative fixed effects analysis adopted here.

income are compared to the most. The introduction of the upward comparison and similarity parameters significantly change the explanation of life satisfaction when pooling cross-sectional observations. The evidence, however, is not so strong using fixed effects analysis. No significant improvement to the explanation of the time-variation in life satisfaction was seen in those analyses, suggesting that both upward comparison and similarity effects are driven primarily by unobservable heterogeneity within individuals.

The findings in this paper are important for both economics and the literature on social comparisons. In economics individual comparison is important for the topic of redistribution of wealth. Upward comparison suggests that there will not be a straightforward equity-efficiency trade-off. Instead substantial welfare gains can be achieved without the reduction in incentives. Coupled with this it appears that upward comparison is a fixed personality characteristic within the individual so will not be influenced by taxation. This upward comparison characteristic is doubly important for the social comparison literature and adds further to the evidence that comparison can be simultaneously both positive and negative.

In a representative sample individuals are found to compare to those slightly better than themselves. However this type of comparison is being driven primarily by unobservable characteristics that result in the individual both comparing to slightly better others and also having greater life satisfaction. This finding suggests that some individuals must be making positive upward comparisons (Buunk et al., 1990). These upward comparing individuals probably see income improvements as achievable and may therefore have higher ability (Falk & Knell, 2004). These conclusions could be extended beyond the consideration of income into other personal evaluations, such as school grades, health or even sports performance. It seems upward comparison aids

achievements, which, under the right circumstances, can create more satisfied individuals.

The relative income hypothesis states that the individual cares about their performance in relation to others. Comparison is useful for assessing current performance and also for improving future performance. This paper shows that this is a complex process. The mean reference group income approach cannot uncover both positive and negative effects, only showing which one dominates. Future discussions need to isolate these affects and also consider reference group formation more fully.

The evidence presented here suggests that comparison with others does take place. The comparison is primarily made with individuals with similar incomes and also those that earn more. It seems possible that if the individual feels improvement is achievable then comparison to those slightly better can provide the information needed to better one's self.

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Table 1: Summary Statistics for the full sample (N = 86679)

Variable:	Mean	Standard Deviation
Life Satisfaction	5.25	1.30
Household Income Adjusted for Household Size and Deflated by Regional Living Costs (£)	11,464	9,327
Female	0.55	0.50
Age	46.00	18.22
College Educated	0.25	0.43
Graduate Educated	0.12	0.32
Married	0.55	0.50
Children in Household Dummy	0.34	0.47
House Ownership Dummy	0.73	0.44
Social Housing Dummy	0.19	0.39
Unemployed	0.03	0.18
Disabled	0.08	0.28

Table 2: Pooled OLS and Fixed Effect (FE) regressions on life satisfaction comparing logarithm of absolute income and income rank

	Dependent Variable: **Life Satisfaction**					
Independent Variables:	**1**	**2**	**3**	**4**	**5**	**6**
	OLS	**OLS**	**OLS**	**FE**	**FE**	**FE**
Income Rank[1]	**0.376**		**0.393**	**0.126**		**0.077**
	(21.46)**		**(10.60)****	**(5.78)****		**(2.02)***
Logarithm of Household Income[2]		**0.131**	**-0.008**		**0.044**	**0.021**
		(18.66)**	**(0.53)**		**(5.63)****	**(1.55)**
Individual Characteristics						
Female	0.021	0.019	0.021			
	(2.43)*	(2.23)*	(2.43)*			
Age	-0.146	-0.142	-0.146	-0.142	-0.142	-0.143
	(30.85)**	(30.09)**	(30.86)**	(8.73)**	(8.68)**	(8.74)**
Age-Squared/100	0.267	0.259	0.267	0.268	0.265	0.268
	(26.49)**	(25.76)**	(26.49)**	(10.91)**	(10.83)**	(10.91)**
Age-Cubed/10000	-0.137	-0.133	-0.137	-0.181	-0.180	-0.181
	(20.82)**	(20.21)**	(20.82)**	(11.24)**	(11.18)**	(11.25)**
College Educated	-0.052	-0.041	-0.052	0.063	0.064	0.064
	(4.85)**	(3.86)**	(4.87)**	(1.73)	(1.76)	(1.77)
Graduate Educated	-0.074	-0.056	-0.074	0.002	0.003	0.002
	(5.05)**	(3.85)**	(5.05)**	(0.04)	(0.06)	(0.04)
Married	0.320	0.318	0.320	0.130	0.129	0.130
	(31.54)**	(31.37)**	(31.54)**	(6.63)**	(6.62)**	(6.63)**
Children in Household Dummy	-0.021	-0.038	-0.021	0.015	0.011	0.014
	(1.92)	(3.45)**	(1.90)	(0.92)	(0.72)	(0.88)
House Ownership Dummy	0.085	0.093	0.086	0.025	0.023	0.023
	(5.12)**	(5.55)**	(5.13)**	(1.10)	(1.05)	(1.03)
Social Housing Dummy	-0.113	-0.126	-0.112	0.010	0.008	0.009
	(6.02)**	(6.72)**	(5.98)**	(0.37)	(0.29)	(0.33)
Unemployed	-0.378	-0.390	-0.378	-0.222	-0.223	-0.222
	(15.63)**	(16.14)**	(15.63)**	(9.66)**	(9.70)**	(9.66)**
Disabled	-0.759	-0.764	-0.759	-0.174	-0.174	-0.174
	(47.07)**	(47.37)**	(47.05)**	(8.61)**	(8.61)**	(8.61)**
Constant	7.126	6.988	7.134	7.530	7.503	7.522
	(94.78)**	(92.86)**	(93.31)**	(13.86)**	(13.81)**	(13.84)**
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.0838	0.0826	0.0838			
R-squared (within)				0.0103	0.0103	0.0104
Observations	86679	86679	86679	86679	86679	86679

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

1. Based on the individuals household income adjusted for household size and deflated by regional livings cost

2. Adjusted for household size and deflated by regional livings costs

Table 3: Testing for a mis-specified rank variable and non-linearities using fixed effect (FE) regressions on life satisfaction

	Dependent Variable: **Life Satisfaction**			
Independent Variables:	**1**	**2**	**3**	**4**
	FE	**FE**	**FE**	**FE**
Logarithm of Household Income[2]	0.044			
	(5.63)**			
Logarithm of Regional Average Income	0.009			
	(0.08)			
Logarithm of Household Income[2] Relative to the Regional Average (restricting to equal magnitudes)		0.043		
		(5.61)**		
Logarithm of Income Rank[1]			0.026	
			(4.91)**	
Income Rank[1]				0.075
				(1.12)
Income Rank[1] - Squared				0.053
				(0.80)
Individual Characteristics				
Age	-0.142	-0.142	-0.140	-0.143
	(8.67)**	(8.69)**	(8.58)**	(8.74)**
Age-Squared/100	0.265	0.265	0.263	0.268
	(10.83)**	(10.83)**	(10.73)**	(10.93)**
Age-Cubed/10000	-0.180	-0.180	-0.179	-0.181
	(11.18)**	(11.18)**	(11.09)**	(11.25)**
College Educated	0.064	0.064	0.062	0.063
	(1.76)	(1.76)	(1.70)	(1.73)
Graduate Educated	0.003	0.003	0.002	0.003
	(0.06)	(0.07)	(0.03)	(0.05)
Married	0.129	0.129	0.129	0.130
	(6.62)**	(6.62)**	(6.57)**	(6.63)**
Children in Household Dummy	0.011	0.011	0.009	0.016
	(0.72)	(0.72)	(0.54)	(0.98)
House Ownership Dummy	0.023	0.023	0.024	0.025
	(1.05)	(1.05)	(1.08)	(1.13)
Social Housing Dummy	0.008	0.008	0.009	0.010
	(0.29)	(0.29)	(0.31)	(0.37)
Unemployed	-0.223	-0.223	-0.224	-0.223
	(9.70)**	(9.70)**	(9.72)**	(9.67)**
Disabled	-0.174	-0.174	-0.174	-0.174
	(8.60)**	(8.61)**	(8.60)**	(8.60)**
Constant	7.482	7.609	7.585	7.538
	(12.50)**	(13.99)**	(13.94)**	(13.87)**
Regional Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
R-squared (within)	0.0103	0.0103	0.0102	0.0103
Observations	86679	86679	86679	86679

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level
1. Based on the individuals household income adjusted for household size and deflated by regional livings cost
2. Adjusted for household size and deflated by regional livings costs

Table 4: Upward comparison effects using both Pooled OLS and Fixed Effect (FE) regressions on life satisfaction

	Dependent Variable: **Life Satisfaction**							
Independent Variables:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	OLS	**OLS**	**OLS**	**OLS**	**FE**	**FE**	**FE**	**FE**
Upward Comparison (η)	**1.25**	**1.5**	**1.75**	**2**	**1.5**	**1.75**	**2**	**2.25**
Income Rank[1]	0.397	0.396	0.394	0.386	0.083	0.084	0.084	0.084
	(10.87)**	(10.97)**	(11.00)**	(10.89)**	(2.22)*	(2.26)*	(2.27)*	(2.27)*
F-Statistic on inclusion of upward comparison parameter#	5.98*	8.05**	8.75**	6.40*	1.06	1.30	1.35	1.33
Logarithm of Household Income[2]	-0.008	-0.005	-0.003	0.003	0.020	0.021	0.021	0.022
	(0.54)	(0.37)	(0.22)	(0.19)	(1.57)	(1.60)	(1.68)	(1.75)
Individual Characteristics								
Female	0.021	0.021	0.021	0.020				
	(2.41)*	(2.40)*	(2.39)*	(2.38)*				
Age	-0.146	-0.146	-0.146	-0.146	-0.143	-0.143	-0.143	-0.143
	(30.92)**	(30.96)**	(30.97)**	(30.97)**	(8.76)**	(8.76)**	(8.76)**	(8.76)**
Age-Squared/100	0.268	0.268	0.268	0.268	0.268	0.268	0.268	0.268
	(26.56)**	(26.59)**	(26.60)**	(26.61)**	(10.93)**	(10.93)**	(10.93)**	(10.93)**
Age-Cubed/10000	-0.138	-0.138	-0.138	-0.138	-0.182	-0.182	-0.182	-0.182
	(20.88)**	(20.91)**	(20.92)**	(20.93)**	(11.26)**	(11.26)**	(11.26)**	(11.26)**
College Educated	-0.053	-0.053	-0.054	-0.054	0.064	0.064	0.064	0.064
	(4.95)**	(4.99)**	(5.00)**	(5.01)**	(1.78)	(1.78)	(1.78)	(1.78)
Graduate Educated	-0.077	-0.080	-0.081	-0.083	0.002	0.002	0.003	0.003
	(5.30)**	(5.47)**	(5.54)**	(5.66)**	(0.05)	(0.05)	(0.05)	(0.05)
Married	0.320	0.320	0.320	0.320	0.130	0.130	0.130	0.130
	(31.55)**	(31.56)**	(31.57)**	(31.58)**	(6.63)**	(6.63)**	(6.64)**	(6.64)**
Children in Household Dummy	-0.020	-0.019	-0.018	-0.018	0.015	0.015	0.015	0.015
	(1.77)	(1.69)	(1.67)	(1.65)	(0.93)	(0.93)	(0.95)	(0.95)
House Ownership Dummy	0.086	0.087	0.087	0.087	0.023	0.023	0.023	0.023
	(5.16)**	(5.19)**	(5.21)**	(5.24)**	(1.04)	(1.04)	(1.04)	(1.05)
Social Housing Dummy	-0.112	-0.113	-0.113	-0.114	0.009	0.009	0.009	0.009
	(5.99)**	(6.02)**	(6.05)**	(6.10)**	(0.33)	(0.33)	(0.32)	(0.32)
Unemployed	-0.379	-0.381	-0.382	-0.383	-0.222	-0.222	-0.222	-0.223
	(15.70)**	(15.76)**	(15.80)**	(15.87)**	(9.66)**	(9.67)**	(9.67)**	(9.67)**
Disabled	-0.758	-0.758	-0.757	-0.757	-0.174	-0.174	-0.174	-0.174
	(46.99)**	(46.94)**	(46.93)**	(46.90)**	(8.61)**	(8.61)**	(8.60)**	(8.60)**
Constant	7.151	7.161	7.168	7.169	7.527	7.529	7.530	7.530
	(93.26)**	(93.20)**	(93.14)**	(93.09)**	(13.85)**	(13.85)**	(13.85)**	(13.86)**
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.0838	0.0838	0.0838	0.0838				
R-squared (within)					0.0104	0.0104	0.0104	0.0104
Observations	86679	86679	86679	86679	86679	86679	86679	86679

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level
# $F_{1, 86641, 0.05} = 3.84$
1. Adjusted for household size and deflated by regional livings costs
2. Based on the individuals household income adjusted for household size and deflated by regional livings cost

Table 5: Similarity effects using both Pooled OLS and Fixed Effect (FE) regressions on life satisfaction

	Dependent Variable: **Life Satisfaction**							
Independent Variables:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	OLS	**OLS**	**OLS**	**OLS**	**FE**	**FE**	**FE**	**FE**
Similarity effect (γ)	**-0.4**	**-0.3**	**-0.2**	**-0.1**	**-0.4**	**-0.3**	**-0.2**	**-0.1**
Income Rank[1]	0.642	0.554	0.487	0.435	0.108	0.098	0.090	0.083
	(10.76)**	(10.80)**	(10.78)**	(10.70)**	(1.80)	(1.89)	(1.96)*	(2.00)*
F-Statistic on inclusion of similarity parameter#	3.47	4.40*	3.85*	2.28	-1.10	-0.66	-0.32	-0.35
Logarithm of Household Income[2]	-0.046	-0.035	-0.025	-0.016	0.018	0.019	0.019	0.020
	(2.55)*	(2.07)*	(1.56)	(1.04)	(1.13)	(1.23)	(1.33)	(1.44)
Individual Characteristics								
Female	0.021	0.021	0.021	0.021				
	(2.45)*	(2.45)*	(2.44)*	(2.43)*				
Age	-0.146	-0.146	-0.146	-0.146	-0.143	-0.143	-0.143	-0.143
	(30.90)**	(30.90)**	(30.89)**	(30.87)**	(8.73)**	(8.74)**	(8.74)**	(8.74)**
Age-Squared/100	0.267	0.267	0.267	0.267	0.268	0.268	0.268	0.268
	(26.53)**	(26.53)**	(26.52)**	(26.51)**	(10.90)**	(10.91)**	(10.91)**	(10.91)**
Age-Cubed/10000	-0.138	-0.138	-0.138	-0.138	-0.181	-0.181	-0.181	-0.181
	(20.86)**	(20.86)**	(20.85)**	(20.84)**	(11.23)**	(11.24)**	(11.24)**	(11.24)**
College Educated	-0.052	-0.052	-0.052	-0.052	0.064	0.064	0.064	0.064
	(4.86)**	(4.88)**	(4.88)**	(4.88)**	(1.77)	(1.77)	(1.77)	(1.77)
Graduate Educated	-0.077	-0.076	-0.075	-0.075	0.002	0.002	0.002	0.002
	(5.27)**	(5.22)**	(5.17)**	(5.11)**	(0.04)	(0.04)	(0.04)	(0.04)
Married	0.320	0.320	0.320	0.320	0.130	0.130	0.130	0.130
	(31.60)**	(31.58)**	(31.57)**	(31.55)**	(6.63)**	(6.63)**	(6.63)**	(6.63)**
Children in Household Dummy	-0.020	-0.020	-0.020	-0.021	0.014	0.014	0.014	0.014
	(1.80)	(1.80)	(1.83)	(1.86)	(0.87)	(0.87)	(0.88)	(0.88)
House Ownership Dummy	0.085	0.085	0.085	0.085	0.023	0.023	0.023	0.023
	(5.09)**	(5.10)**	(5.11)**	(5.12)**	(1.03)	(1.03)	(1.03)	(1.03)
Social Housing Dummy	-0.114	-0.113	-0.113	-0.112	0.009	0.009	0.009	0.009
	(6.08)**	(6.03)**	(6.01)**	(5.99)**	(0.32)	(0.32)	(0.33)	(0.33)
Unemployed	-0.377	-0.377	-0.377	-0.377	-0.222	-0.222	-0.222	-0.222
	(15.58)**	(15.58)**	(15.59)**	(15.61)**	(9.66)**	(9.66)**	(9.66)**	(9.66)**
Disabled	-0.759	-0.759	-0.759	-0.759	-0.174	-0.174	-0.174	-0.174
	(47.06)**	(47.05)**	(47.05)**	(47.05)**	(8.61)**	(8.61)**	(8.61)**	(8.61)**
Constant	7.094	7.115	7.126	7.132	7.511	7.515	7.519	7.521
	(93.53)**	(93.48)**	(93.41)**	(93.36)**	(13.82)**	(13.83)**	(13.84)**	(13.84)**
Regional Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.0838	0.0838	0.0838	0.0838				
R-squared (within)					0.0104	0.0104	0.0104	0.0104
Observations	86679	86679	86679	86679	86679	86679	86679	86679

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level
# $F_{1, 86641, 0.05} = 3.84$
1. Adjusted for household size and deflated by regional livings costs
2. Based on the individuals household income adjusted for household size and deflated by regional livings cost

Table 6: Using payslip seen by the interviewer as an instrumental variable for income rank

	Dependent Variable:		
	Income Rank	**Life Satisfaction**	
Independent Variables:	**1**	**2**	**2**
	OLS	**OLS**	**FE**
Income Rank - Instrumented		1.100	0.311
		(7.55)**	(2.07)*
Instruments			
Latest Payslip Seen	0.067		
	(34.78)**		
Earlier Payslip Seen	0.091		
	(12.21)**		
Individual Characteristics			
Female	-0.022	0.039	
	(13.35)**	(4.13)**	
Age	0.042	-0.178	-0.150
	(46.50)**	(22.14)**	(8.50)**
Age-Squared/100	-0.080	0.330	0.283
	(41.28)**	(20.41)**	(10.20)**
Age-Cubed/10000	0.044	-0.172	-0.190
	(34.30)**	(17.94)**	(10.76)**
College Educated	0.079	-0.109	0.026
	(38.69)**	(6.96)**	(0.68)
Graduate Educated	0.188	-0.210	-0.056
	(68.76)**	(6.80)**	(0.94)
Married	-0.016	0.331	0.133
	(7.98)**	(31.80)**	(6.75)**
Children in Household Dummy	-0.147	0.088	0.052
	(71.19)**	(3.60)**	(1.88)
House Ownership Dummy	0.145	-0.021	-0.010
	(45.70)**	(0.78)	(0.32)
Social Housing Dummy	-0.034	-0.087	0.021
	(9.41)**	(4.47)**	(0.75)
Unemployed	-0.120	-0.270	-0.182
	(25.59)**	(8.32)**	(5.75)**
Disabled	-0.021	-0.736	-0.166
	(6.82)**	(43.79)**	(8.11)**
Constant	-0.191	7.261	7.563
	(13.22)**	(90.71)**	(13.88)**
Regional Dummies	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
R-squared (within)	0.301	0.080	0.099
Observations	86679	86679	86679

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

1. Based on the individuals household income adjusted for household size and deflated by regional livings cost

2. Adjusted for household size and deflated by regional livings costs

Figure 1: Life satisfaction over the life cycle based on coefficients in Table 2, Columns 3