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ABSTRACT

Testing the Tunnel Effect: Comparison, Age and Happiness in UK and German Panels*

In contrast to previous results combining all ages we find positive effects of comparison income on happiness for the under 45s, and negative effects for those over 45. In the BHPS these coefficients are several times the magnitude of own income effects. In GSOEP they cancel to give no effect of effect of comparison income on life satisfaction in the whole sample, when controlling for fixed effects, and time-in-panel, and with flexible, age-group dummies. The residual age-happiness relationship is hump-shaped in all three countries. Results are consistent with a simple life cycle model of relative income under uncertainty.

JEL Classification: D10, I31, J10

Keywords: subjective life-satisfaction, comparison income, reference groups, age, welfare

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1. Introduction

Among the most important results in happiness research, which help to explain the Easterlin Paradox of flat or declining average life satisfaction over time in the US and other advanced economies, are the strong negative effects of comparison or reference income, found in many different contexts, but particularly for life satisfaction in Germany and the US (Akay and Martinsson, 2012; D'Ambrosio and Frick, 2012; Bartolini et al., 2012; Cuesta and Budria, 2012; FitzRoy et al., 2011a,b; Layard et al., 2010; Senik, 2009; Clark et al., 2008; Ferrer-i-Carbonell, 2005; Luttmer, 2005; Blanchflower and Oswald, 2004). However as Hirschman and Rothschild (1973) observed, just before the beginning of modern research on subjective well-being by Easterlin (1974), comparison with a relevant reference group could have two very different effects. First, the role of status, based on comparison, which had already been emphasized by classical economists such as Smith and Mill, and by Veblen (1899), and more recently by sociologists as 'relative deprivation' (Runciman 1966), refers to evaluation of one's own *current* situation compared to the relevant reference group. However, Hirschman and Rothschild (1973) argued in the context of economic development and resulting inequality combined with rapid growth, that comparison could also indicate one's own *future* (relative) prospects. Thus a higher reference income in this context might be perceived as only a temporary 'relative deprivation', but also as an indicator of better *future* prospects, which they denoted 'the tunnel effect', with an inherently ambiguous net result on *current* subjective well-being.

While such effects in developing countries are plausible, there is also a natural asymmetry in likely response to relative income across age groups, which has received much less attention. Young individuals everywhere are obviously more mobile and likely to see peer success as an indication of their own future prospects, (and perhaps be motivated to greater effort), than less flexible, older people. The careers of the latter group are fully determined at the latest by

retirement, so expectations lose relevance and current perceptions of relative status should dominate.

This asymmetry suggests estimating the effects of relative income separately for younger and older sub-samples, and here we generalize our earlier cross sectional results, which reported the first estimates for different age groups[1] and use the German Socio-Economic Panel (SOEP) and the British Household Panel Survey (BHPS) to estimate life-satisfaction separately for sub-samples of individuals under and over 45, as well as for the complete samples with all ages. We control for the time spent in the panels, and for age with flexible age-group dummies, and find a number of new results which differ from the previous literature.

With all ages, but controlling for time spent in the panel, and individual fixed effects to capture reverse causality and selection (Frijters and Beatton, 2012), we find no effects of comparison income with the GSOEP. This differs from previous studies with GSOEP cited above, which all find large negative effects of comparison income using the full sample. The reason for this seems to be our use of flexible age dummies. With the usual quadratic age control we also find a negative comparison effect in the full sample.

Our main innovation is to actually find a *positive* significant effect of comparison income for those under 45, as well as the usual negative significant effect for the older group in West Germany, (confirming our earlier cross-section results), and these effects essentially cancel when all ages are aggregated. Using pooled OLS we do find a negative comparison effect for the whole sample in West Germany, and again the switch in sign from the young to the old (as in our earlier OLS cross section). Interacting age intervals with reference income yields a similar declining – from positive to negative – effect on happiness with age, as also found by Akay and Martinsson (2012), who combine East and West German data (and report similar

[1] In FitzRoy et al. (2011a, b, c) we used only the 2008 SOEP wave, but obtained many qualitatively similar results. With wave 17 of the BHPS we only found an aggregate negative significant effect of comparison.

effects from an experimental survey in Sweden). However for East Germany we find comparison effects for the complete sample and the sub-samples are *zero*, and other coefficients also differ, (in contrast to Ferrer-i-Carbonell, (2005), who found negative comparison effects for both East and West while aggregating all ages and using the usual age quadratic).

We also obtain similar results for the UK with the BHPS, which appear to be new. Here the comparison effect is negative for the complete sample with both pooled OLS and fixed effects. We find comparison effects for both age groups to be several times larger than very small (though highly significant) own-income effects in the UK, in striking contrast to Germany where magnitudes are similar, as they are in the US in Layard et al. (2010). Already small, own income effects *decline* with age in the UK, in contrast to both German regions.

Thus fundamental results of happiness research change dramatically with flexible age controls, time-in-panel, and fixed effects, and after disaggregating by age: the seemingly robust negative effect of reference income disappears in the all-age SOEP samples, and turns positive in younger sub-samples in all our countries, (a result which is consistent with Hirschman and Rothschild's (1973) pioneering analysis, though not directly predicted by them), but remains strongly negative for older individuals.[2] And comparison income has no effect in the full sample in both parts of Germany, (and is actually insignificant in both age groups with fixed effects in East Germany).

Most happiness studies (including work on relative income cited above) control for age with a quadratic and find a robust U-shaped pure age effect (Blanchflower and Oswald, 2008), though this does not capture the declining happiness of the oldest respondents in samples with all ages and cubic or non-parametric age controls (Fischer, 2009; Bartolini et al., 2012; FitzRoy et al., 2011; Wunder et al., 2013). With fixed effects and controls for time in panel

[2] Negative comparison effects are often misleadingly described as 'envy', which does not capture preference for fairness.

and survey interview, (but no comparison income), Frijters and Beatton (2012) and Kassenboehmer and Haisken-DeNew (2012) show that the U-shape or middle-age decline in happiness disappears. We include comparison income as well as age-intervals, wave dummies, and time in panel, and with fixed effects find a hump-shape, (with only a moderate decline in happiness after 75), in West Germany and the UK. Only East Germany reveals a substantial dip in middle age, and a deeper fall after 75. These results are illustrated in Figure 1, Appendix 1.

We have also formalised some of these ideas in a simple 2-period, life-cycle model with uncertainty, (Appendix 2). Depending on parameters, some members of the younger cohort may find that comparison income can signal either higher or lower expected lifetime relative income, and hence expected life satisfaction. In the second period, realised relative incomes have the usual effect. This is not a general model of relative income, since we do not consider optimizing responses to information and other issues, and focus on exogenous shocks to the labour market, and it does not predict all our results, but it does capture one novel result of the empirical analysis, namely the possibly positive (signalling) effect of higher comparison income on some members of a young cohort's expected well-being, an effect which is lost under the usual aggregation of age groups.

The plan of the paper is to provide a brief review of other tests of the signalling or tunnel hypothesis in section 2, followed by discussion of the SOEP and BHPS data and empirical results followed by robustness tests in section 3. Conclusions are summarized in section 4, and tables and a plot of age effects are in Appendix 1. The life-cycle model is in Appendix 2.

2. Other tests of the tunnel hypothesis and related literature

Hirschman and Rothschild's (1973) ideas were long neglected, and earlier tests of these ideas have produced conflicting results. Thus Drichoutis et al. (2010) found insignificant effects of comparison income for the transition economies of Eastern Europe, in contrast to Senik

(2008, 2004), who obtained positive effects of reference income on life-satisfaction or financial satisfaction for most transition economies and Russia. She ascribes this contrast to 'old' Europe, with mainly negative effects of reference income, to social and economic turmoil after transition and consequent high mobility. Less plausibly, Senik (2008) also finds a strong *positive* or signalling effect of reference income on happiness in the US, attributed to high perceived mobility, but this result is directly contradicted by Layard et al. (2010), using the same GSS data, and by Luttmer (2005) and others with various data sets.

A different kind of test of the signalling effect of comparison income has been carried out by Clark et al. (2009), using Danish establishment wage data, and finding that job-satisfaction is higher in establishments with higher average pay, which plausibly signals one's own prospects for promotion in the future. Interestingly in the light of our findings below and our life-cycle model, they find less effect for those near retirement. However, it is also likely that higher average pay will be correlated with work-place public goods as part of rent-sharing with workers, which may explain part of the observed influence.

Most of the earlier related literature does not directly address the tunnel hypothesis, but emphasizes the negative effects of comparison. Thus in an early study with UK data for employees, Clark and Oswald (1996) found a strong negative effect of reference income on job-satisfaction (which is generally an important component of life-satisfaction), equal in magnitude and opposite in sign to the own-income effect. Card et al. (2012) also find a negative effect of higher comparison income on job-satisfaction, when this information is first revealed to co-workers. There is also evidence for the importance of comparison in general from neuroscience (Fliessbach et al., 2007), and from much work in psychology and behavioural economics as reviewed by Clark et al. (2009). Our work suggests that it is vital to control for position in the life-cycle to distinguish between positive and negative effects, and also for individual fixed effects and 'reverse causality', because much happiness-enhancing behaviour and disposition is already imparted in early childhood (Headey et al., 2012). People

with these early advantages go on to be healthier and more successful in careers and personal relationships, all of which are themselves major contributors to later well-being (Frijters and Beatton, 2012).

An alternative approach to distinguishing the status or positional, relative deprivation effect of comparison income from the signalling or tunnel effect by D'Ambrosio and Frick (2012) is to add lagged income in a dynamic context. They confirm familiar, opposite-signed status effects of income distances from richer and poorer individuals in the whole sample, and also interpret a negative effect of comparison with people who are currently poorer but were richer in the previous period as a signal of possible loss of own future status. The importance of signalling thus also emerges in a very different context from our age-related, peer group comparison. Senik (2009) also considers dynamics, and compares various reference incomes for transition countries, including past own income. She finds stronger negative effects of relative decline than positive effects of relative gain, thus confirming loss aversion in this context. Another extension of the standard income comparison due to Cuesta and Budria (2012) and Bellami and D'Ambrosio (2010) includes deprivation measures in various non-monetary, social and consumption domains, which turn out to be independently important for well-being.

3. Empirical Analysis

Our dependent variable is an individual's self-reported life-satisfaction. Our main explanatory variables of interest are individual and comparison or reference income, which are both measured at the household level.[3] Instead of the usual quadratic in age we use age dummies for 10 year intervals. For the identification of the comparison or reference income, we make the standard assumption that an individual compares his/her own income with the average income of people who are in the same age range, have the same gender and have attained a

[3] We control for size of household, and number of children.

similar education level. We therefore define an individual's reference group by age, education region and gender. With respect to age, we assume that an individual compares with peers in a similar age range. In particular, we use rolling 10-year-age intervals by assuming that an individual compares at point t with all peers up to 3 years younger and 6 years older. Motivated by large and persisting socio-economic and cultural differences between West and East Germany (Pfaff and Hirata, 2011), we estimate the same model for East and West Germany separately, and find substantial differences.

To test the influence of reference income on life-satisfaction we estimate the following model:

$$H = \beta_0 + \beta_1 lnY + \beta_2 ln\overline{Y} + \alpha X + \gamma g(Age) + \varepsilon, \quad (1)$$

where H measures self-reported life-satisfaction, and X is a vector of individual covariates including individual characteristics like gender, education, employment status, self-reported health and time spent in the panel, as well as dummies for regions. Y captures annual household income of an individual, while $\overline{Y}$ describes the mean income of the corresponding reference group defined by age, gender, education and region. When an aggregate variable such as this comparison income is used with individual variables, standard errors may be biased downwards unless they are clustered (Moulton, 1990), so we follow Stutzer (2004) and report clustered standard errors. (This contrasts with previous work on relative income cited above, where standard errors may thus be downward-biased). With respect to age, we follow Frijters and Beatton (2012) and use a flexible function of age, *g(Age)*. In particular, we include age-dummies with bands of 10 years. Our reference category are those respondents younger than 25.

We treat life-satisfaction scores as cardinal and comparable across respondents. This assumption is sometimes criticised in the economic literature, but unreported estimates from a random effects ordered probit model are qualitatively similar to the ones reported here. This

is in line with the findings of Ferrer-i-Carbonell and Frijters (2004) who demonstrate that the assumptions impact on the empirical results, so we proceed with pooled OLS and fixed effects estimates as in Layard et al. (2010).

3.1 West and East Germany

The data used for Germany comes from the German Socio-Economic Panel (SOEP), which is a representative micro data set providing detailed information on individuals, families and households in Germany (Wagner et al. 2007). The SOEP was started in 1984 and has become a widely used database for social scientists. A major advantage is the comprehensive nature of the data set, which combines objective indicators (e.g. income, employment status, family structure), as well as subjective or self-assessed life-satisfaction. In this paper, we make use of the 2000-2010 waves of the SOEP and also split into subsamples of individuals under 45, and those older than (or exactly) 45. We have almost 158 thousand observations for 27,521 individuals in West Germany, and do not constrain ages as do Layard et al. (2010).

Self-reported life-satisfaction is measured on an 11-point scale, 0 being the lowest value, while 10 is reported by individuals who are very satisfied with their actual life. Household income is measured after deducting taxes and social insurance contributions. For the identification of the reference income, we define an individual's reference group by gender, age (+3/-6), education (low, medium and high) and region (North, West, South-West, South). In the case of East Germany, we distinguish two regions (North and South).

In the Appendix, tables 1a and 1b show brief summary statistics for West and East Germany. Initially, it becomes obvious that individuals in East Germany are on average less satisfied with their life than those living in West Germany. This pattern corresponds to the fact, that East Germans are more affected by unemployment and have significantly lower household income then West Germans. The differences in happiness and economic outcomes between West and East Germany holds true when we compare people within age groups. However, the

average life-satisfaction score in East Germany is still about 6.55, which is fairly high compared to self-reported happiness in the US (Layard et al. 2010). The table further shows that young adults in East and West Germany are on average more satisfied with their life than older individuals.

Tables 2a and 2b report pooled OLS estimates for the whole sample and the two age groups for both regions, restricted to the key household and comparison income variables. The negative comparison effect in the full West German sample in column (1) matches previous work discussed in the Introduction. The results in column (2) highlight that reference income has a positive significant effect for individuals under 45. For older individuals, reference income has the well-known negative effect on life-satisfaction. These findings are in line with our earlier cross-sectional results focusing on the 2008-wave of the SOEP (FitzRoy et al. (2011a, b, c)).

As expected, in East Germany the income coefficient has a larger magnitude than the one found for West Germany. In regions that are characterized by low income and high unemployment levels, own income has a higher relevance for individual well-being. In addition to this, results from the full sample indicate that reference income does not matter for individuals in East Germany. Interestingly, splitting the sample suggests that the positive comparison effect for the under 45s also holds in East Germany.

In the next step, we exploit the panel structure of the SOEP and take into account individual time constant unobserved heterogeneity by including individual fixed effects. The corresponding results are presented in tables 3a and 3b. The results support our findings from the pooled OLS estimation: the influence of reference income is different for young and old people. While young people experience gains in life-satisfaction if peer income rises, older people experience the well-known decrease in well-being if reference income increases. An interesting artefact is that comparison for the young is exactly offset by the usual negative comparison effect for those over 45, so the net result for the whole sample is a zero

coefficient for comparison, differing from all previous work with GSOEP data that we are aware of, where age groups are aggregated and the (net) effect of comparison income is negative.

In East Germany, we find no comparison effects at all. This stands in contrast to Ferrer-i-Carbonell's (2005) random effects probit estimates and our own estimates from the Pooled OLS model. The own-income coefficient is, as in the Pooled OLS model, substantially larger than in the Western sample, which is plausible in a poorer region. Another result is that own income becomes more important with age in East and West Germany.

In tables 4a and 4b, we report estimates with interactions of comparison income with 10 year age-interval dummies, and an interaction for over 45.[4] These obviously provide more detail than just the two sub-samples, but essentially confirm the main pattern, in particular the positive comparison effect for the under-45s in West- but not East- Germany, and the stronger own-income benefits for the over 45s. In the East, there is just one significant negative comparison effect for the 55-64 group.

The pure age effects from the age-interval dummies in the full sample, fixed effects estimates (columns 1 of tables 3a and 3b) are plotted in Figure 1. They are quite different from the frequently found U-shape in estimates without controlling for time spent in the panel and presence of an interviewer, and are actually more like an inverse U-shape or hump, except that East Germany has a distinctive M-shaped pattern of happiness over the life-cycle. These results confirm Frijters and Beatton's (2012) and Kassenboehmer and Haisken-DeNew's (2012) main finding that fixed effects and the extra controls remove the U-shape.

[4] All variables except comparison income are interacted with a >45 dummy, but not reported.

3.2 United Kingdom

Our UK data[5] are taken from Waves 6-10 and 12-18 of the British Household Panel Survey, (BHPS), covering a period that runs from 1996/07 to 2008/09. We use data for 153189 observations across 25312 individuals, with those cases where there are missing values excluded. One point worthy of note is the deliberate over-sampling of the smaller nations of the UK since Wave 9 – so that about half of the individuals in the BHPS are from Scotland, Wales and Northern Ireland, compared to less than 20% in the underlying overall population. While there are differences compared to England, they are much less than between West and East Germany, so do not warrant separate estimates. The range of coverage of this data set – which focuses on issues of interest to the social sciences, and for policy purposes, across the members of a specific sample of households – is similarly broad as the SOEP, although unsurprisingly not identical.

In the BHPS data set, self-reported life-satisfaction is measured on a 7-point scale, 1 being the lowest value, while 7 is reported by individuals who are very satisfied with their life overall. For the identification of the reference income, we define an individual's reference group by gender, age (+3/-6), education (low or high), region (south of England, north of England, outside of England) and BHPS wave.

In the Appendix, table 1c shows summary statistics for the BHPS data. To make approximate comparisons[6] with overall life satisfaction in Germany, a simple linear transformation can be undertaken (subtract 1, then multiply by 5/3). BHPS individuals have higher overall life satisfaction than in East Germany, but less than in West Germany. When the complete age range is considered, the UK average is pretty close to its counterpart from West Germany. However, for the younger age group, the BHPS average is relatively lower and nearer to its

[5] Technically, the earlier waves of the BHPS were limited in coverage to Great Britain. In our case, this is true up to Wave 10. The full United Kingdom (including Northern Ireland) is covered in Waves 12-18. BHPS data are available via the UK Data Service (formerly the UK Data Archive).

[6] Although a linear transformation can provide arithmetic equivalence, this does not negate underlying issues concerning the question of whether such scales are cardinal (with points on the scale representing equal distances in the strength of response) or simply ordinal (in which case the mean is a problematic concept).

East German equivalent. The BHPS contrasts with the SOEP, in that the older age group displays higher life satisfaction. This effect looks somewhat surprising, given the 23% lower relative household income observed for the older age group in the UK case. The cross-country difference in age-income profile could, however, be linked to the use of a gross household income measure in the UK case.

Table 2c covers pooled OLS estimates for the whole sample and the two age groups, reporting only household and comparison income variables. The negative effect of comparison income in the full UK sample is statistically significant, like the West German case. As in our own earlier preliminary cross-sectional work on the BHPS, the comparison effect in the younger group remains statistically insignificant: by inspection, however, it does appear significantly different (in a negative direction) from the effect among the older age group[7].

Fixed effects results (table 3c) include a comparison income effect, in the full sample, that is negative and only statistically significant at the 10% significance level. The sample split very clearly demonstrates the difference between the two age ranges[8] – with the comparison income effects statistically significant and positive in the younger group, and of the opposite sign (but again significant) in the older group. This pattern is very similar to West Germany.

Also, own household income has a noticeably larger effect among the younger group (in contrast to the results for Germany) – and this effect is, rather surprisingly, much smaller throughout than the impact of comparison income. It is of course also much smaller than the own income effect in Germany (as also found by Helliwell et al. (2012), who did not, however, include reference income).

[7] This can be confirmed by estimation for the whole sample with an interaction dummy for age 45+.

[8] However, the age split for which results are shown in columns (2) and (3) cannot be simply expressed as a generalised case in column (1) – since there, under fixed effects estimation, the correlation between the two components of the disturbance term takes a particular value; whereas, in general, this correlation will take different values in each of columns (2) and (3).

In table 4c, column (1) pooled OLS estimation can be compared to the results shown in columns (2) and (3) of table 2c. The inclusion of comparison income interactions with age grouping dummies has negligible influence on the estimates for own household income. However, it becomes evident that the insignificant positive estimate for comparison income in column (2) of table 2c is a consequence of an effect that is becoming less positive with increased age[9]. The negative estimate for comparison income in column (3) of table 2c appears to originate principally from an effect in the 55-74 age range.

The results for own household income in column (2) of table 4c correspond fairly obviously to those in table 3c. The fixed effects estimates for comparison income exhibit an even more obvious tendency towards a larger negative effect with advancing age. Although it may appear a little odd that none of the youngest three age groups has an overall effect of comparison income that seems likely to be positive and significant, it should be recalled that column (2) of table 4c constrains the disturbance correlation.[10]

The pure age effects are plotted in Figure 1 (column 1 of tables 3c) and are very similar to West Germany.

3.3 Robustness Tests

Here we summarise the results of additional tests which support the robustness of our main results. [11] As a first test, we excluded the income of an individual when constructing his comparison income. Since comparison income was on average calculated on the basis of two or three hundred individual observations, excluding own income did not affect comparison coefficients. Second, we constructed reference groups with fixed age categories instead of rolling age windows. This still preserved the West German (though not the BHPS) results.

[9] The overall effect of comparison income is negative and significant at the 10% level for the under 25s, but is negative overall (albeit insignificant) for the 35-44 age group.

[10] Results for an unreported specification with fixed effects, age group interactions and an age split either side of the 45th birthday, show statistically significant positive overall effects for comparison income in the younger age range (like in column (2) of table 3c).

[11] Results are available from the authors on request.

East German comparison income was consistently insignificant. Thirdly, we estimated reduced specifications excluding controls like health, time in panel and type of interview. The corresponding results are in line with those from our preferred benchmark specification.

In view of widespread use of quadratic age controls and random effects we have also estimated such models and found similar comparison income effects for the two age groups in West Germany, and kept signs but lost significance in the UK. Surprisingly, random effects yielded the only significant and positive effect of comparison income for the younger group in East Germany. The quadratic age coefficients were almost always negative, and hence consistent with the results of our flexible age-interval estimates.

Regional unemployment is a potential signalling variable, but refers to economic prospects for all. Its inclusion did not change the effects of comparison income, which is obviously a much more precise, micro-measure, in any of the three samples (nor did state-year interactions). Furthermore, comparison income is a relative indicator: if you are currently young and doing badly compared to your peers, their higher income suggests you could do better and improve your relative standing in the future.

Finally, the age-happiness plots in Figure 1 were derived from estimates in the full samples with all ages, though we actually reject this specification. We therefore looked at age-interval coefficients in the subsamples and found similar patterns.

4. Conclusions

We present strong panel evidence for the tunnel effect in West Germany and the UK, with very robust positive comparison income coefficients for the subsample under 45, and the more familiar negative effects of comparison for older individuals. Surprisingly, with fixed effects these coefficients are equal in magnitude in West Germany, yielding no overall comparison effect for the full sample, in contrast to previous work with German SOEP data yielding a negative effect. Our panel estimates control for individual heterogeneity, and time

in the panel. Flexible age-interval dummies (instead of the usual quadratic) yield a hump-shaped pure age pattern. In the UK, the comparison effect is still negative in the complete sample with all ages, and the own-income effect is much smaller than the comparison effect. In East Germany, fixed effects estimates show little significant comparison, suggesting a still-different culture long after reunification.

Our paper indicates that life-satisfaction and other measures of well-being clearly need to be estimated separately for young and old in future research, and that the explicit role of expectations, mobility and inequality seem worth exploring for their relevance to well-being and social comparison. Furthermore, our results provide an additional explanation for the observed trends in happiness in industrialized/developed countries. Due to ageing populations, and shrinking shares of young people (who are likely to experience gains in well-being from increasing reference income and economic growth), average happiness is more likely to stagnate.

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Appendix 1 – Tables

Table 1a: Summary Statistics, West Germany, 2000-2010			
	All	<45	>=45
Life-Satisfaction	7.15 (1.74)	7.22 (1.65)	7.08 (1.80)
Age	48.21 (17.17)	32.61 (7.77)	61.10 (11.02)
Household income	2878 (1868)	2876 (1661)	2879 (2023)
Comparison income	2867 (799)	2901 (552)	2838 (955)
N	157919	71425	86494

Arithmetic means; standard deviations in parentheses. Life-Satisfaction measures self-reported life-satisfaction on an 11-point scale. Age describes the age of the respondent. Household income measures the net monthly real household income of the respondent. Comparison income measures the average net monthly real income within a reference group (Age (-3/+6), Sex, Education (3 categories), Regions (4 categories)) to which the respondent belongs. Source: SOEP

Table 1b: Summary Statistics, East Germany, 2000-2010			
	All	<45	>=45
Life-Satisfaction	6.55 (1.78)	6.73 (1.69)	6.42 (1.82)
Age	48.70 (17.31)	31.77 (8.05)	60.90 (10.64)
Household income	2250 (1295)	2351 (1255)	2177 (1319)
Comparison income	2239 (560)	2360 (441)	2151 (618)
N	56984	23864	33120

See table 1a. Comparison income measures the average net monthly real income within a reference group group (Age (-3/+6), Sex, Education (3 categories), Regions (2 categories)) to which the respondent belongs. Source: SOEP

Table 1c: Summary Statistics, GB, Waves 6-10 and UK, Waves 12-18 (across 1996/97-2008/09)			
	All	<45	>=45
Life-Satisfaction	5.23 (1.29)	5.15 (1.21)	5.31 (1.36)
Age	45.57 (18.38)	30.66 (8.32)	61.52 (11.53)
Household income	2715.10 (2155.56)	3060.37 (2102.17)	2345.82 (2066.91)
Comparison income	2680.10 (886.50)	3060.16 (622.30)	2273.61 (944.73)
N	153189	79168	74021

See table 1a. Life satisfaction measures self-reported life-satisfaction on a 7-point scale. Household income measures real household income, using the Consumer Prices Index as deflator. Comparison income measures the average real household income within a reference group (Age (-3/+6), Sex, Education (2 categories), Regions (3 categories)) to which the respondent belongs. Source: BHPS

Table 2a West Germany, SOEP, 2000-2010	(1) all	(2) <45	(3) >=45
Pooled OLS			
Household income	0.54***	0.42***	0.62***
	(51.64)	(27.83)	(43.96)
Comparison income	-0.09***	0.19***	-0.19***
	(-3.30)	(4.02)	(-5.78)
Observations	157,919	71,425	86,494
Adj. R-squared	0.201	0.196	0.207

Dependent variable: Life-Satisfaction. Controls for gender, marriage, cohabiting, children, health status, foreign-born, education, work status, interview form, time in panel, year of last interview, household size, age group, year of survey and federal states are included. Standard errors clustered at the level of skill groups, robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2b East Germany, SOEP, 2000-2010	(1) all	(2) <45	(3) >=45
Pooled OLS			
Household income	0.80***	0.61***	0.97***
	(42.22)	(22.70)	(36.77)
Comparison income	0.05	0.28***	-0.10
	(1.11)	(3.60)	(-1.53)
Observations	56,984	23,864	33,120
Adj. R-squared	0.221	0.216	0.222

See table 2a. *** p<0.01, ** p<0.05, * p<0.1

Table 2c UK, BHPS, Waves 6-10, 12-18	(1) all	(2) <45	(3) >=45
Pooled OLS			
Household income	0.086***	0.114***	0.054***
	(14.87)	(15.09)	(6.29)
Comparison income	-0.073***	0.039	-0.086**
	(-2.81)	(1.00)	(-2.38)
Observations	153,189	79,168	74,021
Adj. R-squared	0.166	0.147	0.182

Dependent variable: Life-Satisfaction. Controls for gender, marital status (including cohabiting), children, health status, education, work status, time in panel, year of last interview, household size, age group, wave number and regions are included. Standard errors clustered at the level of skill groups, robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3a West Germany, SOEP, 2000-2010	(1) all	(2) <45	(3) >=45
Fixed Effects			
Household income	0.25***	0.20***	0.30***
	(14.90)	(8.67)	(11.82)
Comparison income	0.01	0.24**	-0.22***
	(0.16)	(2.47)	(-2.59)
Observations	157,919	71,425	86,494
Number of persons	27,521	15,093	15,316
Adj. R-squared	0.0605	0.0690	0.0534

Dependent variable: Life-Satisfaction. Controls for marriage, cohabiting, children, health status, foreign-born, education, work status, interview form, time in panel, year of last interview, household size, age group, year of survey and federal states are included. Standard errors clustered at the individual level, robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3b East Germany, SOEP, 2000-2010	(1) all	(2) <45	(3) >=45
Fixed Effects			
Household income	0.38***	0.31***	0.43***
	(12.23)	(7.59)	(8.88)
Comparison income	-0.01	0.14	-0.14
	(-0.09)	(0.90)	(-0.82)
Observations	56,984	23,864	33,120
Number of persons	9,092	4,904	5,240
Adj. R-squared	0.0572	0.0628	0.0522

See table 3b. *** p<0.01, ** p<0.05, * p<0.1

Table 3c UK, BHPS, Waves 6-10, 12-18	(1) all	(2) <45	(3) >=45
Fixed Effects			
Household income	0.039***	0.058***	0.018*
	(6.17)	(6.86)	(1.92)
Comparison income	-0.087*	0.260***	-0.290***
	(-1.91)	(3.38)	(-4.52)
Observations	153,189	79,168	74,021
Number of persons	25,681	16,327	12,034
Adj. R-squared	0.0374	0.0420	0.0340

Dependent variable: Life-Satisfaction. Controls for marital status (including cohabiting), children, health status, education, work status, time in panel, year of last interview, household size, age group, wave number and regions are included. Standard errors clustered at the individual level, robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4a West Germany, SOEP, 2000-2010	(1) Pooled OLS	(2) Fixed Effects
Interacted Model, full sample		
Household income	0.42***	0.21***
	(27.70)	(9.59)
Household income*45+	0.19***	0.09***
	(9.36)	(2.87)
Comparison income	0.57***	0.38***
	(5.84)	(2.67)
Comparison income*25-34	-0.47***	-0.26*
	(-3.84)	(-1.74)
Comparison income*35-44	-0.48***	-0.19
	(-4.52)	(-1.36)
Comparison income*45-54	-0.85***	-0.53***
	(-7.86)	(-3.53)
Comparison income*55-64	-0.87***	-0.56***
	(-8.16)	(-3.78)
Comparison income*65-74	-0.65***	-0.45***
	(-6.19)	(-2.96)
Comparison income*75+	-0.53***	-0.56***
	(-4.34)	(-3.12)
Observations	157,919	157,919
Number of persons	27,521	27,521
Adj. R-squared	0.204	0.0617

Dependent variable: Life-Satisfaction. In addition to the variables listed in tables 2a and 3a, controls for interactions of all explanatory variables with a dummy for being older than 44 are included. Reference group of age groups: 18-24.

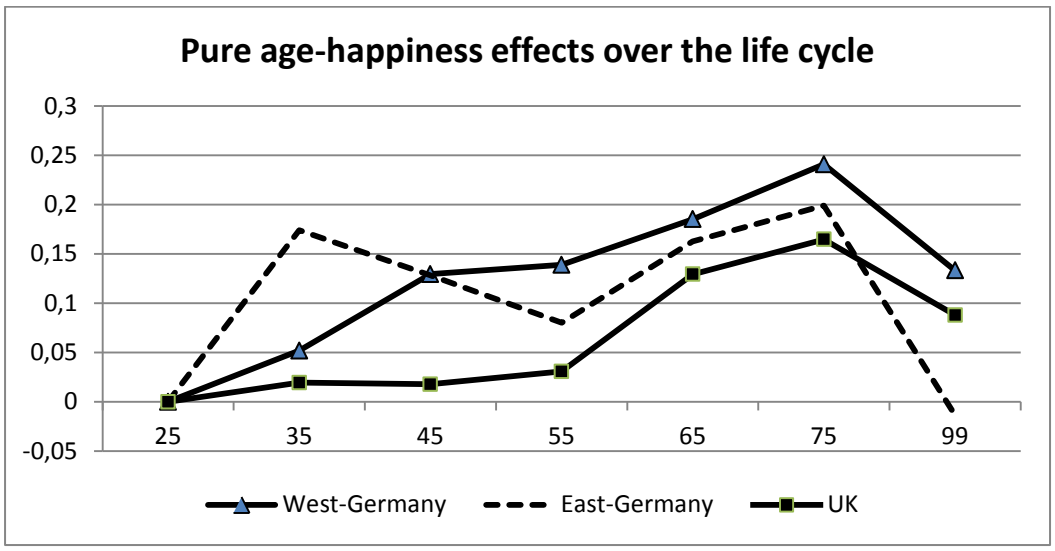
Table 4b East Germany, SOEP, 2000-2010	(1) Pooled OLS	(2) Fixed Effects
Interacted Model, full sample		
Household income	0.61***	0.34***
	(22.71)	(8.91)
Household income*45+	0.35***	0.10*
	(9.42)	(1.85)
Comparison income	0.32**	0.31
	(1.99)	(1.51)
Comparison income*25-34	-0.05	-0.22
	(-0.27)	(-0.86)
Comparison income*35-44	-0.06	-0.16
	(-0.35)	(-0.63)
Comparison income*45-54	-0.34*	-0.37
	(-1.92)	(-1.46)
Comparison income*55-64	-0.67***	-0.68***
	(-3.60)	(-2.60)
Comparison income*65-74	-0.18	-0.25
	(-0.84)	(-0.85)
Comparison income*75+	-0.02	-0.37
	(-0.08)	(-0.94)
Observations	56,984	56,984
Number of persons	9,092	9,092
Adj. R-squared	0.226	0.0591

Dependent variable: Life-Satisfaction. In addition to the variables listed in tables 2b and 3b, controls for interactions of all explanatory variables with a dummy for being older than 44 are included. Reference group of age groups: 18-24.

Table 4c UK, BHPS, Waves 6-10, 12-18	(1) Pooled OLS	(2) Fixed Effects
Interacted Model, full sample		
Household income	0.115***	0.055***
	(15.14)	(6.63)
Household income*45+	-0.060***	-0.038***
	(-5.23)	(-3.12)
Comparison income	0.114*	0.127
	(1.69)	(1.36)
Comparison income*25-34	-0.032	0.023
	(-0.49)	(0.29)
Comparison income*35-44	-0.141**	-0.016
	(-2.13)	(-0.18)
Comparison income*45-54	-0.035	-0.153
	(-0.42)	(-1.32)
Comparison income*55-64	-0.233***	-0.247**
	(-2.92)	(-2.15)
Comparison income*65-74	-0.296***	-0.391***
	(-3.71)	(-3.27)
Comparison income*75+	-0.151	-0.734***
	(-1.59)	(-5.14)
Observations	153,189	153,189
Number of persons	25,681	25,681
Adj. R-squared	0.170	0.0387

Dependent variable: Life-Satisfaction. In addition to the variables listed in tables 2c and 3c, controls for interactions of all explanatory variables with a dummy for being at least 45 are included. Reference group of age groups: under 25.

Figure 1



Appendix 2

A Model of Happiness over the Life Cycle

Theory

In this section we set out a model that supports our empirical findings – specifically the finding that, in the early stages of working life, the average income of the comparison group may have either a positive or insignificant effect on reported happiness or life-satisfaction.

The essential insight we wish to capture is that life-satisfaction may depend on not just a comparison of a person's own current income with the current income of their peers, but also on a comparison of how their life as a whole is going relative to their peers, and so on relative lifetime income. Of course early in their working life people do not know for sure how their lives might pan out and, in particular, how not just their own lifetime income but that of the comparison group will evolve. So they use information about how their life has gone to date – specifically their current income and that of their peers – to draw inferences about how things might go in the future. In this context a high current income of the comparison group may signal that there has been a significant amount of promotion to date and hence future promotion prospects and so expectations of relative future lifetime income are good.

The aim of the model is to formalise this idea and show that there are indeed contexts in which, in the earlier part of working life, the current income of the comparison group may be positively associated with reported happiness.

The Model

The model is framed in a way that is consistent with the data on which the empirical analysis has been conducted. So it is assumed that individuals' working lives are split into two periods.

We also assume that all individuals have a *comparison/peer* group with whom they compare how their lives are going. Accordingly we consider a sub-population of individuals who are identical in terms of some observable characteristics: age, educational attainment, location

etc. This constitutes the *comparison/peer* group to which everyone within the sub-population compares themselves.

Though identical in certain respects, individuals differ in some other characteristics that are unobservable to them but will manifest themselves over the course of their lifetime in two different respects:

- Individuals may turn out to be Hares or Tortoises. Hares show early promise and get promoted early (in period 1). Tortoises develop more slowly, and get promoted, if at all, later in life – in period 2. Individuals learn in period 1 whether or not they have been promoted and hence whether they are Hares or Tortoises. So in period 1 the current income of a Tortoise is $c_1^T = b$ where $b > 0$ denotes basic income, while the current income of a Hare is $c_1^H = b(1+\varphi)$ where $\varphi > 0$ is the proportionate income supplement obtained through promotion in Period 1.
- Individuals may turn out to be genuinely Smart or basically Dull. Smartness only manifests itself in period 2, and leads to Smart people – Tortoises or Hares – being promoted (further promoted) in Period 2. It is assumed that Smart Tortoises turn out to equally smart as Smart Hares and so, in period 2, their current incomes are $c_2^{ST} = c_2^{SH} = b(1+\sigma+\varphi)$ where $\sigma > 0$ represents a smartness factor – the extent to which promoted people get an extra income supplement to reflect the value of real smartness rather than the flashiness of a Hare. In Period 2 some of the Hares who were promoted in period 1 will turn out not to actually have much substance and will be Dull Hares. Having already been promoted they tread water in terms of income and so in period 2 get current income $c_2^{DH} = b(1+\varphi)$. Finally Dull Tortoises don't get promoted in period 2 either and so end up with current income $c_2^{DT} = b$.

For simplicity it is assumed that these two manifested characteristics – flashiness and smartness – are independently distributed in the population. Let p_H, $0 < p_H < 1$ be the

proportion of people who are Hares, and p_S, $0 < p_S < 1$ be the proportion of people who are Smart.

In period 1 the average current income of the group is

$$\bar{c}_1 = p_H c_1^H + (1 - p_H) c_1^T = b(1 + p_H \varphi),$$

while in period 2 it is

$$\bar{c}_2 = b\left[1 + p_S(\sigma + \varphi) + (1 - p_S) p_H \varphi\right] = \bar{c}_1 + p_S b\left[\sigma + \varphi(1 - p_H)\right]$$

It is assumed that the happiness experienced by each person in each period depends on

i. A comparison of their current income with the average current income of their peers.

ii. A comparison of their view of their lifetime income with the average lifetime income of their peers. In period 1 lifetime income is not fully known so individuals have to estimate both their own lifetime income and the average lifetime income of their peers.

It follows from the above assumptions that, at the end of Period 1:

- the expected lifetime income of a Hare is

$$y_1^{eH} = 2c_1^H + p_S b\sigma$$

- the expected lifetime income of a Tortoise is

$$y_1^{eT} = 2c_1^T + p_S b(\sigma + \varphi)$$

- the expected average lifetime income of the peer group is

$$\bar{y}_1 = 2\bar{c}_1 + p_S b\left[\sigma + \varphi(1 - p_H)\right].$$

Now suppose that although, for individuals, the probability of being Smart is the same whether they are a Hare or a Tortoise, nevertheless in the population as a whole, the proportion of Smart people is related to the proportion of Hares by

$$p_S = p_H \quad [12] \qquad (1)$$

It follows from this that, at the end of Period 1:

- the expected lifetime income of a Hare is

$$y_1^{eH} = 2c_1^H + p_H b\sigma \qquad (2)$$

- the expected lifetime income of a Tortoise is

$$y_1^{eT} = 2c_1^T + p_H b(\sigma + \varphi) \qquad (3)$$

- the expected average lifetime income of the peer group is

$$\bar{y}_1 = 2\bar{c}_1 + (p_H b)(\sigma + \varphi) - (p_H b)^2 \frac{\varphi}{b}. \qquad (4)$$

Information structure

The information structure of the model is as follows.

- At the outset, and throughout their lives, individuals know: the values of φ and σ – the income premiums to flashiness and smartness respectively; the relationship between period 1 and period 2 incomes conditional on being of various types; and the relationship between p_S and p_H as given by (1).
- However initially they do not know the economic prospects for their cohort – whether they have skills that will turn out to be in high demand and lead to high opportunities for promotion. That is, initially they do not know the values of *b* and p_H.
- However in Period 1 they learn their own income and that of their peers, and so, by comparing them, they know whether they have turned out be a Hare or a Tortoise. Formally, they learn $c_1^j, \quad j = H, T$; the average income of their peers, $\bar{c}_1$; their

[12] We could make the more general assumption that $p_S = \theta p_H, \quad 0 < \theta < \frac{1}{p_H}$, but that adds very little to the analysis.

current income relative to that of their peers, ${}^{c}r_1^j = \frac{c_1^j}{\bar{c}_1}, \quad j = H,T$ and hence their type *H* or *T*. Also from what they learn in Period 1 they can deduce the values of *b* and p_H and hence, from (1), the value of their future promotion prospects, p_S. Using this they can use (2), (3) and (4) to calculate their own expected lifetime income and the average of that of their peers.

- In period 2 everything is revealed. Individuals learn the value of their current income in period 2 and the average current income of their peers. Comparing their current income in period 2 to that earned in period 1, they learn whether they are Smart or Dull, so they now fully know their type. They can now carry out a full comparison of how their life has gone relative to their peers in terms of both their relative current income and their relative lifetime income. Formally individuals learn their period two income $c_2^{jk}, \quad j = S,D; \quad k = H,T$ and hence their type $jk, \quad j = S,D; \quad k = H,T$. They also learn the average period 2 income of their peers $\bar{c}_2$.[13] Individuals therefore know their full lifetime income $y_2^{jk} = c_1^k + c_2^{jk}, \quad j = S,D; k = H,T$ and the average lifetime income of their peers: $\bar{y}_2 = \bar{c}_1 + \bar{c}_2$.

Implications

Having set out the assumptions of the model, we now derive the implications. The fundamental issue we want to investigate is how the average current income of the peer group in each of the two periods affects each individual's reported happiness, taking as given their own income. In particular we want to explore the possibility that, although a higher level of peer income in Period 1 lowers relative **current** income, it might raise expected relative **lifetime** income, since it sends a signal about higher promotion prospects in the future.

Unfolding Lives

[13] Though they were able to work this out in period 1.

Period 1

Hares

In period 1 Hares learn their current income $c_1^H = b(1+\varphi)$ and the average income of their peers, $\bar{c}_1 = b(1+p_H\varphi)$. Hence they know their relative current period 1 income

$$^{c}r_1^H = \frac{c_1^H}{\bar{c}_1} > 1$$

which is, of course, a strictly decreasing function of the average period 1 income of their peers.

From this they calculate:

$$b = \frac{c_1^H}{1+\varphi}; \quad bp_H = \frac{\bar{c}_1(1+\varphi) - c_1^H}{\varphi(1+\varphi)} \tag{5}$$

Substitute (5) into (2) and (4) to get:

$$y_1^{eH} = \frac{2\varphi(1+\varphi)c_1^H + \sigma\left[\bar{c}_1(1+\varphi) - c_1^H\right]}{\varphi(1+\varphi)} \tag{6}$$

$$\bar{y}_1^H = \frac{2\varphi(1+\varphi)\bar{c}_1 + (\sigma+\varphi)\left[\bar{c}_1(1+\varphi) - c_1^H\right] - \left[\bar{c}_1(1+\varphi) - c_1^H\right]^2 \frac{1}{c_1^H}}{\varphi(1+\varphi)} \tag{7}$$

where $\bar{y}_1^H$ is the average lifetime income that Hares expect their peers to get on the basis of the information available to Hares in Period 1.

It is straightforward to show that

$$\frac{\partial \bar{y}_1^H}{\partial \bar{c}_1} = \frac{(\sigma+\varphi) + 2(1-p_H)\varphi}{\varphi} > \frac{\sigma}{\varphi} = \frac{\partial y_1^{eH}}{\partial \bar{c}_1} > 0 \tag{8}$$

so, other things being equal, the higher is the current income of their peers, the higher is the realised proportion of Hares in the population, and so, from (1), the greater the promotion prospects they face in Period 2. This raises Hares' estimated value of their own lifetime income, but also that of their peers, and indeed the latter increases by more than the former.

Now from (6) and (7), in Period 1 Hares expect to end up with a relative lifetime income:

$$
\begin{aligned}
{}^{y}r_1^{eH} &= \frac{y_1^{eH}}{\overline{y}_1^{H}} \\
&= \frac{2\varphi(1+\varphi)c_1^H + \sigma\left[\bar{c}_1(1+\varphi) - c_1^H\right]}{2\varphi(1+\varphi)\bar{c}_1 + (\varphi+\sigma)\left[\bar{c}_1(1+\varphi) - c_1^H\right] - \left[\bar{c}_1(1+\varphi) - c_1^H\right]^2 \frac{1}{c_1^H}}
\end{aligned}
\qquad (9)
$$

It is straightforward to show that

$$
{}^{y}r_1^{eH} = \frac{2(1+\varphi) + \sigma p_H}{\left[2(1+\varphi) + \sigma p_H\right] - \varphi(1-p_H) - \varphi(1-p_H)^2} > 1 \qquad (10)
$$

and so, as we know must be the case, the expected lifetime income of Hares is greater than the expected lifetime income of their peers.

By differentiating (9) w.r.t $\bar{c}_1$ we get:

$$
\frac{\partial\, {}^{y}r_1^{eH}}{\partial \bar{c}_1} = \frac{\dfrac{\partial y_1^{eH}}{\partial \bar{c}_1} - {}^{y}r_1^{eH}\dfrac{\partial \overline{y}_1^{H}}{\partial \bar{c}_1}}{\overline{y}_1^{H}} \qquad (11)
$$

which, from (8) and (10) is strictly negative, so the relative lifetime income expected by Hares in period 1 is a decreasing function of average current income of their peers, and so too is their happiness.

Tortoises

In period 1 Tortoises learn their current income $c_1^T = b$ and the average income of their peers, $\bar{c}_1 = b(1+p_H\varphi)$. Hence they know their relative current period 1 income

$$
{}^{c}r_1^{T} = \frac{c_1^T}{\bar{c}_1} < 1 \qquad (12)
$$

which is, of course, a strictly decreasing function of the average period 1 income of their peers.

From this information Tortoises can also work out:

$$b = c_1^T; \qquad bp_H = \frac{\bar{c}_1 - c_1^T}{\varphi} \tag{13}$$

Substitute (13) into (3) and (4) to get:

$$y_1^{eT} = \frac{2\varphi c_1^T + (\sigma + \varphi)\left(\bar{c}_1 - c_1^T\right)}{\varphi} \tag{14}$$

$$\bar{y}_1^T = \frac{2\varphi \bar{c}_1 + (\sigma + \varphi)\left(\bar{c}_1 - c_1^T\right) - \left(\bar{c}_1 - c_1^T\right)^2 \frac{1}{c_1^T}}{\varphi} \tag{15}$$

where $\bar{y}_1^T$ is the average lifetime income that Tortoises expect their peers to get on the basis of the information available to Tortoises in Period 1.

It is straightforward to show that

$$\frac{\partial \bar{y}_1^T}{\partial \bar{c}_1} = \frac{(\sigma + \varphi) + 2(1 - p_H)\varphi}{\varphi} > \frac{\sigma + \varphi}{\varphi} = \frac{\partial y_1^{eT}}{\partial \bar{c}_1} > 0 \tag{16}$$

so, just as with Hares, the higher is the current income of their peers, the higher is the realised proportion of Hares in the population, and so, from (1), the greater the promotion prospects that Tortoises face in Period 2. This raises Tortoises' estimated value of their own lifetime income, but also that of their peers, and indeed the latter increases by more than the former.

Now from (14) and (15), in Period 1 Tortoises expect to end up with a relative lifetime income:

$${}^{y}r_1^{eT} = \frac{y_1^{eT}}{\bar{y}_1^T} = \frac{2\varphi c_1^T + (\sigma + \varphi)\left(\bar{c}_1 - c_1^T\right)}{2\varphi \bar{c}_1 + (\sigma + \varphi)\left(\bar{c}_1 - c_1^T\right) - \left(\bar{c}_1 - c_1^T\right)^2 \frac{1}{c_1^T}} \tag{17}$$

It is straightforward to show that

$${}^{y}r_1^{eT} = \frac{2 + (\sigma + \varphi) p_H}{\left[2 + (\sigma + \kappa) p_H\right] + \varphi p_H (2 - p_H)} < 1 \tag{18}$$

and so, as we know must be the case, the expected lifetime income of Tortoises is lower than the expected lifetime income of their peers.

By differentiating (18) w.r.t $\bar{c}_1$ we get:

$$\frac{\partial {}^{y}r_1^{eT}}{\partial \bar{c}_1} = \frac{\frac{\partial y_1^{eT}}{\partial \bar{c}_1} - {}^{y}r_1^{eT}\frac{\partial \bar{y}_1^{T}}{\partial \bar{c}_1}}{\bar{y}_1^{T}} \qquad (19)$$

Consequently

$$\frac{\partial {}^{y}r_1^{eT}}{\partial \bar{c}_1} \gtreqless 0 \quad \Leftrightarrow \quad \frac{\frac{\partial y_1^{eT}}{\partial \bar{c}_1}}{\frac{\partial \bar{y}_1^{T}}{\partial \bar{c}_1}} \gtreqless {}^{y}r_1^{eT} \qquad (20)$$

Substitute (16) into (20) and we get:

$$\frac{\partial {}^{y}r_1^{eT}}{\partial \bar{c}_1} \gtreqless 0 \quad \Leftrightarrow \quad \frac{\sigma+\varphi}{(\sigma+\varphi)+2(1-p_H)\varphi} \gtreqless \frac{2+(\sigma+\varphi)p_H}{2+(\sigma+\varphi)p_H+\varphi p_H(2-p_H)} \qquad (21)$$

It is clear that if $p_H = 0$ then $\frac{\partial {}^{y}r_1^{eT}}{\partial \bar{c}_1} < 0$, whereas if $p_H = 1$ then $\frac{\partial {}^{y}r_1^{eT}}{\partial \bar{c}_1} > 0$, so the conclusion is that if p_H is sufficiently large then an increase in the average income earned by their peers in Period 1 **raises** the expected relative lifetime income of Tortoises and so, potentially their happiness.

Period Two

This is straightforward.

Each type of individual knows their current period 2 income, c_2^{jk}, $j = S, D$; $k = H, T$ and the average period 2 income of their peers $\bar{c}_2$. Consequently they can work out their relative current income

$${}^{c}r_2^{jk} = \frac{c_2^{jk}}{\bar{c}_2} \quad j = S, D; \quad k = H, T$$

which is a strictly decreasing function of the average income of their peers.

Each individual also sees clearly their relative performance in terms of lifetime income

$$ {}^{y}r_2^{jk} = \frac{y_2^{jk}}{\bar{y}_2} = \frac{c_1^k + c_2^{jk}}{\bar{c}_1 + \bar{c}_2} \quad j = S, D; \quad k = H, T $$

and this too is a strictly decreasing function of the average period 2 income of their peers $\bar{c}_2$. So, unambiguously, happiness of all individuals is a strictly decreasing function of the average period 2 income of their peers $\bar{c}_2$.

Conclusion

Though very simple this model seems to be capable of generating predictions that are consistent with the empirical evidence, namely that, under some circumstances and for some individuals an increase in the average current income earned by their peers may make people happier early in life, because of the signalling role it plays on prospects for future relative lifetime income. However later in life when everything has been learned, then, *ceteris paribus*, the higher the current income of their peers the worse people think they have performed in relative terms whether this is viewed in terms of just current performance or, looking back over one's life, in terms of lifetime performance.