So far so Good:
Age, Sex, Happiness and Relative Income

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Abstract

With data from the German Socio-Economic Panel we confirm the standard negative effects of comparison income on life satisfaction, with a cubic for age to capture declining happiness of the oldest, instead of a quadratic. However when we split the sample by age we find a *positive significant* effect of comparison income in the under 45s, and the usual negative effect only in those over 45. When we split by gender as well, the positive comparison effect *only* holds for young men, but the negative effect for older, non-retired women is three times larger than for older men. Our results provide first evidence that usual aggregation of ages and genders (with standard controls) can obscure major differences in the effects of relative income. We also show that the age differences are consistent with a simple 2-period model of relative income under uncertainty, where higher comparison income for younger individuals can signal higher or lower expected lifetime *relative income*, and hence either increase or decrease expected lifetime well-being.

JEL classification: D10, I31, J10

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1. Introduction

Among the most important results in happiness research, which largely explain the Easterlin Paradox, are the negative effects of comparison or reference income, found in many different contexts (Layard et al. 2010, Clark et al. 2008, Ferrer-i-Carbonell (2005), Luttmer, 2005). 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. The relative income effect, which had already been discussed by a few economists, and more widely by sociologists as 'relative deprivation' (Runciman 1966), and by some earlier economists as status (Veblen, 1899), refers to comparison of one's own current situation with that of 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 prospects. Thus a higher reference income in this context might be perceived as only a temporary 'relative deprivation', but also as an indicator of a better future, which he denoted 'the tunnel effect', with an inherently ambiguous net result on current subjective well-being (SWB).

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 deprivation or success should dominate. This asymmetry suggests estimating the effects of relative income separately for young and old sub-samples, which is our approach here, and does not seem to have been implemented previously.

To test these ideas we use data from the German Socio-Economic Panel (SOEP) to estimate life-satisfaction separately for sub-samples of individuals between 18 and 45, over 45 but not retired, and those who are retired, as well as for the complete sample with all ages. With the full sample we confirm the results of Layard et al. (2010), and Ferrer-i-Carbonell (2005), who also find strong negative effects of comparison income with SOEP data, using a quadratic in age and many controls. However, we show that a cubic in age is necessary to control for declining happiness of the oldest respondents, following Fischer (2009).

Our main innovation, in contrast to all previous work that we are aware of, is to split the sample by age (and gender, below), 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, non-retired group, though comparison income loses significance for the retired. Thus fundamental results of happiness research change dramatically after disaggregating the complete sample, a change not captured by the usual quadratic in age: the seemingly robust negative effect of reference income turns *positive* in younger sub-samples, (a result which is consistent with Hirschman and Rothschild's (1973) pioneering analysis, though not directly predicted by them), and loses significance for the oldest.[1]

We have also formalised some of these ideas in a simple 2-period model with uncertainty. Depending on parameters, some members of the younger cohort may find that higher current 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. These potential differences are thus obscured by the usual aggregation of all age

[1] In an earlier version of this paper, FitzRoy et al. (2011), we also reported some results using UK data from the BHPS for 2008. This showed that coefficients on comparison income went from being significant to insignificant once the sample was disaggregated, and so confirmed the sensitivity of these estimated coefficients to disaggregation. However the coefficients for the aggregate sample were out of line with those reported for other advanced countries, being of the same sign, but much smaller than usual for own income and smaller in absolute magnitude than for comparison income. So we are undertaking further research to better understand the link between income and life-satisfaction for the UK.

groups with a quadratic in age, (which also misses declining happiness of the oldest). 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.

Gender effects in well-being research are usually captured by a dummy which typically shows very small, positive female effects, and another novelty here is that we also disaggregate by *age and gender*. This reveals an interesting, new result, which is basically consistent with the theory, though not explicitly included. We would expect young males to be more exclusively career oriented than at least some young women, who tend to have more family and child care responsibilities, so the response of younger men to the signal of comparison income should be stronger than that of women. However, women form a more heterogeneous group than men, the age of first marriage has been rising, and more women remain single for longer, or remain childless after marriage and concentrate on their careers. Thus net effects are not entirely obvious.

In fact we find that *only* young men in West Germany react positively and significantly to comparison income, with no significant effect for young women (perhaps due to the signalling and deprivation effects for different groups cancelling on average). In contrast, the negative, relative deprivation, or status effect for older, non-retired women is significant and about *three times larger* than for older men. Interestingly, and perhaps surprisingly, retired women are also indifferent to comparison income. The unreported control coefficients are very similar for men and women, though there are more differences between the age groups.

The plan of the paper is to provide a brief review of some more relevant literature in section 2, followed by the theoretical model in section 3. Discussion of the SOEP data, and subsequent empirical results are in section 4. Conclusions are summarized in section 5, and tables are in the appendix.

2. A Brief Literature Review

While Hirschman and Rothschild's ideas have long been neglected, they were tested by Drichoutis et al. (2010), who found insignificant effects of comparison income for the transition economies of Eastern Europe, and by Senik (2008, 2004), who found positive effects of relative 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. Much less plausibly, Senik (2008) also finds a strong *positive* effect of relative 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. Senik argues that Luttmer's neighbourhood mean income does not have the same informational content as comparison with an educational or professional peer-group, but this is questionable. Living in a more prosperous area surely also offers better career prospects than being surrounded by poverty, with lower mobility costs, as well as probably providing various local public goods, better quality services, etc., which are likely to directly raise well-being. Thus Luttmer's (2005) negative comparison effect (for all ages) arises *in spite of* several potential underlying positive neighbourhood effects.

Senik (2008) includes all ages, but omits regional effects, and most seriously, both employment status and health from her second-stage explanatory variables, though these are generally found to be among the most important determinants of SWB, so their omission

could cause omitted variable bias. She also uses individual income instead of the more natural household income; thus some women with little or no income may be living in affluent households, but the precise reasons for her anomalous results are unclear. Very surprisingly, Senik (2008) also reports *positive* significant relative income effects on financial satisfaction for Germany, Netherlands, Ireland and Spain in her Table 3, though she discusses these effects for only Ireland and Spain in the text. These results for stable western countries are clearly contradicted by studies mentioned above – and ours below for life satisfaction.[2] She claims 'predominantly negative' relative income effects in her sample of 14 West European countries, but reports negative significant coefficients for only 6 countries.

In a previous version of the above paper, Senik (2006) reported quite different results for financial satisfaction in the same West European countries, with highly significant, negative effects of reference income in all cases, but she does not mention these differences in the later, published version.

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, with the plausible finding that job-satisfaction is higher in establishments with higher average pay, which plausibly signals one's own prospects. Interestingly in the light of our findings below, 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.

By contrast, 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. (2011) find a negative effect of higher comparison income on

[2] Senik (2008) uses 'jealousy' in her title and text, to refer to the relative deprivation effect of comparison, (sometimes interpreted as preference for fairness, or as envy). In fact, jealousy refers to 'an anticipated loss' and 'is not to be confused with envy' (Wikipedia).

job-satisfaction, when this information is first revealed. There is also evidence for the importance of comparison from neuroscience (Fliessbach et al., 2007). Separating by age and gender does not seem to have been considered previously.[3]

3. 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[4].

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.

[3] Senik (2008) uses an age-interaction term to find stronger positive effects of reference income for younger respondents in Eastern Europe, and in the US, but reports no evidence of negative comparison effects for older individuals.

[4] As noted, this contrasts with the well-established finding – which we also report – that, when all age groups are pooled together, average income of the comparison group has a significant negative impact on reported happiness or life-satisfaction.

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

$$p_S = p_H{}^5 \qquad (1)$$

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).

[5] 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.

- 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 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 $\bar{c}_2$.[6] 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: $\bar{y}_2 = \bar{c}_1 + \bar{c}_2$.

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

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

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

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

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:

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

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:

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

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:

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

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

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

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

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

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

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:

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

It is straightforward to show that

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

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

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

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

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

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, $c_2^{jk}, \quad j = S, D; \quad k = H, T$ 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.

4. Empirical Evidence from the German SOEP

The data used for this section comes from the German Socio-Economic Panel (SOEP), which is a representative micro data set providing detailed information on persons, families and households in Germany (Wagner et al. 2007). The SOEP was started in 1984 and has become a widely used database for sociologists and economists. 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 our paper, we make use of the entire 2008 wave of the SOEP but disaggregate by gender, retired, non-retired, and under 45 status,[7] to analyse the nexus between happiness, relative income and age based on 9,725 individual observations.

Our dependent variable is an individual's self-reported life-satisfaction which 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. Our main explanatory variables of interest are individual and reference income, which are both measured at the household level after deducting taxes and social insurance contributions.[8] The quadratic in age favoured by economists (Blanchflower and Oswald, 2008), does not capture the striking decline in well-being among those over 80, as shown by Fischer (2009) and Wunder et al. (2011), who control for cohort effects. Our use of a cubic in age also reveals that older women's life satisfaction declines earlier (from around age 80), and falls further than men's, though, strikingly, not as far as the almost identical minimum for both sexes just before 40. For the identification of the comparison or reference income, we follow Layard et al. (2010) and assume 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 similar education level. We therefore define an

[7] Results remain very similar if we consider over 65 instead of retirement as the upper 'boundary'.

[8] We adjust for the number of adults in the household, though this makes little difference to the results. In cases with 2 adults, we divide household income by 1.6. In cases of three or more adults within a household, we use a divisor of 2.1.

individual's reference group by his/ her age (6 categories), education (2 categories) and gender. Experiments with different definitions of comparison income show that results are robust. We also follow Layard et al. (2010) in restricting our analysis to West Germany, motivated by large and persisting socio-economic and cultural differences between West and East Germany which go beyond our scope here (Pfaff and Hirata, 2011). To test the influence of reference income on life-satisfaction we estimate the following model:

$$H = \beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 lnY + \beta_4 ln\bar{Y} + \alpha X + \varepsilon, \quad (22)$$

where H measures self-reported life-satisfaction on an 11-point scale, and X is a vector of individual covariates including individual characteristics like gender, employment status and self-reported health as well as dummies for federal states. Y captures annual net household income of an individual, while $\overline{Y}$ describes the mean income of the corresponding reference group defined by age, gender, education and region.

We first illustrate 'pure' age effects over the life-cycle for men and women in Figures 1 and 2, where other characteristics are held constant. The estimated age-life satisfaction profile is based on parameters taken from an OLS regression based on our whole sample with quadratic and cubic terms in age, and socio-economic controls. Women start happier than men, both decline to the same minimum around 40, but male life-satisfaction increases until they are well over 80, to a much higher level than the earlier peak for women, whose happiness then declines much further. These age effects are captured by linear, quadratic and cubic terms in the following tables.

Column (1) of table 2 reports the results of our benchmark specification for West Germany. Our positive and significant income coefficient has a similar size as in Layard et al. (2010),

who exploit the panel aspect of the SOEP and use individual fixed effects.[9] With respect to the role of relative income, we confirm the recent findings of Layard et al. (2010), Luttmer (2005), Ferrer-i-Carbonell (2005) and many others with all-age samples: reference income has a negative effect on individual well-being. However, the positive influence of own income is still larger than the negative effect of reference income.

Using many controls provides higher explanatory power of our estimates than is usual in cross-sectional regressions. For data reasons we do not use the full panel with individual fixed effects, but Layard et al. (2010) show that fixed effects only reduce the size of the coefficients of own-income and relative income (and some controls), but do not change signs or statistical significance of the income variables. They also show that adaptation provides only small additional explanatory power in the SOEP.

By estimating a simple OLS model, we treat life-satisfaction scores as cardinal and comparable across respondents. This assumption is sometimes criticised in the economic literature, but estimates from an 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 on cardinality or ordinality of answers to life-satisfaction questions have no substantial impact on the empirical results. The other individual factors and control variables influence individual life-satisfaction in the usual way: e.g. being married is positively associated with individual well-being, as is health, social contact and work status.

Table 2 also provides estimates for West Germany stratified by age groups. The results in column (2) highlight that reference income has a *positive* significant effect for individuals not older than 45. The standard negative relationship between reference income and individual

[9] However, they exclude immigrants and individuals under 30 and over 55. Due to the cross-sectional nature of the data used, we do not control for unobserved heterogeneity of the respondents. Layard et al. (2010) find that individual fixed effects preserve a highly significant, negative reference income effect, nearly as large in magnitude as the own income effect.

well-being only holds true for individuals older than 45 (see column 3).[10] Thus a fundamental result of happiness research changes dramatically as soon as we disaggregate the sample into young and old individuals. Our findings are consistent with the model prediction that the positive signalling effect can dominate the negative deprivation effect for young adults, (though only for men as we see below): during early career phases with high job and income mobility, comparison income helps to predict own future earnings and therefore impacts positively upon own satisfaction. Only when an individual has reached a stable position within his/her career, does comparison with reference income signal lasting positive status or relative deprivation in the usual manner, so that higher comparison income reduces corresponding well-being.

Next in Tables 3 and 4, we report separate estimates for West German men and women, for all ages and the three age groups. A comparison of the results in column (1) shows that comparison income has a much larger negative effect for all-age women than for all men. Remarkably, for younger men the *positive* effect of comparison income is *twice as large as the effect of own income*, which suggests the importance of expectations, whereas for younger (and retired) women it is insignificant. In contrast, for older, non-retired women the negative effect of comparison is nearly three times larger than for older men, and *twice* the size of the own income effect.

Our data provides household income, corrected for the number of adults in the household, so women who earn less than their partners are also actually comparing partners' success, but it is not clear why comparison should be more important for older, non-retired women than for men at the peak of full time careers, (or for retired women). A possibility is that men are more involved in their work, and hence less interested in status and comparison. On the other hand, many younger women are likely to be preoccupied with family and children, so it is

[10] Our results are qualitatively similar if we change the age limits for the two sub-samples.

very plausible that they are not interested in comparison, though the growing number of 'career women' should be. Thus our estimates are probably capturing average effects over heterogeneous groups of women.

5. Conclusions

While results from the entire samples confirm previous findings that reference income has a strong negative effect on well-being, our sub-sample regressions for different age/gender groups show that the effect of comparison income on individual life-satisfaction changes dramatically over the life-cycle in West Germany, and between men and women. The age effects are certainly consistent with our model (and with Hirschman's 'tunnel hypothesis', but in the unexpected context of a stable, advanced economy with relatively low mobility), and clearly have major consequences for the interpretation of well-being, comparison, and relative optimism or deprivation over the life-cycle. The next surprise comes from the gender split. Comparison income does not affect young women in West Germany, or older, retired women, and has the strongest negative effect on older, non-retired women; its strong positive effect is restricted to young men. Aggregation over age and gender in previous well-being studies thus obscures major differences in the role of relative income, and similarly detailed, disaggregated studies of other countries are clearly needed. Finally, we emphasize that all our results are robust to alternative age splits and definitions of comparison income.

Going beyond our cross-sectional focus here, these results may perhaps also 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 SWB from increasing reference income and economic growth), average happiness is more likely to stagnate.

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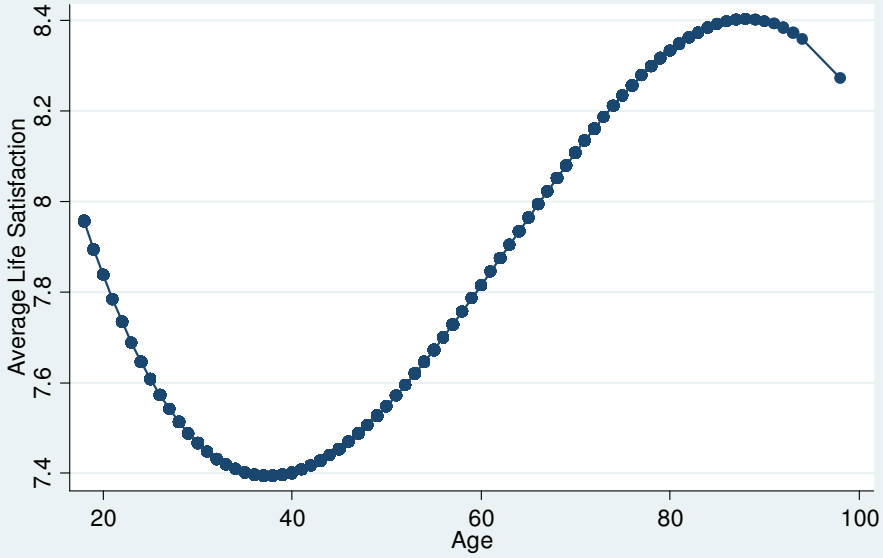
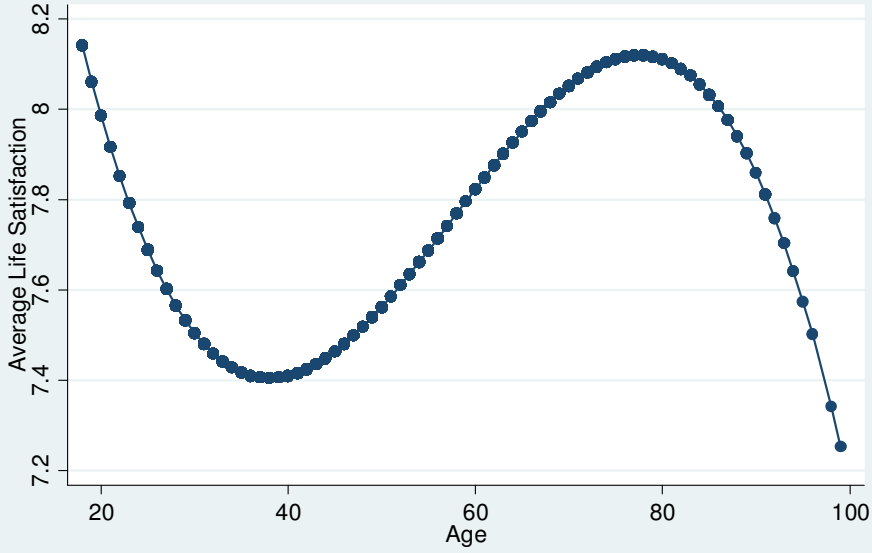
Figure 1: Life Satisfaction Over The Life Cycle, Men



Source: GSOEP, 2008, own calculations

Figure 2: Life Satisfaction Over The Life Cycle, Women



Source: GSOEP, 2008, own calculations

Table 1: Summary Statistics West Germany, by age groups and gender					
	All	<=45	>45 All	>45 Non-retired	>45 Retired
Life-Satisfaction	7.12	7.19	7.06	7.10	7.00
	(1.73)	(1.63)	(1.80)	(1.72)	(1.9)
Age	49.71	33.41	62.15	54.70	71.39
	(17.33)	(8.250)	(10.97)	(6.44)	(8.00)
Household income per capita	2016	2010	2021	2325	1645
	(1279)	(1116)	(1392)	(1575)	(1003)
Comparison income per capita	2016	2029	2006	2230	1729
	(500)	(349)	(590)	(593)	(452)
N					

Mean coefficients; 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 per capita measures the net monthly household income of the respondent adjusted by the number of adults in the household. Comparison income per capita measures the average net monthly adjusted household income within the skill group (Age (6 categories), Sex, Education (2 categories), Region (East vs. West)) to which the respondent belongs. Source: SOEP 2008

Table 2: West Germany, by age groups					
	(1) all	(2) <=45	(3) >45 All	(4) >45 Non-retired	(5) >45 Retired
Age (linear)	-0.12***	-0.01***	0.10***	0.02***	0.20***
	(-6.35)	(-4.32)	(4.78)	(5.06)	(3.66)
Age (quadratic)	0.12***		-0.03***		-0.07***
	(6.19)		(-4.18)		(-3.56)
Age (cubic)	-0.01***				
	(-5.66)				
Household income p.c.	0.48***	0.27***	0.62***	0.59***	0.66***
	(14.53)	(5.34)	(14.32)	(10.50)	(9.57)
Comparison income p.c.	-0.37***	0.34**	-0.54***	-0.68***	-0.29
	(-4.37)	(2.31)	(-4.88)	(-4.99)	(-1.45)
Observations	13,085	5,666	7,419	4,108	3,311
Adj. R-squared	0.217	0.205	0.228	0.243	0.227

Results from OLS regressions. Dependent variable: Life-Satisfaction. Controls for gender, marriage, cohabiting, children, health status, foreign-born, social activities, higher education, work status, interview form and federal states are included. The quadratic and cubic age regressors are divided by 50 and 500, respectively, to assist in yielding reasonable scaling of attached estimates. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: West Germany, men by age groups				
	(1)	(2)	(3)	(4)
	all	<=45	>45	>45
			Non-retired	Retired
Age (linear)	-0.08***	-0.01**	0.03***	0.19**
	(-2.99)	(-2.53)	(4.92)	(2.19)
Age (quadratic)	0.08***			-0.07**
	(2.85)			(-2.13)
Age (cubic)	-0.00**			
	(-2.47)			
Household income p.c.	0.53***	0.27***	0.66***	0.80***
	(11.14)	(3.65)	(8.63)	(7.99)
Comparison income p.c.	-0.26**	0.62***	-0.37**	-0.42*
	(-2.31)	(3.01)	(-2.05)	(-1.76)
Observations	6,238	2,682	1,976	1,580
Adj. R-squared	0.226	0.192	0.278	0.252

Results from OLS regressions. Dependent variable: Life-Satisfaction. For an overview of the controls included see end of table 2. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: West Germany, women by age groups				
	(1)	(2)	(3)	(4)
	all	<=45	>45	>45
			Non-retired	Retired
Age (linear)	-0.15***	-0.02***	0.02**	0.21***
	(-5.87)	(-3.88)	(2.36)	(2.98)
Age (quadratic)	0.15***			-0.07***
	(5.75)			(-2.90)
Age (cubic)	-0.01***			
	(-5.38)			
Household income p.c.	0.43***	0.27***	0.53***	0.53***
	(9.44)	(3.79)	(6.66)	(5.65)
Comparison income p.c.	-0.44***	0.18	-0.98***	-0.16
	(-3.57)	(0.85)	(-4.76)	(-0.45)
Observations	6,847	2,984	2,132	1,731
Adj. R-squared	0.211	0.222	0.217	0.207

Results from OLS regressions. Dependent variable: Life-Satisfaction. For an overview of the controls included see end of table 2. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1