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LIFE SATISFACTION, INCOME COMPARISONS AND INDIVIDUAL TRAITS

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People gain utility from occupying a higher ranked position in the income distribution of the reference group. This paper investigates whether these gains depend on an individual's set of personality and affective traits. Using the 2000 to 2013 waves of the German Socio-economic Panel dataset (SOEP), a subjective question on Life Satisfaction, and three different measures of personal and affective traits, we find significant and robust differences across groups and conclude that traits determine the relationship between rank and life satisfaction. The heterogeneity on the importance of income comparisons is relevant, for example, when building economic models, predicting individuals' behavior, or making welfare judgments.

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1. Introduction

Individuals care about how well they perform in comparison with the relevant others. There is a large literature devoted to understanding how individuals are influenced by their reference group and who their reference group is. Over the last two decades, the distinction between absolute and relative formulations of utility has proven a useful concept to rationalize a large set of unexplained phenomena in a variety of fields, including asset pricing, growth, consumption behavior, and wealth inequality (for a survey, Thimme, 2017). Advances at the theoretical level have been parallel to a new wave of empirical papers assessing

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the importance of relative effects for individuals' utility or welfare. Some of these empirical papers are based on the use of self-reported happiness or life satisfaction as a proxy for individual utility. The empirical evidence seems clear: people gain utility from occupying a higher ranked position in the income distribution of the reference group (Brown *et al*., 2008; Clark *et al*., 2009a; Powdthavee, 2009; Boyce, 2010; Burkhauser *et al*., 2016).

This paper examines whether the income rank effect differs between individuals endowed with different personality and affective traits. The interaction between these non-cognitive skills and social comparisons remains mostly unexplored in the happiness or life satisfaction literature. This is somewhat surprising insofar as evidence from other fields suggests that personality and affective traits influence individuals' attention and sensitiveness to social information. For example, psychologists have long recognized that the degree to which one compares and competes with others and the costs (benefits) of ranking low (high) depend on an individual's personality and other non-cognitive skills, such as self-esteem or optimism (Wheeler and Miyake, 1992; Aspinwall and Taylor, 1993; Derryberry and Reed, 1994; Lyubomirsky and Ross, 1997; Lyubomirsky *et al*., 2001; Beach and Tesser, 2000; Garcia *et al*., 2005). Boyce (2010) has already argued that individuals' personality is the most important component of individual heterogeneity in life satisfaction equations. In this paper, we empirically test whether the mediating role of personality and affective traits extends to the realm of income comparisons and life satisfaction. Therefore, it contributes to the subjective satisfaction literature that empirically shows the relevance of personality on defining the importance of income for life satisfaction (Boyce and Wood, 2011; Proto and Rustichini, 2015) by introducing heterogeneity on the effect of social comparisons.

This paper also contributes to the increasing awareness and interest in economics to understand the importance of personality and other non-cognitive skills to shape individuals' behavior and outcomes. Over the last years, there has been growing evidence on the relationships between personality and a variety outcomes, including health (Hampson *et al*., 2006), test performance (Cobb-Clark *et al*., 2014; Heckman *et al*., 2014), economic success (for a survey, Almlund *et al*., 2011), occupational choices and job search effort (Ham *et al*., 2009; Caliendo *et al*., 2014, 2015), employment (Mohanty, 2010; Uysal and Pohlmeier, 2011), and earnings (Mueller and Plug, 2006; Semykina and Linz, 2007, and Heineck and Anger, 2010). These findings have led researchers to argue that personality should be given greater consideration in economics (Borghans *et al*., 2008). This paper contributes to this literature to the extent that social comparisons are part of individuals' welfare and preferences and thus influence human behavior in several domains. In addition, income and consumption externalities have important implications for a variety of policy relevant issues at the micro and macro level, including optimal taxation, public redistribution, and the welfare costs of aggregate fluctuations (Frey and Stutzer, 2002; Di Tella *et al*., 2003; Senik, 2005, and Clark *et al*., 2008a; Kuhn *et al*., 2011).

The paper concludes that individuals at the top of the distribution of extraversion, conscientiousness, external locus of control, and negative reciprocity obtain larger satisfaction gains from being on the top of the income distribution

than the rest; while the opposite is true for those on the top of the distribution of openness-to-experiences and positive reciprocity.

The paper is organized as follows: Section 2 discusses the literature; section 3 presents the data, and the satisfaction and the personality measures used in this paper; section 4 outlines the empirical approach and research hypotheses; section 5 presents the results; and section 6 presents the concluding remarks. The paper also contains and Appendix that provides a detailed description of the personality measures used in the paper and summary statistics for the relevant variables.

2. Previous Literature

The relative income or interdependence of preferences hypothesis was first put forward in economics by Veblen (1899) and Duesenberry (1949) who sated that individuals care not only about their absolute but also about their relative income. Later contributions are Frank (1985). In psychology, Parducci's work postulates a specific function of income comparisons in which the most relevant information for the individuals is the rank they occupy within in the income distribution (Parducci, 1965). Based on Parducci's work, the existing empirical evidence using self-reported satisfaction data does find that individuals gain satisfaction from occupying a higher position in the income rank. While in economics earlier evidence captured the relative income effect using a (transformed) measure of the average income of the reference group (Clark and Oswald, 1996; Senik, 2004; Ferrer-i-Carbonell, 2005; Luttmer, 2005), recent literature has shown that income rank is a better predictor of life satisfaction and, most important, it has a stronger theoretical foundation (e.g., Boyce *et al*., 2010; Brown *et al*., 2008; Burkhauser *et al*., 2016). For example, Boyce *et al*. (2010) use data from the British Household Panel Survey to test for relative income effects using both, the average income of the reference group and the rank, to conclude that income rank as a better indicator. In this paper thus we use income rank.

Earlier evidence that empirically tested the relative income hypothesis using the mean income level of the reference group typically found a negative (and statistically significant) effect of the reference group mean income on self-reported satisfaction (Clark and Oswald, 1996; Blanchflower and Oswald, 2004; Ferrer-i-Carbonell, 2005; Luttmer, 2005; Senik, 2009). The robustness of this effect is remarkable except for a few idiosyncratic exceptions: Senik (2004) finds a positive effect of the mean income of the reference group on happiness for Russia during the 1994–2000 transition period; Caporale *et al*. (2009) for Eastern European countries; and Clark *et al*. (2009b) for job satisfaction data when using co-workers as the comparison group.

Turning into the more recent literature that captures relative income by means of the rank, Clark *et al*. (2009a) using matched data of the Danish European Community Household Panel (ECHP) with administrative data find evidence that individual reported financial satisfaction positively depends on the income rank that the households occupies in the neighborhood. Specifically, a 1-decile increase in the income rank is as important in terms of financial satisfaction as an income increase by a factor of almost 5. Based on Indonesian cross-section

data from the year 2000, Powdthavee (2009) provides very similar estimates when using respondents' perception on own relative economic position as dependent variable. Following Parducci's model, Burkhauser *et al*., (2016) using the 2006–12 waves of the Gallup World Poll, find that income rank and range are positively and statically correlated with life satisfaction. Brown *et al*. (2008) use laboratory data as well as a data for 16,000 workers in 900 workplaces within the UK and find evidence of a positive effect of a worker's rank within the workplace earnings distribution on self-reported satisfaction in different job related domains. In sum, current empirically evidence find a consistent positive effect of income rank on self-reported life satisfaction or happiness.

2.1. *Personality, social comparisons, and economic outcomes*

The existing literature estimates the relationship between income comparisons and life satisfaction for the average respondent with the exception of two papers that look at the life-cycle patterns of income comparisons (Akay and Martinsson, 2012; FitzRoy *et al*., 2014). Up to date the only existing empirical evidence on the interplay between personality and other individual traits and social comparisons is based on laboratory experiments in psychology and does not focus on income comparisons. For example, there are few experiments examining whether personality determines individuals' tendency to make upward versus downward comparisons. Although this literature does not offer a direct comparison to our research, it does indicate that response to social comparisons depends on personality (Wheeler and Miyake, 1992; Aspinwall and Taylor, 1993). Nevertheless, how and to what extent these effects expand to the realm of income comparisons remains unexplored. Based on the evidence found in psychology we present our hypothesis on the role that personality and affective traits will have on shaping the importance of income comparisons for happiness or life satisfaction:

Big 5:

- Conscientious individuals set themselves higher and longer term goals and care more about achieving them (Barrick *et al*., 1993; DeNeve and Cooper, 1998; DeYoung and Gray, 2009). Related to this, evidence also suggests that conscientious individuals tend to value more wealth accumulation (Ameriks *et al*., 2003). Therefore, we hypothesize that conscientious individuals will derive larger life satisfaction from ranking higher in the income rank.
- Agreeableness is related to prosocial behavior such as empathy, cooperation, and trust (DeYoung and Gray, 2009). While some individuals might get satisfaction from ranking high, we hypothesize that individuals with characteristics such as empathy will not particularly benefit from doing better than their reference group. Therefore we do not expect any influence of this personality on the correlation between income comparisons and life satisfaction.
- Neurotic people are more sensitive to negative emotions, such as anger, hostility and depression (Clark and Watson, 2008) and negative outcomes, threats and punishments (see DeYoung *et al*., 2010, for a survey).

Neuroticism has been associated with higher interest in social comparison (Van der Zee *et al*., 1996, 1998). Therefore, we hypothesize that neuroticism enlarges the effect of rank on life satisfaction.

- Extraversion: In contrast to neuroticism, extrovert people are more sensitive to positive emotions, such as reward (DeYoung and Gray, 2009). Since relative income is related to reward, we hypothesize that extrovert individuals will experience a larger correlation between life satisfaction and rank.
- Openness to experience: this trait has been found to be positive associated with intelligence, creativeness (Wolfradt and Pretz, 2001; Kaufman *et al*., 2016), and divergent thinking (McCrae, 1987; Silvia *et al*., 2009). To the extent that openness correlates with divergent thinking, which is characterized by nonconformity and creativity that does not follow the norm, we hypothesize that openness-to-experience individuals will also be less sensitive to social comparisons.

Locus of Control (LOC):

- External LOC: individuals with an external LOC believe that their own life depends to a large extent on external factors such as lack, the environment, or others. These individuals do not see themselves as responsible for the course of their own life and as a consequence they typically achieve lower economic and educational outcomes, have unhealthier habits, and make less parental investments (Coleman and DeLeire, 2003; Caliendo *et al*., 2015; Cobb-Clark *et al*., 2014; Lekfuangfu *et al*., 2017; Piatek and Pinger, 2016). In addition, external individuals also show lower life satisfaction and mental health as well as larger satisfaction drops right after a negative shock (Buddelmeyer and Powdthavee, 2016). Most important, individuals with external LOC also have a lower self-esteem (Judge *et al*., 2002). We hypothesize that individuals with lower self-esteem will get a larger utility from favorable comparisons than those with higher self-esteem and therefore expect that external individuals will derive larger life satisfaction from ranking higher in the income rank. Positive and negative reciprocity:[1]
- Positive reciprocity is often linked to reciprocal altruism, empathy, and ability to see and share others' unhappiness. To the extent that positive reciprocal individuals are empathic and derive disutility from seeing others suffering, we would expect that they obtain no satisfaction from occupying a higher rank. In contrast, negative reciprocity is negatively correlated with behaviors such as trust (Dohmen *et al*., 2008) as well as with happiness and number of friends (Dohmen *et al*., 2009); and is positively correlated with anger (Fehr and Gächter, 2002). Therefore, we expect that negative reciprocal individuals derive, if anything, larger satisfaction from occupying a higher rank in the income distribution.

[1]Since the current data shows no correlation between positive and negative reciprocity, and in line with previous literature, we consider them as separate traits and are independently incorporated into the regression (Dohmen *et al*., 2009).

3. Data and Measurement

3.1. *Data*

Initiated in 1984, the German SOEP is a representative longitudinal annual household survey that contains information on a large set of personal and household characteristics (for detailed information see Wagner *at al*., 2007, and Frick *et al*., 2007). The empirical analysis presented in this paper is based on waves 2000 to 2013 and the unit of analysis is the individual. The final sample, after excluding observations with missing values, is of 223,805 observations.

Life satisfaction is measured with a question in which respondents are asked "how satisfied they are with their life, all things considered". The answer to this question can take discrete values from 0 to 10 and hereafter will be referred to as Life Satisfaction (LS). Despite a long tradition among sociologist and psychologist, subjective data was subject to criticisms among some economists concerned about the potential biases arising from cultural differences, framing problems, cognitive bias, and mood effects. Although for reasons of space we do not enter into details, we note that the evidence accumulated over recent years has proven the validity and consistency of self-reported data. In a nutshell, self-reported measures of satisfaction have shown predictive power over relevant actions such as future divorce (Guven *et al*., 2012) and job quits (Clark, 2001); and are related (in the expected direction) to a number of objective indicators including physical health and longevity (Danner *et al*., 2001), macroeconomic fluctuations (Di Tella *et al*., 2003), unemployment (Clark *et al*., 2008b), and to measures of revealed preferences (Oswald and Wu, 2010). These life satisfaction measures also show a reasonable amount of internal consistency and temporal reliability: they correlate well with one another and with alternative methods of measurement, including ratings made by family and friends, facial measures of emotion, and a vast array of psychological and psychosocial indicators (Sandvik *et al*., 1993; Kahneman, 1999; Cacioppo *et al*., 2008). For an overview see Ferrer-i-Carbonell (2013) and Stutzer and Frey (2013).

Table A1 in the Appendix contains the summary statistics of the sample. Average Life Satisfaction over the sample period is 6.97 (SD = 1.77). Average monthly household income amounts to 2,782 euros.[2] Average age is 49.9 years and the average educational attainment is 12.2 years of schooling. Women account for 52.2 percent of the sample. Most individuals are employed (62.2 percent) and married or live with a partner (66.2 percent). In the regression, household income, age and age squared, years of completed education, number of children, and adults at home are entered in their logarithm form so as to take into account their decreasing marginal contribution to life satisfaction. In order to consider heterogeneous household size and cost-of-life adjustments, all income-based variables in the paper are transformed using the OECD equivalence scale and normalized into real terms using the yearly consumer price index.

[2]Frick and Grabka (2005) argue for inputting income in the German SOEP due to the underlying selectivity processes of item non-response on income questions. This paper uses the 5 alternative income imputations provided in the dataset. Specifically, the household income variable used in the paper is a weighted average of the 5 imputations.

3.2. *Personality and affective traits*

3.2.1. *Measurement*

An important field within personality research is the development of a taxonomy that allows categorizing individuals' personality into some domains. The development of theoretical models of personality has been accompanied by research on how to measure such theoretical constructs. There are currently a set of self-reported questions that have been developed and tested to measure different personality taxonomies. One of the most known and used measures within this literature is the Big 5 and LOC, although other taxonomies of personality are also broadly accepted.

In 2005 the German SOEP included for the first time a set of self-reported questions designed to capture two taxonomies of personality and a measure of social preferences or affective trait: a short version of the Big Five Inventory (BFI), a set of items related to LOC, and measures of negative and positive reciprocity norms. These measures were asked again in the 2009, 2013 (BFI), and 2010 (LOC, reciprocity) waves of the SOEP. The Big Five and the LOC measures are two alternative well known ways to describe individuals' personality. LOC aims at capturing the degree to which individuals believe that the course of their life is under their control (e.g. depends on effort and ability) or depends on external circumstances (e.g. luck or social conditions). The Big Five is a measure to describe the five major traits that define human personality across cultures (Costa and McCrae, 1992): neuroticism, extraversion, openness-to-experiences, agreeableness, and conscientiousness. Neuroticism is the tendency to experience negative emotions such as anxiety and depression; extraversion is the tendency to be sociable, warm, active, assertive, cheerful, and in search of stimulation; openness is the tendency to be imaginative, creative, unconventional, and artistically sensitive; agreeableness reflects a dimension of interpersonal relations and is characterized by altruism, trust, modesty, and cooperativeness; and conscientiousness is the tendency to be organized, strong-willed, persistent, reliable, and a follower of rules and ethical principles[3].

There are different self-reported inventories to measure the Big Five model. The Big Five Inventory (BFI), for example, consists of 44 self-report items while the NEO personality inventory consists of 60 items. The data used in this paper is based on a short version of the BFI (BFI-S) that consists of 15 self-reported items, 3 for each personality dimension (for details see Lang *et al*., 2011). Short versions of the BFI are typically used in large-scale household questionnaires, as time is an important constraint. Despite psychologists typically work with longer questionnaires, the shortened version used in this paper has been validated against longer inventories. Using multiple samples and for two languages, English and German *et al*. (2007) conclude that, despite some losses in comparison to the full-scale, a short BFI questionnaire exhibits acceptable psychometric properties. Lang *et al*. (2011) also show that the short BFI questionnaire can replicate a five-factor structure in face-to-face as well as self-administrative questionnaires. Hahn

[3]For a detailed discussion on the origin, measurement and conceptualization of the Big Five and, more generally, personality constructs, see Borghans *et al*. (2008).

et al. (2012) examine the degree to which this brief measure captures the intended constructs as assessed by longer, more differentiated, and robust questionnaires. Their results show convergent as well as discriminant validity of the BFI-S scales with the NEO-PIR dimensions and facets, confirming previous findings by Herzberg and Brähler (2006). They also find acceptable levels of internal consistency and stability over a period of 18 months. In our data, factor analyses clearly replicated the Big Five factors by yielding a correlation matrix with five eigenvalues above unity. The five principal components accounted for 60.7 percent of the total variance. The Cronbach's alphas for the five dimensions were 0.659, 0.621, 0.618, 0.596 and 0.502. In their detailed test of validity of the BFI-S, Hahn *et al*. (2012) report similar coefficients and regard them as satisfactory, despite shortcomings for agreeableness.

Locus of Control (LOC), a model developed by Rotter (1966), is the degree to which individuals feel the control of their life is on their own hands (internal) or depends on external factors (external). People with a high score in the items measuring external LOC believe that fate, luck, social conditions, or any other external circumstances are important determinants of the course of their lives; while those with a high score on internal LOC perceive that their life depends on own ability and effort. In the SOEP data, LOC is surveyed with 10 items. Other papers using this measure are Caliendo *et al*. (2015) and Piatek and Pinger (2016). In our data internal LOC was found to exhibit a very limited amount of construct validity,[4] which means that the items were not appropriate for measuring the underlying scale and we therefore excluded this measure from the analyses. This is, the empirical analysis only includes external LOC items.

Our last measures of individual traits are positive and negative reciprocity. While some argue that reciprocity is fairly persistent and it can therefore be considered an (affective) trait (McCullough *et al*., 2002), behavioral economists would typically model reciprocity as behavior or social preferences (Falk and Fischbacher, 2006; Dohmen *et al*., 2008). In this paper we exempt from this discussion, but we refer to reciprocity as an affective trait. In the data reciprocity is measured with six items of which three refer to cooperative and rewarding tendencies ("positive reciprocity") and the other three to punishment and retaliatory aspects ("negative reciprocity") when individuals respond to other's actions. Despite the reduced number of items, the internal consistency of these two constructs is remarkably large.[5]

Table A2 in the Appendix shows the sample averages for each of the eight measures used in the paper. In the empirical analysis each trait is normalized to an average of zero and a standard deviation of 1. Figure A1 shows the frequency distribution of the normalized values. The Appendix also contains a description of all items used in the questionnaire as well as a detailed explanation of the construction of the personality measures used in the paper. An important issue in

[4]The alpha reliability coefficient was below 0.20.

[5]The Cronbach's alphas for the two dimensions were 0.623 and 0.824, respectively. Auxiliary factor analysis supported the existence of two orthogonal factors, thus validating the a priori distinction between positive and negative reciprocity.

personality measures is the concern that variability in the resulting scores might arise from measurement error.

3.2.2. *The stability of personality affective traits*

Since individual's personality and affective traits are measured three times in our panel (2005, 2009/2010, 2013), we use this information to construct an individual time-invariant score for each personality and affective trait. This is, if personality and affective traits were to change over the life-cycle, we extract from the data that part that is time constant and exclude the yearly variation. This yearly variation can be caused, among others, by true personality changes or by measurement errors. Although there is a large debate in the personality literature around the stability of such individual traits, there seems to be consensus among researchers on that personality is enduring and that changes after adulthood are smaller than at younger ages (Roberts and Del Vecchio, 2000; Costa and McCrae, 2002, 2006; Srivastava *et al*., 2003). Nevertheless, the size and importance of adulthood personality changes are at debate. While some argue that personality changes are modest, others defend that changes can be significant until age 40 (Roberts *et al*., 2006); although there is agreement on that these changes decrease with age.

Most relevant to our paper is whether the determinants of these personality changes are related to changes in happiness as well.[6] Current evidence points to changes in personality due to a maturity process (Roberts *et al*., 2001) rather than to the environment. In other words, personality changes are to a large extent related to age only. For example, with age individuals become less neurotic and more agreeable and conscientious (Soto *et a*l., 2011; Kandler *et al*., 2012). McGuee *et al*. (1993), quoted in Borghans *et al*. (2008), argue that "environmental factors do not exert cumulative long-lasting influences [. . .] even when substantial, environmental factors do not normally lead, in adulthood, to a long-term redirection to the individual course of personality development" (pp. 105–6). Cobb-Clark and Schurer (2012) use the BFI to study individual personality changes in a four year period using the HILDA, an Australian household panel dataset similar to the one used in this paper. Their findings show that individual changes are not only small but also generally unrelated to experiencing adverse life events, such as family related events (death of a spouse, child, relative, or friend or being a victim of property crime), employment and income changes (worsening of finances, retiring, being fired or being unemployed), and health related shocks (serious illness or injury, physical violence, or new health conditions). Another relevant article in the context of the present paper is Boyce *et al*. (2013), who examine how personality changes correlate with life satisfaction. Although the authors find a correlation between personality changes and life-satisfaction, we cannot rule out that these are due to aging, as the regressions use individuals fixed effects and can thus not control for age.

[6]In the Appendix we show a table of correlations between our personality measures and income rank. The correlations with all measures are very low. Since rank is defined mainly by education and income, this correlation might be driven by these two variables.

In short, the current literature, both in psychology and economics, seems to agree on that personality changes after adulthood are small and not related to life-circumstances, which in turn might affect happiness. This current evidence rules out endogeneity issues. In addition, and even if the mean age of the respondents in our sample is 49.9 years and therefore any interplay between early life events and personality is likely to be insignificant, we construct a score for each personality and affective measure that is clean from age. In concrete, we regress each trait on a fourth order polynomial in age and an individual fixed effect and we take the estimated time-invariant individual fixed effect as our measure. This means that our personality and trait measures are time constant and free from any age effect. In other words, and following Boyce (2010), we take personality scores in our regression to be constant over time. In alternative specifications, we included more explanatory variables in the personality regression (e.g. labor-market status, marital condition income, health and region), which lead to very similar regression results.

4. Empirical Approach

4.1. *Definition of reference group*

The literature on reference group formation does not yet provide much empirical evidence or theoretical insights on how individuals form their reference group and what is the stability of these across time and domains (for an exception see Falk and Knell, 2004). On one side, large-scale surveys do not contain direct questions about the composition of the reference groups and empirical results from pilot surveys or experimental evidence (see for example Clark and Senik, 2010) are not yet directly applicable to large questionnaires. Although the empirical literature has diverged on the operationalization and identification of the reference group, the studies can be clustered into two: those assuming that comparisons take place among people living in the same geographical area; and those defending that individuals' reference group is formed by those who are similar to them (e.g. same age or socio-economic status). In the first group, we find a large variety in the level of aggregation, ranging from countries (Di Tella and MacCulloch, 2003), states in the US (Blanchflower and Oswald, 2004), Public Use Microdata Areas in the US (Luttmer, 2005), census tracks in Canada (Helliwell and Huang, 2010) to neighborhoods (Clark *et al*., 2009a; Dittmann and Goebel, 2010) and sub-districts (Powdthavee, 2009). Similarly, the variables defining the reference group in the second group of studies differ slightly: while some authors consider that comparisons take place only between those in the same cohort (McBride, 2001), others include a larger set of individual characteristics (Senik, 2004; Ferrer-i-Carbonell, 2005) or include those with similar wage determinants when it comes to satisfaction with the job (Brown *at al*., 2008; Clark *et al*., 2009b).

This paper follows a mixed approach by constructing reference groups taking into account some individual characteristics as well as introducing a geographical dimension into the analysis. In concrete, we generate reference groups by partitioning the sample into various groups using the geographical region where the

household lives (West or East Germany), the gender of the respondent, the education attainment of the respondent (less than 10, 10-10.5, 11-11.5, 12, and more than 12 years of schooling), and the age of the respondent (younger than 25, 25–34, 35–44, 45–64, and older than 64). The combination of these criteria produces 100 different groups. Although sensitive analysis showed that it did not affect our results, we dropped those individuals in a group with less than 10 observations in a given year. In total 395 observations were dropped from the sample.[7]

While the reference group is defined at the individual level, the reference income is taken at the household level. In other words, individuals are assumed to obtain information about the others through their own reference group, i.e. we assume that individuals generate information by looking at those similar to them. Nevertheless, we take equivalent household (and not personal) income as the relevant measure and assume that, at least to a large extent, there is income pooling at the household level.

4.2. *Estimating procedure*

Life Satisfaction (*LS*) is assumed to be a function of personal characteristics and circumstances,

$$LS = f(LS^*(X, y, r)) \tag{1}$$

where X is a vector of socio-economic characteristics, y is household income, and r is the individual normalized income rank. The rank is defined as the position of individual i in terms of his or her household income as a proportion of the number of individuals in group g. This is: $(P_{ig}\text{-}1)/(N_g\text{-}1)$, where P_{ig} is the position of individual i in group g, and N_g is the number of individuals in the group. Normalized rank is zero for the poorest individual in the group and one for the richest one.

We take reported life satisfaction to be cardinal. This is, we assume that the distance between the eleven satisfaction categories carry a meaning. It has been shown that assuming cardinality as oppose to regress satisfaction with ordinal models is rather irrelevant for the results in terms of trade-offs between explanatory variables (Ferrer-i-Carbonell and Frijters, 2004), while it has the advantage of yielding coefficients that can be directly interpreted as marginal effects. We rely on the Probit Adapted Ordinary Least Squares (POLS) as developed by Van Praag and Ferrer-i-Carbonell (2008, p. 29–34). As a robustness check, we have estimated the model with the standard linear model and found very small differences in terms of trade-offs between variables and statistical significance. The POLS model has been applied in the happiness literature by Stevenson and Wolfers (2008, 2009) and Boes *et al.* (2007), among others. Implementing POLS begins by deriving $\{\mu_j\}_{j=0}^{J}$ values of a standard normal associated with the cumulative frequencies of the J different categories of the dependent variable, with $\mu_0 = -\infty$, $\mu_J = \infty$. Then the expectation of a standard normally distributed

[7]In the final sample the average size of the reference group is 388.2 (SD = 243.2), with a minimum size of 10 (by construction) and a maximum of 1,695 individuals.

variable is taken for an interval between any two adjacent values. Thus if the true unobserved continuous variable for individual i at time t is LS^*_{it} where the observed is $LS_{it}=j$ if $\mu_{j-1} < LS^*_{it} < \mu_j$ for $j=1,\ldots, J$, then the conditional expectation of the latent variable is given by:

$$(2) \qquad L\ddot{S}_{it}=E(LS^*_{it}|\,\mu_{j-1} < LS^*_{it} < \mu_j) = \frac{n(\mu_{j-1})-n(\mu_j)}{N(\mu_j)-N(\mu_{j-1})}$$

$$(3) \qquad L\ddot{S}_{it}=\alpha X_{it}+\beta y_{it}+\gamma r_{it}+v_i+\varepsilon_{it}$$

where X includes age and age squared, years of completed education, household size (number of children and number of adults at home), and a set of dummy variables for marital situation, employment status and health condition. Year fixed effects and controls for the 16 German federal states are included as additional explanatory variables. The term v_i represents the individual fixed effect and ε_{it} an iid error term.

In this paper we hypothesize that the effect that rank r has on life satisfaction (γ) depends on the individual personality trait p. Since we assume that each personality facet is constant across time (see section 3.2.2.), our estimation strategy is based on the premise that the vector of personality measures p is already included in the individual effect v_i. Since in the literature fixed effects are typically regarded as good controls for personality factors, our assumption, which mimics Boyce (2010), seems appropriate. We test for the existence of heterogeneous effects by interacting rank with the full vector of personality and affective traits measures,

$$(4) \qquad L\ddot{S}_{it}=\alpha X_{it}+\beta y_{it}+\gamma r_{it}+\delta p_i \cdot r_{it}+v_i+\varepsilon_{it}$$

A well determined coefficient on the personality-rank interaction terms δ would imply that the effect of the income rank on life satisfaction depends on individual's personality and affective traits. Although a way to estimate equation (4) would be using an individual random effects model and include the personality measure as an independent variable, we preferred the current approach as one cannot safely assume orthogonality between an individual random effect and the explanatory variables. This is, we cannot assume that there is no correlation between, for example, intelligence or optimism and education or income.

5. Results

Table 1 reports the estimates for equation (3) and (4). The first specification abstracts from rank-personality interactions and is used to illustrate the income rank hypothesis: people gain utility from occupying a higher rank in the income distribution of their reference group. In the data, the average effect of income rank on life satisfaction amounts to 0.057 (SD = 0.017) and is significant at the 1% level. Using the coefficient of household income as a reference (0.131, SD = 0.010), we calculate the trade-off between income and rank that maintains

TABLE 1
Rank and Personality, Fe–German Soep 2000–13

	Coeff.	t-ratio	Coeff.	t-ratio
Ln (Household income)	0.131 ***	12.580	0.135 ***	12.870
Rank	0.057 ***	3.340	0.052 ***	3.040
Rank interactions with				
Neuroticism			0.009	0.830
Extraversion			0.030 ***	2.710
Openness-to-experiences			−0.039 ***	−3.640
Agreeableness			0.015	1.230
Conscientiousness			0.050 ***	4.490
External LOC			0.039 ***	4.680
Positive reciprocity			−0.026 ***	−2.810
Negative reciprocity			0.027 **	2.480
Ln (Age)	−0.834 ***	−4.230	−0.861 ***	−4.370
Ln (Age^2)	0.111 ***	3.520	0.114 ***	3.620
Ln (Years of schooling)	−0.128 **	−2.450	−0.126 ***	−2.410
Ln (No. of adults)	−0.089 ***	−7.350	−0.088 ***	−7.220
Ln (No. of children+1)	0.000	0.000	0.001	0.150
Employed	0.018 ***	2.680	0.018 ***	2.610
Unemployed	−0.182 ***	−21.670	−0.181 ***	−21.540
Single	−0.067 ***	−5.740	−0.069 ***	−5.890
Divorced	0.063 ***	5.390	0.065 ***	5.540
Widow	−0.110 ***	−7.020	−0.106 ***	−6.640
Badhealth	−0.412 ***	−79.480	−0.412 ***	−79.440
R-squared	0.149		0.132	

Notes: i) * denotes significance at the 10% level, ** denotes significance at the 5% level, *** denotes significance at the 1% level; ii) Year fixed effects and controls for the 16 German federal states are included as additional regressors.

life satisfaction constant. We find that individuals would need a compensation of about 54.5 percent of their current income to move from the top (rank = 1) to the bottom (rank = 0) of the income distribution of their reference group ([exp(0.057/0.131)-1]x100 = 54.5%).[8] In other words, individuals would be indifferent between a 54.5 percent increase on own household income or a reduction of the income of the other members of their reference group such that they move from the bottom to the top of the rank.

As for the remaining covariates, the results are in line with those in the literature. Life satisfaction correlates negatively with education, the number of adults at home, unemployment, singlehood and widowhood, and correlated positively with being divorced, employment, and health.[9] The relationship between age and life satisfaction is u-shaped with a minimum around 42.

5.1. *The role of personality traits*

Next, we turn to the specification that introduces the income-rank interactions (equation (4)). The results show a clear heterogeneity on the correlation between rank and life satisfaction. Although the rank coefficient remains virtually

[8]This is $[\exp(\gamma/\beta * \Delta r) - 1] * 100$ in which "−1" and "*100" are added so as to obtain the result in percentage terms.

[9]Excluding subjectively perceived health status from the regression reduces the R-squared, but does not change the other relevant coefficients in any significant way.

TABLE 2
THE RANK-HOUSEHOLD INCOME EQUIVALENCE SCALE, BY PERSONALITY GROUPS

	Average	95% confidence interval
Rank	4.46 %	[1.23 % ; 7.80 %]
	114.6 €	[31.6 € ; 200.16 €]
Rank with		
Neuroticism	4.61 %	[1.06 % ; 8.28 %]
	118.3 €	[27.1 € ; 212.7 €]
Extraversion	6.27 %	[2.43 % ; 10.24 %]
	161.0 €	[62.5 € ; 262.9 €]
Openness-to-experiences	0.96 %	[−2.11 % ; 4.12 %]
	24.6 €	[−54.1 € ; 105.8 €]
Agreeableness	5.07 %	[1.35 % ; 8.93 %]
	130.2 €	[34.6 € ; 229.3 €]
Conscientiousness	7.84 %	[3.85 % ; 11.99 %]
	201.3 €	[98.8 € ; 307.8 €]
External LOC	6.96 %	[3.20 % ; 10.85 %]
	178.6 €	[82.2 € ; 278.5 €]
Positive reciprocity	1.98 %	[−1.07 % ; 5.12 %]
	50.8 €	[−27.6 € ; 131.5 €]
Negative reciprocity	6.07 %	[2.30 % ; 9.97 %]
	155.8 €	[59.0 € ; 256.0 €]

the same (0.052, SD 0.171), 6 of the 8 personality measures show a statistically significant interaction with rank. As predicted by the theoretical hypothesis described in section 2.2., agreeableness does not play a role on the interaction between rank and life satisfaction. This is, agreeableness is not relevant in defining the effect that occupying a higher rank has on satisfaction. Also in accordance with our hypotheses, individuals at the top of the extraversion, conscientious, external LOC, and negative reciprocity distribution experience larger satisfaction gains from being at the top of their rank than the rest. In contrast, individuals at the top of the openness-to-experiences and positive reciprocity distribution obtain smaller satisfaction gains when at the top of the distribution of the income rank of their reference group than the rest. Finally, the results for neuroticism are not consistent with our initial hypothesis. We find that neuroticism does not mediate in the rank-life satisfaction relationship, whereas the psychological literature finds that neurotic people respond more sensitively to social comparisons (Van der Zee *et al*., 1996, 1998). A candidate explanation for this divergence is that previous studies were based on cancer patients. It has been recently shown that different social comparison processes (emotional, coping, procedural) are at play among cancer patients and that, under some circumstances, neurotic people can be less, not more, reactive no social information (Buunk *et al*., 2009). A second explanation is that we control simultaneously for a wide range of traits. In contrast, previous evidence relies on neuroticism scales that abstract from other traits, which can be partially related with neuroticism.

In order to evaluate the economic significance of such differences across individuals, we use the results in Table 1 to calculate the trade-off between household income and rank for different traits. Table 2 presents the results of the household income equivalent taking a 1-decile increase in rank as a reference.

The first row presents the results in percentages and the second row transforms this percentage into euros per month using the sample average household income. In brackets we show the 95 percent confidence interval.[10] If we do not take personality and affective traits differences into account, the income variation needed to compensate a 1-decile increase in rank is 4.46 percent which, for the sample average household income, amounts to €114.6 a month. In other words, on average individuals would be indifferent in terms of satisfaction between €115 a month or a 1-decile increase in the income rank of their reference group. This trade-off however varies depending on individuals' traits, generating large heterogeneity across groups. For example, the corresponding figure is €201.3 or 7.84 percent for someone scoring one standard deviation above the average conscientiousness score. As argued in section 2.2., conscientious individuals typically value wealth more and exert more effort to achieve higher and longer term goals. Therefore, we hypothesize that they would derive larger satisfaction from occupying a higher rank. These numbers are similar for those individuals one standard deviation above the average of the extraversion (6.27 percent), external LOC (6.96 percent), and negative reciprocity (6.07 percent) distribution. Extraverts are sensitive to positive emotions, such as reward, and we therefore predicted a stronger correlation between life satisfaction and rank. External individuals in turn have lower self-esteem and thus are more dependent on outside information and get larger utility from favorable comparisons. Finally, negative reciprocity correlated positively with anger and negatively with trust. If anything, we had therefore hypothesized that they would obtain larger satisfaction from occupying a higher rank. Although the interactions between rank and openness-to-experience and positive reciprocity were statistically significant, the trade-offs are not statistically significant. Finally, agreeableness gives no significant statistical results, which is in line with our earlier hypothesis: since agreeableness is correlated with altruism and empathy, we predicted that these individuals would not obtain more satisfaction from occupying themselves a higher rank.

6. Conclusions

This paper uses economic data from a large scale household survey to document the importance of personality and affective traits to shape the relationship between income rank and life satisfaction. Previous research in psychology confined to laboratory or case studies pointed to important personality effects in response to social comparisons. The results of this paper, based on fixed effects estimates from the 2000–13 waves of the German Socio-economic Panel, two different sets of personality measures, and two measures of affective traits also finds relevant differences across groups. We have found consistent evidence that the importance of income rank for individuals' reported life satisfaction varies significantly across individuals endowed with different traits.

[10]The equivalent income measure is a ratio of two distinct covariates. Therefore, we need to take into account the standard deviation of such a ratio in order to compute the confidence interval. This is done by using the "nonlinear combinations of estimators" option in STATA, which yields first and second moments of nonlinear combinations of the different covariates.

A first implication of our findings regards the design of economic models. In words of Clark *et al*. (2008a) "taking relative income seriously is an important step toward greater behavioral realism in Economics, such that our models and empirical analysis move closer to how real people feel and behave". At the theoretical level, the distinction between absolute and relative formulations of utility has proven a useful concept to rationalize a large set of unexplained phenomena in a variety of fields, including consumption, savings, growth, and financial regularities. Acknowledging the extent of individual heterogeneity surrounding relative effects would prove fruitful to bring closer the theory to data and, most probably, to account for yet unexplained phenomena. As a second implication, welfare analysis should take into account the diverging importance of income externalities, for example, when designing optimal income taxation or defining poverty. The poverty literature has explicitly argued that relative concerns matter for individuals and some researchers have consequently defended that we should base the poverty line on relative rather than absolute consumption. Although in practice taking personality differences into account for relative poverty measures would be very difficult, our results warn that imposing a common benchmark might be misleading. This concern also applies to the welfare analysis of deprivation and social exclusion promoted within the Europe 2020 Strategy. Finally, and to the extent that individuals behave so as to improve their life satisfaction (Heffetz *et al*., 2012), the importance of income rank for individuals' life satisfaction will partly drive individuals' behavior in several life domains. Therefore, understanding the heterogeneity of preferences over relative income will help us to understand individuals' behavior in the markets. For example, status motives are an important determinant of labor supply and of amount of effort at work (Neumark and Postlewaite, 1998). Our results suggest that individuals endowed with different personality and affective traits may respond very differently to relative income concerns. A next natural step would be to test these hypotheses using labor market data.

This paper contributes to the literature by corroborating the importance of income comparisons in Germany and most important by identifying an important source of heterogeneity. Our estimates identify certain personality and affective traits that tend to be more responsive to the social context and in concrete to the position individuals occupy within the income distribution of their reference group (rank). Depending on this, individuals will be much less responsive to general economic growth if equally distributed but they may be more responsive to job environments. Earlier findings in the literature show that some personality profiles are correlated with larger happiness reports (Boyce, 2011) and that personality also shapes the marginal utility of income (Boyce and Wood, 2011). Our results are consistent with these findings. Understanding the relationship between income comparisons, satisfaction, and personality identifies an important dimension in defining the heterogeneity in individuals' sensitiveness and therefore reactions to others' income.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Appendix: Personality measures
Table A1. Summary statistics – Socioeconomic characteristics
Table A2. Summary statistics – Personality traits
Figure A1. Distribution of personality traits