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**Working Paper**

# Life Satisfaction, Income and Personality

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# Life Satisfaction, Income and Personality

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February 2015

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

# Life Satisfaction, Income and Personality

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February 2015

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# ABSTRACT

## Life Satisfaction, Income and Personality

We use personality traits to better understand the relationship between income and life satisfaction. Personality traits mediate the effect of income on life satisfaction. The effect of neuroticism, which measures sensitivity to threat and punishment, is strong in both the British Household Panel Survey and the German Socioeconomic Panel. Neuroticism increases the usually observed concavity of the relationship: individuals with a higher neuroticism score enjoy extra income more than those with a lower score if they are poorer, and enjoy extra income less if they are richer. When the interaction between income and neuroticism is introduced, income does not have a significant effect on its own. To interpret the results, we present a simple model based on Prospect Theory, where we assume that: (i) life satisfaction is dependent on the gap between aspired and realized income, and this is modulated by neuroticism; and (ii) income increases in aspirations with a slope less than unity, so that the gap between aspired and realized income increases with aspirations. From the estimation of this model we argue that poorer individuals tend to over-shoot in their aspirations, while the rich tend to under-shoot. The estimation of the model also shows a substantial effect of traits on income.

JEL Classification: D03, D87, C33

Keywords: life satisfaction, income, personality traits, neuroticism, prospect theory

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# 1 Introduction

Given its importance for welfare analysis and public policy, the general relation between self-reported well-being and personally available income has been widely investigated. A regression of life satisfaction on income using both cross-sectional and panel survey data from a developed country generally shows a significant, positive, but small estimated coefficient of income (e.g. Blanchflower and Oswald, 2004; Ferrer-i-Carbonell and Frijters, 2004). Although the debate on the existence of a satiation point is still open, there is general agreement that the size of the effect is decreasing with income, consistent with the usual assumptions on the utility function of individuals, as Layard et al. (2008) explicitly point out.[1]

However, a significant amount of evidence suggests that the link between income and life satisfaction is more complex than that. Life satisfaction appears to be monotonically increasing with income when one studies this relation at a point in time across nations (e.g. Deaton, 2008; Stevenson and Wolfers, 2008). Over time, however, the relation between GDP and life satisfaction appears rather different. In a well-known finding, Easterlin reports no significant relationship between happiness and aggregate income in time-series analysis. For example, the income per capita in the USA in the period 1974-2004 almost doubled, but the average level of happiness shows no appreciable trend upwards. This puzzling finding, appropriately called the Easterlin Paradox (Easterlin, 1974) has been confirmed in similar studies by psychologists (Diener et al., 1995) and political scientists (Inglehart, 1990), and has been shown to also hold for European countries (Easterlin, 1995).[2] A recent paper by Proto and Rustichini (2013) finds a positive relationship between growth and satisfaction for countries with a GDP below 15,000 USD but shows that this relationship is flat in richer countries, suggesting a gap between aspiration and realised income.

A potential explanation of the paradox is that individuals adapt to current conditions, and the level of subjective well-being tends to revert to a baseline level depending on a reference

[1] Layard et al. (2008) find that marginal life satisfaction with respect to income declines at a faster rate than that implied by a logarithmic utility function. Kahneman and Deaton (2010) argue that the effect of income on an emotional dimension of well-being, like happiness self-reports, reaches a maximum at an annual income of 75,000 USD, and it has no further positive influence for higher values; while the non-emotional measures of well-being like the Cantrill ladder do not feature this satiation point

[2] There is some disagreement in the time-series based analyses: Oswald (1997) shows evidence of a small positive temporal correlation between life satisfaction and GDP in industrialized countries and Stevenson and Wolfers (2008) find significant happiness gains in Japan in the post-war period.

point, an idea originally proposed by Brickman and Campbell (1971). Aspirations are naturally associated with the reference point provided by current income. Hence, to the extent that an increase in income leads to an increase in aspirations, changes in income may not have a long-run effect on subjective wellbeing.[3] Another explanation of the Easterlin Paradox hinges on the concept that relative, rather than absolute income, is the main determinant of life satisfaction, an idea that can be dated back to Duesenberry (1949). The two explainations are closely related.[4]

The present paper aims to shed more light on the relation between personal income and life satisfaction by analyzing how personality affects this relation. Recently, economists have recognized the importance of introducing personality traits into economic models (Borghans et al., 2008; Rustichini, 2009; Almlund et al., 2011). Recent studies show that personality has a biological basis, as DeYoung and Gray (2010) argue in an exhaustive survey of the literature.

The rest of the paper is organized as follows. In section 2 we describe the datasets, the main variables (2.1) and the econometric model (2.2). In section 3 we show the results from the estimation of the econometric model. In section 4 we describe our theory and estimate the structural model (4.1). In section 5 we discuss the main results and conclude. Additional analysis and more technical details are in the appendix.

# 2 Data and Methods

## 2.1 Data

We use two national data sets: the British Household Panel Survey (BHPS), covering the years 1996-2008 (the question on life satisfaction was introduced in 1996), and the German Socioeconomic Panel Study (SOEP), available for the years 1984-2009. Both SOEP and BHPS are longitudinal datasets, with the same individuals interviewed every year. Summary statistics relating to all the main variables are presented in tables 1 and 2. We now provide a brief

[3] Easterlin (2005), Stutzer (2004) and McBride (2010) provide some empirical evidence on how aspirations increase in income, Di Tella et al. (2010) show evidence that individuals adapt to status, although they cannot reject the hypothesis of no full adaptation to a change in income in four years.

[4] Clark and Oswald (1996), Blanchflower and Oswald (2004), Ferrer-i-Carbonell, (2005), Luttmer (2005) and Senik (2009), among others, present empirical validations of this hypothesis. See Clark et al. (2008) for an extensive survey of the theoretical and empirical literature explaining the Easterlin Paradox.

description of the main variables.

**Big 5 Personality Traits.** The Big Five are usually measured through self-report based on the NEO Five-Factor Inventory (see e.g. Costa and McCrae, 1992). There is a large literature demonstrating the reliability of this questionnaire and the stability of the personality traits. The data used in the current paper have been elaborated from the standard short questionnaire present in the BHPS and SOEP datasets (in the year 2005). Personality traits are usually assessed with the NEO-Five Factor Inventory (NEO-FFI) with 60 items (12 items per domain). However, recent scale-development studies have indicated that the Big Five traits can be reliably assessed with a smaller number of items (e.g., Gosling et al., 2003). For instance, pilot work from the German Socio-Economic Panel (GSOEP) study led to a 15-item version of the well-validated Big Five Inventory (Benet-Martinez and John, 1998) that can be used in large-scale surveys. The questions are presented in section A of the appendix.

We use data on the Big Five personality traits in the 2005 waves of the BHPS and SOEP datasets as measures of individuals' personality for the entire time span that we observe each individual for. Borghans et al. (2008) argue that personality traits vary little for individuals aged between 18 and 65, the life span we are considering. Our data are consistent with this result since when we regress the personality traits against age and age squared we find that they explain a very small portion of the variance. For example in a regression of neuroticism with age and age$^2$, the $R^2 = 0.0027$ in the SOEP and $R^2 = 0.0025$ in the BHPS. The effect on all other traits is very similar. Although it is unlikely that this variation can bias our estimates, in our analysis we use the residuals after controlling for the age effects. Accordingly, our results refer to the age-invariant factor of the personality trait, which as we argued above, explains more than 99 percent of the total variance.[5]

Furthermore, considering the data related to one year rather than time-changing measures generally avoids the problem that the estimation can be biased by short-term fluctuations that contemporaneously affect income, life satisfaction and personality. A final concern might be related to some external shock that permanently changes personality, income and life satisfaction. In this respect, Cobb-Clark et al. (2011), using data from two separate waves of the

[5]Our estimates are generally robust to the inclusion of the raw data instead of the residuals.

Household, Income and Labour Dynamics in Australia (HILDA) survey measuring personality, show that that personality traits only change after main life shocks to a negligible extent. For example, individuals who experience five or more employment/income-related negative shocks like worsening finances, retiring, being fired, or becoming unemployed, between 2006 and 2009 (in their data more than three standard deviations) become more neurotic in the order of 0.28 standard deviations for men and 0.15 for women. Cobb-Clark et al. quantify this effect considering the usual estimated effect of traits on income (see e.g. Mueller and Plug (2006), and also our estimation below) in a decrease of 0.012 USD in the hourly wage.

**Life satisfaction.** In the BHPS, the life satisfaction question is: *"How dissatisfied or satisfied are you with your life overall?"* and it is coded on a scale from 1 (not satisfied at all) to 7 (completely satisfied). In the SOEP, the questions is *"We would like to ask you about your satisfaction with your life in general"*, coded on a scale from 0 (completely dissatisfied) to 10 (completely satisfied).

We present the percentage of responses in each category for both datasets in figure A.1 of the appendix. To ease comparability of the statistical results for different datasets, we have transformed the measures of life satisfaction to always lie in a range between 1 and 7. In particular, we transform the index of the SOEP survey according to the formula $1 + \frac{\text{life satisfaction } \times 6}{10}$.

**Household income.** In both the SOEP and the BSHP datasets income has been converted into USD at 2005 constant prices, using the Consumer Price Index (CPI) of the World Bank-World Development indicators. Data on income are all in 10K units. Figure A.2 in the appendix displays the histograms of income distributions for the UK and Germany. As is common in the literature analyzing the effect of life satisfaction at the individual levels (e.g. Oswald and Blanchflower, 2004; Ferrer-i-Carbonel, 2005), we use household income instead of personal income. It is natural to conjecture that in a household there are significant amounts of income transfers between the members; at the same time personal income earning decisions are dependent on the income earned by the other members of the household. Considering only personal income would have implied the exclusion of these pervasive externalities.

**Control variables.** Unless explicitly stated otherwise, in all regressions we control for the

usual demographic variables: age, age$^2$ and gender, marital status (a set of dummies depending on whether the respondent is married, divorced, separated or widowed), number of children in the household, the highest academic qualifications based on the education systems of the two countries (a set of dummies measuring high school achievement, vocational training or college degree). In addition, we introduce, as a control for health status, a set of dummies indicating the number of visits to the doctor. We use this variable for two reasons: (i) it is an objective indicator of health;[6] and (ii) it is present in both the SOEP and the BHPS datasets in a similar form. We also introduce a dummy for region of residence of the household; the regional aggregation in Germany in the SOEP dataset is based on the NUTS 1 code of the European Union (16 regions), while for the UK data in the BHPS dataset it roughly follows the NUTS 2 code (18 regions). Finally, we control for a series of labour environment-related variables: labour force participation (a set of dummies depending on whether the individual labour market status is employed, housekeeper, unemployed, retired); occupation types (a standard set of dummies for socioeconomic status: manager, professional, white collar, blue collar, farm worker and so on), hours worked per week and the latter squared.[7]

## 2.2 Econometric Specification

We use a quadratic specification for a model linking income to life satisfaction because we are interested in analyzing how prsonality traits influence the concavity of this relation. In order to avoid the excessive weight given to outliers by this specification, we exclude from the sample the top and bottom 1 percent of observations. Excluding observations in the two tails of income distribution is standard in this literature.[8]

In particular, we estimate the following model:

$$h_{it} = \beta_1 y_{it} + \beta_2 y_{it}^2 + \beta_1' \theta_i y_{it} + \beta_2' \theta_i y_{it}^2 + \Gamma z_{it} + \Lambda \theta_i + \epsilon_i + \eta_t + e_{it} \quad (1)$$

[6] This avoids possible biases from introducing a subjective variable in the RHS of a happiness equation.

[7] When an individual is recorded as unemployed for employment status, she is recorded with 0 hours worked, and he/she is recorded as unemployed also in occupation types.

[8] For example, in the SOEP this excludes 3964 observations with an income between 114K and 1,515K at the top and at the bottom 4019 observations with an income less than or equal to 7,277 euro per year. All the following results are robust to different thresholds of exclusion.

In equation (1), $i$ represents the individual and $t$ the year of the survey, $h_{it}$ is life satisfaction and $y_{it}$ household income. The individual fixed effect is described as $\Lambda\theta_i + \epsilon_i$, where

$$\theta_i = (N_i, E_i, C_i, A_i, O_i, M_i) \tag{2}$$

with $N = Neuroticism$, $E = Extraversion$, $C = Conscientiousness$, $A = Agreeableness$, $O = Openness$, $M = Male$ and $\epsilon_i$ is the individual specific random effect. The terms $\beta_1'\theta_i y_{it} + \beta_2'\theta_i y_{it}^2$ represent the interaction of a personality trait index with the income variables. The vector $z_{it}$ consists of time-changing individual characteristics. The variable $\eta_t$ denotes a year (and wave) fixed effect and $e_{it}$ is random noise.

# 3 Results

Figures 1 and 2 display the residuals of life satisfaction – after controlling for age, age$^2$, gender and the five personality traits, as a function of income residuals after controlling for the same variables, in the UK and Germany respectively. From the two panels in figure 1, we note that for individuals with a high neuroticism score, the curve is more concave, while for those with low neuroticism this relation is almost linear. Furthermore, in both countries the relation is steeper for high neuroticism scores with respect to low neuroticism scores in the region of the graph corresponding to lower incomes, while it is flatter for high neuroticism scores with high income. Finally, we note from the graphs in figure 2 that no other trait has such a clear effect on the relation we are analyzing.

The panels in Figures 1 and 2 are based on data pooled across waves. To exploit the longitudinal nature of our dataset by taking into account individuals' heterogeneity and to exclude the role of omitted variables, we estimate a number of econometric models controlling for a large number of potentially confounding factors. We estimate model (1) by OLS estimation and report the results in table 3, where in order to take into account possible heteroscedasticity, we cluster the standard errors at the individual levels.[9] The table shows that in both datasets

[9] It is known in this literature that assuming ordinality or cardinality of happiness scores makes little difference (Ferrer-i-Carbonell Frijters 2004). This can also be observed in table 5, where we report the estimation of a similar model using an ordered probit estimator.

neuroticism is the only one of the five personality traits to affect the relation between income and life satisfaction, and in a qualitatively similar way. No other trait significantly interacts in the relationship between income and life satisfaction. Furthermore, both in Germany and in the UK, the usually observed marginal decreasing effect of income on life satisfaction is entirely mediated by neuroticism. Once the interacted term is taken into account, either there is no effect of income on life satisfaction or this effect becomes convex as in column 2.

A possible concern is that the random effect estimator is not consistent due to the fact that $\epsilon_i$ is correlated with the other regressors. We therefore estimate an equation similar to model 1 with individual fixed effects. The results are reported in table 4. Finally, we further interact the terms neuroticism*income with a male dummy. From table 6 we note that for males neuroticism affects the relation between income and life satisfaction more strongly than for females. In other words, the concavity of this relation, due to the neuroticism, is stronger among males.

Why do we observe this strong effect of neuroticism in modulating the relationship between income and life satisfaction? Neuroticism is linked to higher sensitivity to negative emotions like anger, hostility or depression (e.g. Clark and Watson, 2008), and is associated with structural features of the brain systems associated with sensitivity to threat and punishment. For this reason, modern studies identify this personality trait with sensitivity to negative outcomes, threats and punishments (see DeYoung and Gray (2010) for a recent survey). It is therefore reasonable to assume that people with higher neuroticism experience higher sensitivity to losses or failure to meet their expectations, an effect similar to loss aversion in the prospect theory. In the next section, we will therefore derive an explanation of the effect of neuroticism we see in figure 1 and tables 4 and 6 by estimating a prospect theory-based model.

We will assume that neuroticism modulates the effect of the gap between aspired and realized income and we show that, when aspirations are not observed, neuroticism appears to decrease the elasticity between income and life satisfaction for high income levels and to increase this elasticity for lower income levels, as observed in this section. Furthermore, our model below will also explain why personality traits underlying motivation, like conscientiousness, openness and extraversion (see e.g. DeYoung and Gray 2010) do not have an effect on the way income

affects life satisfaction, but they significantly affect income.

# 4 A model of life satisfaction, income and personality

To better understand the relation presented in the previous section between happiness, income and personality, we present a simple structural model based on the insights deriving from the theories of personality traits that we outlined above. We show that this model is able to produce an equation similar to equation 1 as a reduced form and we estimate this model. We then interpret the coefficient of the estimation in the light of the underlying structural model.

The terms $e_{it}; u_{it}; v_{it}$ are error terms. The model has three equations. The dependent observable variables are household income $y_{it}$ and life satisfaction $h_{it}$. The dependent latent variable is the *desired income* for any individual $i$ at time $t$ and is denoted by $a_{it}$. We assume that the aspiration to an income, $a_{it}$ induces (through effort, persistence, and confidence) a real level of income that is increasing in the aspiration level. Thus the *Level of income* depends on the desired income as follows:

$$y_{it} = \alpha_2 + \beta_2 a_{it} + u_{it}. \tag{3}$$

Let $\alpha_2 > 0$ and $\beta_2 \in (0, 1)$, so that the aspiration to an income $a_{it}$ induces (through effort, persistence, and confidence) a real level of income that is increasing in the aspiration level, but at a rate smaller than 1. Individuals with low aspirations on average overshoot by earning more than aspired. The linear form is for convenience: what is essential is that the relationship is monotonic and has decreasing returns.

We summarize the argument in the following hypotheses: *(i)* higher motivation produces aspiration to higher income, and hence to higher realized income; *(ii)* high aspirations are necessary to become rich, but the higher they are, the more likely it is that they go unfulfilled.

The effect of aspiration on realized income therefore occurs at a decreasing rate. This is a standard assumption. To illustrate it, consider the search for the "aspired" occupation. An individual searching for the occupation may set a minimum level of earnings to be reached before he or she stops searching. The higher the aspiration level the higher the final earnings

will be, everything else being equal, although perhaps at a later date. Increasing aspirations may increase realized income, but, only up to a point: if they are too high they will never be fulfilled even after a long period of searching. Note that this applies to different job statuses: for a self-employed individual the right occupation can be found in a new project; for an employee, the right occupation can be a promotion or a new position; for an unemployed individual or somebody in search of a new occupation this is a new job; for a capital owner this can be the right investment. Furthermore, we also note that the interpretation of this model can also be extended to the marriage market, as representing the search for the right partner.

Using equation 3, it is possible to argue that this implies that the rich fail to meet their aspirations on average more than the poor. In other words, the rich under shoot in their aspirations on average more than poorer individuals.

A crucial assumption is that an individual's sensitivity to the gap between aspired and realized income depends on his/her personality. As mentioned above, recent literature in psychology views neuroticism as sensibility to negative outcomes. Ex-post, individuals perceive the negative gap between real and aspired income as a negative outcome, and the higher their neuroticism score, the higher the potential subjective welfare cost of this gap. This is also an application of prospect theory.

Accordingly we assume that *life satisfaction* depends on realized income and other variables, but it also depends on the distance with aspirations and this distance is modulated by neuroticism.

$$\begin{aligned} h_{it} &= \alpha_1 + \beta_1 y_{it} + \delta y_{it}^2 + \\ &+\gamma_1 N_i \left(a_{it} - y_{it}\right) + \gamma_{2,1} N_i [(a_{it} - y_{it})^+]^2 + \\ &+\gamma_{2,2} N_i [(a_{it} - y_{it})^-]^2 + \Gamma_1 z_{hit} + \Lambda_1 \theta_{hi} + e_{it}. \end{aligned} \tag{4}$$

where the term $(a_{it} - y_{it})^+$ is $(a_{it} - y_{it})$ when the value within brackets is positive and it is 0 when $a_{it} < y_{it}$, while $(a_{it} - y_{it})^-$ is $(a_{it} - y_{it})$ when $a_{it} < y_{it}$ and 0 otherwise. We expect the term $\gamma_1$ to be negative while the terms $\gamma_{2,1}$ and $\gamma_{2,2}$ depend on the concavity of the function. If we consider $a_{it}$ as a reference point, prospect theory would predict that equation 4 is concave

in the "gains", i.e. when $a_{it} < y_{it}$ and convex in the "losses", i.e. when $a_{it} > y_{it}$. Accordingly, we should observe $\gamma_{2,1} < 0$ and $\gamma_{2,2} > 0$.

Personality traits also affect life satisfaction by shifting the intercept and interacting with income. The vector $\theta_{h,i}$ includes neuroticism and extraversion, in addition to gender (variable Male). $z_{hit}$ includes time-changing personal characteristics.

We assume that aspirations are exogenous with respect to individuals' choices. Hence individuals do not choose their level of aspirations by maximizing their ex-post level of life satisfaction. Following the literature on the hedonic treadmill theory (Diener and Lucas, 1999), we assume that they are determined as it follows:

$$a_{it} = \alpha_0 + \eta_0 y_{it-1} + \Gamma_0 z_{ait} + \Lambda_0 \theta_{ai} + v_{it} \tag{5}$$

where $\theta_{ai}$ is a vector containing time-independent personal characteristics (gender and the personality traits), $z_{ait}$ are the time-dependent personal characteristics and $y_{it-1}$ is the real income in the previous wave. The interpretation of equation 5 is as follows: at any time $t$, individuals form realistic aspirations for the next period's income, with an upward adjustment affected by their characteristics, education and age.

This model is consistent with the idea of "Keeping up with the Jones" (Duesenberry, 1949) if we consider that aspiration could be set to depend on the top incomes of some reference group. It is also consistent with habit formation ideas (Brickman and Campbell, 1971) since aspirations are updated with past income. The main problem in estimating the model described by equations 3, 4 and 5 is that the aspiration level, $a_{it}$, is not observable. We therefore solve for $a_{it}$ in equation 5 and substitute it into equation 4, leading to a "semi-reduced" form that can be estimated.

Before we proceed with this strategy, we check the plausibility of this model by estimating the two equations 3 and 5 using a proxy for aspiration present in the SOEP dataset, provided by the answer to the question: *Importance of Success In Job.*[10] The results are presented in

[10]This question is answered by the entire sample in the waves 1990, 1992, 1995, 2004, 2008. We choose the year 2004 as the closest to 2005, the year personality was measured. The answers are originally inversely coded and distributed as it follows: Unimportant [1], 9.78%; Not Very Important [2], 15.86%; Important [3] 51.94 %; Very Important [4] 22.42 %.

table A.1 of the appendix. As expected, the answer to this question correlates positively and significantly with the traits implying motivations: openness, conscientiousness and extraversion (and negatively with the others) in the first stage regression and, as an instrumented variable, the same question is a significantly positive predictor of income in the 3-stage least squares estimation.

Next, we solve equation 3 for $a_{it}$, and substitute it into 4 to obtain the equations below. For $y_{it} > \frac{u_{it}+\alpha_2}{1-\beta_2}$

$$\begin{aligned} h_{it} = \gamma_{2,1} N_i \left( \frac{-u_{it} + y_{it} - \alpha_2}{\beta_2} - y_{it} \right)^2 + \gamma_1 N_i \left( \frac{-u_{it} + y_{it} - \alpha_2}{\beta_2} - y_{it} \right) + \\ \beta_1 y_{it} + \delta y_{it}^2 + \Gamma_1 z_{hit} + \Lambda_1 \theta_{hi} + \alpha_1 + e_{it}. \end{aligned} \tag{6}$$

For $y_{it} < \frac{u_{it}+\alpha_2}{1-\beta_2}$

$$\begin{aligned} h_{it} = \gamma_{2,1} N_i \left( \frac{-u_{it} + y_{it} - \alpha_2}{\beta_2} - y_{it} \right)^2 + \gamma_1 N_i \left( \frac{-u_{it} + y_{it} - \alpha_2}{\beta_2} - y_{it} \right) + \\ \beta_1 y_{it} + \delta y_{it}^2 + \Gamma_1 z_{hit} + \Lambda_1 \theta_{hi} + \alpha_1 + e_{it} \end{aligned} \tag{7}$$

We estimate a single equation:

$$\begin{aligned} h_{it} = \gamma_2 N_i \left( \frac{-u_{it} + y_{it} - \alpha_2}{\beta_2} - y_{it} \right)^2 + \gamma_1 N_i \left( \frac{-u_{it} + y_{it} - \alpha_2}{\beta_2} - y_{it} \right) + \\ \beta_1 y_{it} + \delta y_{it}^2 + \Gamma_1 z_{hit} + \Lambda_1 \theta_{hi} + \alpha_1 + e_{it}, \end{aligned} \tag{8}$$

which implies that $\gamma_2$ is the sum of two different effects. For example, if the equation is concave when $y_{it} > \frac{u_{it}+\alpha_2}{1-\beta_2}$ and convex when $y_{it} < \frac{u_{it}+\alpha_2}{1-\beta_2}$ and if $\gamma_2 < 0$, then this suggests that the concavity of the function when aspirations are "over shooting" is stronger than its convexity when aspirations are "under shooting". Equation 8 can be rewritten as

$$\begin{aligned} h_{it} = \alpha_1 + \beta_1 y_{it} + \delta y_{it}^2 + \gamma_2 \left( \frac{1-\beta_2}{\beta_2} \right)^2 N_i y_{it}^2 + \left( C u_{it} + B \right) N_i y_{it} + \\ + N_i \left( F u_{it}^2 + G u_{it} + D \right) + \Gamma_1 z_{hit} + \lambda_E E_i + e_{it}, \end{aligned} \tag{9}$$

where $B, C, D, F$ and $G$ are constants that depend on the parameters of the structural model

that we present in Appendix B. Moreover, substituting equation 5 into equation 3, we have:

$$y_{it} = A_2 + B_2 y_{it-1} + C_2 z_{ait} + D_2 \theta_{ai} + \beta_2 v_{it} + u_{it}. \tag{10}$$

## 4.1 Estimation of the structural model

The results of the estimations of the system of equations 9 and 10 are presented in table 7. We note from the top of this table that in both datasets both the linear and quadratic interactions of income with neuroticism are significant with the sign we observed in the previous analysis. The non-interacted relation between income and life satisfaction is insignificant, suggesting again that the entire relationship between income and life satisfaction is entirely mediated by neuroticism. Therefore, our structural model is able to explain the relationship observed in the previous analysis, and in particular why neuroticism is responsible for the convexity of the relationship between income and life satisfaction.

Furthermore, it is instructive to interpret the results of table 7 in the light of our structural model represented by equations 3, 4 and 5. Considering the estimated equation 9, we note that $B > 0$, where

$$B = \frac{(1 - \beta_2)(\beta_2 \gamma_1 - 2\alpha_2 \gamma_2)}{\beta_2^2}. \tag{11}$$

The sign of the coefficient of $N_i y_{it}^2$ is negative. Therefore the sign of $\gamma_2$ is identified and negative.

We assumed that income aspirations, $a_{it}$, induce (through effort, persistence, and confidence) a real level of income increasing in the aspiration level, but at a rate smaller than 1, so that $0 < \beta_2 < 1$ and that $\alpha_2 > 0$. Hence, $\gamma_1$ can be negative as expected. Moreover, consistent with the literature (Cohen et al., 2003; Vitters and Nilsen, 2002), the direct effects of neuroticism on life satisfaction are negative, large and significant; those of extraversion are positive and significant.

Some interesting insights can be derived from the analysis of the effect of personality traits on income. In the bottom of table 7 we present results from estimating of equation 3, which provide an estimate of the effect of personality traits on income. Motivation is likely to increase income. Hence, openness, conscientiousness and extraversion (traits underlying motivation)

should affect income positively.[11]

The magnitudes of the effects of personality on household income per year are noticeable. For example, in the UK sample the size is around $2.2K$ USD for openness, $-4.1K$ USD for neuroticism, and $3.5K$ USD for extraversion. For comparison, the effect of Male is $1.2K$ USD per year. Hence, the effects of some personality traits are between two and three times larger than the gender gap. These results confirm that personality traits are important for predicting life outcomes, income in this case (see Mueller and Plug, 2006; Roberts et al., 2007; Burks et al., 2009, for other life outcomes).

# 5 Discussion

Our analysis shows that neuroticism affects not just the level of life satisfaction, but also modulates the relationship between income and life satisfaction in both the British Household Panel Survey and the German Socioeconomic Panel. The effect of income seems largely mediated by personality traits. When the interaction between income and neuroticism is introduced, income does not have a significant effect on its own. Neuroticism increases the usually observed concavity of the relationship between income and life satisfaction. Individuals with higher neuroticism scores enjoy income more than those with a lower score if they are poorer; conversely, they enjoy income less if they are richer. These results are fully consistent with Boyce and Wood (2010), who find that neuroticism interacts negatively in a model with the logarithm of income in a life satisfaction equation.

Why do we observe this strong effect? Neuroticism is linked to higher sensitivity to negative emotions like anger, hostility or depression (e.g. Clark and Watson, 2008), and is associated with structural features of the brain systems associated with sensitivity to threat and punishment (DeYoung and Gray, 2010) and with low levels of serotonin in turn associated with aggression, poor impulse control, depression, and anxiety (Spoont,1992). For this reason modern studies identify this personality trait with sensitivity to negative outcomes, threats and punishments (see DeYoung and Gray, 2010 for a recent survey). It is therefore reasonable to

[11] Mueller and Plug (2006) and Boyce et al. (2010) successfully test a related assumption that conscientiousness matters for life satisfaction indirectly when interacted with unemployment.

argue that people with higher neuroticism experience higher sensitivity to losses or failure to meet their expectations. Accordingly, we propose an explanation of why neuroticism decreases the elasticity between income and life satisfaction for high income levels and increases this elasticity for lower income levels. The explanation is based on the sensitivity to the gap between aspirations and realisations of income.

In a simple structural model, we take the aspiration determined by personality traits and income to be a monotonic function of aspiration, and assume that the responsiveness of life satisfaction to the gap between aspired and realized income is proportional to neuroticism. Estimation of the model shows that the elasticity between income and life satisfaction increases with neuroticism for lower incomes and declines with neuroticism at higher incomes. Thus, aspirations are on average fulfilled for low income and on average un-fulfilled for high income.

We therefore estimate the elasticity of life satisfaction on income as a variable dependent on an individual's personality. Kahneman et al. (2006) and Akin et al. (2009) show that individuals tend to underestimate the life satisfaction of the poor. Their conclusion is that individuals work to become richer because of the illusion that wealth brings happiness. The present paper brings personality theory into the analysis and suggests a different reading of these empirical findings. Richer people, having a different personality to poorer people, estimate correctly how bad they would feel if they themselves were poorer, and it is also for this reason that they are not poorer.

The estimation of the reduced form of our structural model unveils other relevant empirical results. Traits underlying motivation, like conscientiousness, openness and extraversion, increase income significantly. These results confirm that personality traits are important in predicting life outcomes, income in this case (see Barrick and Mount, 1991 and Almlund et al., 2011, for the relationship with income; and Roberts et al., 2007 and Burks et al., 2009 for other life outcomes).

Furthermore, we note that the result that the marginal satisfaction of individuals with higher neuroticism declines faster for high income levels provides a possible explanation of the finding that more neurotic individuals tend more often to choose life scenarios with a lower level of life satisfaction (Benjamin et al., 2011). Neurotic and highly ambitious individuals,

even when they prefer to be richer, expect that the cost of being rich is high for then. Hence, they may predict that this leads to less satisfaction.

In summary, our empirical test provides support for our theory based on the gap between aspirations and income, explaining our findings that life satisfaction declines faster at higher income when neuroticism is higher. This conclusion suggests a different interpretation of the well-established fact that life satisfaction increases slowly, or is completely flat at high levels of income (Kahneman and Deaton 2010). This finding has so far been interpreted with the argument that marginal life satisfaction is decreasing, just like utility. Our results suggest a stronger reason: the flatness of happiness with income is the effect of opposite forces on life satisfaction: the usual positive effect and a negative effect induced by the gap between aspirations and realizations.

A possible area of further research relates to exploring the merit of alternative explanations. A plausible alternative hypothesis, also consistent with the notion of neuroticism as sensitivity to negative rewards and punishment, is that higher income is also associated with higher variance of income. Higher income variance and the associated anticipated anxiety might reduce the level of life satisfaction in individuals with higher scores for neuroticism. According to this explanation, the effect of neuroticism is produced by anticipation of future fluctuations in income, rather than a comparison with past aspiration levels. This hypothesis is harder to test with the data we are using, although we see it as complementary to the one discussed here.

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Table 1: Germany: SOEP dataset years 1984-2009: main variables used in the regressions.

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|---|---|---|---|---|---|
| Life Satisfaction | 5.187 | 1.088 | 1 | 7 | 324354 |
| Income | 3.749 | 1.822 | 0.728 | 11.49 | 309166 |
| Age | 41.762 | 12.827 | 18 | 65 | 325313 |
| Male | 0.492 | 0.5 | 0 | 1 | 325313 |
| Agreeableness* | 5.419 | 0.971 | 1 | 7 | 15389 |
| Conscientiouseness* | 5.95 | 0.9 | 1 | 7 | 15364 |
| Extraversion* | 4.857 | 1.129 | 1 | 7 | 15407 |
| Neuroticism* | 3.959 | 1.212 | 1 | 7 | 15393 |
| Openness* | 4.516 | 1.181 | 1 | 7 | 15332 |
| Agreeableness | 0.618 | 0.117 | 0.082 | 0.813 | 219832 |
| Conscientiouseness | 0.618 | 0.108 | 0.008 | 0.832 | 219250 |
| Extraversion | 0.613 | 0.135 | 0.134 | 0.904 | 219981 |
| Neuroticism | 0.621 | 0.144 | 0.236 | 0.999 | 219955 |
| Openness | 0.609 | 0.144 | 0.19 | 0.92 | 218995 |
| Hours worked | 28.715 | 20.226 | 0 | 80 | 304634 |

Table 2: UK: BHPS dataset years 1996-2008: main variables used in the regressions.

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|---|---|---|---|---|---|
| Life Satisfaction | 5.143 | 1.267 | 1 | 7 | 117041 |
| Income | 6.44 | 3.702 | 0.433 | 20.774 | 136582 |
| Age | 41.213 | 12.801 | 18 | 65 | 136582 |
| Male | 0.466 | 0.499 | 0 | 1 | 136581 |
| Agreeableness* | 5.45 | 0.985 | 1 | 7 | 10484 |
| Conscientiouseness* | 5.344 | 1.045 | 1 | 7 | 10463 |
| Extraversion* | 4.523 | 1.148 | 1 | 7 | 10475 |
| Neuroticism* | 3.737 | 1.299 | 1 | 7 | 10493 |
| Openness* | 4.502 | 1.167 | 1 | 7 | 10457 |
| Agreeableness | 0.558 | 0.121 | 0 | 0.774 | 105485 |
| Conscientiouseness | 0.558 | 0.129 | 0.007 | 0.828 | 105320 |
| Extraversion | 0.559 | 0.142 | 0.078 | 0.899 | 105433 |
| Neuroticism | 0.557 | 0.16 | 0.203 | 0.985 | 105599 |
| Openness | 0.559 | 0.144 | 0.106 | 0.931 | 105231 |
| Hours worked | 25.949 | 18.739 | 0 | 99 | 132846 |

Table 3: **Life Satisfaction, Income and Neuroticism in the UK and Germany.** Panel data using an OLS estimator with Individual Random Effects. Dependent variable is life satisfaction; all regressions include control for age, age$^2$, gender (omitted from the table). Income is in 10K USD, (standard errors clustered at individual levels are in brackets).

| | Germany 1984-09 b/se | Germany 1984-09 b/se | UK 1996-08 b/se | UK 1996-08 b/se | UK 1996-08 b/se |
|---|---|---|---|---|---|
| Income | 0.0225 | –0.0933* | –0.0020 | –0.0020 | 0.0116 |
| | (0.0233) | (0.0541) | (0.0157) | (0.0047) | (0.0115) |
| Income$^2$ | 0.0022 | 0.0105** | 0.0001 | | |
| | (0.0021) | (0.0051) | (0.0008) | | |
| Neur*Inc | 0.1287*** | 0.1453*** | 0.0864*** | 0.0434*** | 0.0505** |
| | (0.0379) | (0.0388) | (0.0286) | (0.0110) | (0.0234) |
| Neur*Inc$^2$ | –0.0128*** | –0.0139*** | –0.0036** | –0.0016*** | –0.0022* |
| | (0.0035) | (0.0036) | (0.0015) | (0.0004) | (0.0012) |
| Ext*Inc | | 0.0624 | | | –0.0507* |
| | | (0.0449) | | | (0.0301) |
| Ext*Inc$^2$ | | –0.0028 | | | 0.0025 |
| | | (0.0041) | | | (0.0016) |
| Cons*Inc | | 0.1648*** | | | –0.0289 |
| | | (0.0524) | | | (0.0367) |
| Cons*Inc$^2$ | | –0.0130*** | | | 0.0015 |
| | | (0.0049) | | | (0.0020) |
| Open*Inc | | –0.0463 | | | 0.0050 |
| | | (0.0428) | | | (0.0307) |
| Open*Inc$^2$ | | 0.0044 | | | –0.0003 |
| | | (0.0039) | | | (0.0017) |
| Agr*Inc | | –0.0079 | | | 0.0399 |
| | | (0.0502) | | | (0.0370) |
| Agr*Inc$^2$ | | –0.0011 | | | –0.0029 |
| | | (0.0046) | | | (0.0020) |
| Neuroticism | –1.2911*** | –1.3320*** | –2.2545*** | –1.9095*** | –1.9142*** |
| | (0.0939) | (0.0954) | (0.1258) | (0.0852) | (0.1106) |
| Extraversion | 0.2595*** | 0.0734 | 0.4035*** | 0.4683*** | 0.6540*** |
| | (0.0383) | (0.1108) | (0.0648) | (0.0614) | (0.1357) |
| Conscientiousness | 0.2688*** | –0.1194 | 1.0748*** | 0.9551*** | 1.0532*** |
| | (0.0487) | (0.1310) | (0.0750) | (0.0716) | (0.1605) |
| Openness | 0.2385*** | 0.3357*** | –0.1040 | –0.1333** | –0.1444 |
| | (0.0364) | (0.1056) | (0.0662) | (0.0649) | (0.1360) |
| Agreableness | 0.4528*** | 0.5056*** | 0.6498*** | 0.6926*** | 0.5993*** |
| | (0.0443) | (0.1260) | (0.0780) | (0.0747) | (0.1639) |
| Individual random effects | Yes | Yes | Yes | Yes | Yes |
| Wave effects | Yes | Yes | Yes | Yes | Yes |
| Region effects | Yes | Yes | Yes | Yes | Yes |
| Number of children | Yes | Yes | Yes | Yes | Yes |
| Marital status | Yes | Yes | No | Yes | Yes |
| Education | Yes | Yes | No | Yes | Yes |
| Employment status | Yes | Yes | No | Yes | Yes |
| Occupation type | Yes | Yes | No | Yes | Yes |
| Health Status | Yes | Yes | No | Yes | Yes |
| Worked Hours | Yes | Yes | Yes | Yes | No |
| Worked Hours$^2$ | Yes | Yes | Yes | Yes | No |
| N | 177562 | 177562 | 90026 | 88961 | 91085 |

Table 4: **Life Satisfaction, Income and Personality Traits in the UK and Germany.** Panel data using an OLS estimator with Individual Fixed Effects. Dependent variable is life satisfaction, all regressions include control for age, age$^2$, gender (omitted from the table). Income is in 10K USD, (standard errors clustered at individual levels are in brackets).

| | Germany 1984-09 b/se | Germany 1984-09 b/se | UK 1996-08 b/se | UK 1996-08 b/se |
|---|---|---|---|---|
| Income | 0.0241 | | 0.0045 | |
| | (0.0288) | | (0.0057) | |
| Income$^2$ | 0.0014 | | | |
| | (0.0026) | | | |
| Neur*Inc | 0.1156** | 0.0907** | 0.0404*** | 0.0533** |
| | (0.0467) | (0.0387) | (0.0130) | (0.0266) |
| Neur*Inc$^2$ | –0.0121*** | –0.0086** | –0.0022*** | –0.0026* |
| | (0.0044) | (0.0036) | (0.0004) | (0.0014) |
| Ext*Inc | | 0.0465 | | –0.0530 |
| | | (0.0527) | | (0.0344) |
| Ext*Inc$^2$ | | 0.0011 | | 0.0032* |
| | | (0.0049) | | (0.0018) |
| Cons*Inc | | 0.1389** | | –0.0227 |
| | | (0.0601) | | (0.0437) |
| Cons*Inc$^2$ | | –0.0101* | | 0.0014 |
| | | (0.0056) | | (0.0023) |
| Open*Inc | | –0.0498 | | 0.0419 |
| | | (0.0516) | | (0.0346) |
| Open*Inc$^2$ | | 0.0047 | | –0.0019 |
| | | (0.0048) | | (0.0018) |
| Agr*Inc | | –0.0695 | | 0.0470 |
| | | (0.0565) | | (0.0430) |
| Agr*Inc$^2$ | | 0.0029 | | –0.0032 |
| | | (0.0052) | | (0.0022) |
| Individual fixed effects | Yes | Yes | Yes | Yes |
| Wave effects | Yes | Yes | Yes | Yes |
| Region effects | Yes | Yes | Yes | Yes |
| Number of children | Yes | Yes | Yes | Yes |
| Marital status | Yes | Yes | No | No |
| Education | Yes | Yes | No | No |
| Employment status | Yes | Yes | No | No |
| Occupation type | Yes | Yes | No | No |
| Health Status | Yes | Yes | No | No |
| Worked Hours | Yes | Yes | Yes | No |
| Worked Hours$^2$ | Yes | Yes | Yes | No |
| r2 | 0.046 | 0.047 | 0.008 | 0.005 |
| N | 180940 | 177562 | 91246 | 92174 |

Table 5: **Life Satisfaction, Household Income and Traits, Ordered Probit.** The dependent variable is individual life satisfaction (standard errors clustered at individual levels are in brackets).

| | Germany 1984-09 b/se | Germany 1984-09 b/se | UK 1996-08 b/se | UK 1996-08 b/se |
|---|---|---|---|---|
| Income | –0.1091 | 0.0040 | 0.0356 | 0.0040 |
| | (0.0812) | (0.0249) | (0.0471) | (0.0147) |
| $Income^2$ | 0.0120 | | –0.0023 | |
| | (0.0080) | | (0.0025) | |
| Neur*Inc | 0.1585*** | 0.1106** | 0.0986*** | 0.1092*** |
| | (0.0590) | (0.0484) | (0.0368) | (0.0310) |
| $Neur*Inc^2$ | –0.0172*** | –0.0122*** | –0.0034* | –0.0042** |
| | (0.0057) | (0.0045) | (0.0020) | (0.0016) |
| Ext*Inc | 0.0585 | 0.0280 | –0.0692 | –0.0576 |
| | (0.0682) | (0.0645) | (0.0425) | (0.0396) |
| $Ext*Inc^2$ | –0.0015 | 0.0018 | 0.0036 | 0.0029 |
| | (0.0065) | (0.0061) | (0.0023) | (0.0021) |
| Cons*Inc | 0.1460* | 0.1023 | 0.0262 | 0.0310 |
| | (0.0825) | (0.0779) | (0.0473) | (0.0445) |
| $Cons*Inc^2$ | –0.0101 | –0.0053 | –0.0008 | –0.0013 |
| | (0.0078) | (0.0073) | (0.0026) | (0.0024) |
| Open*Inc | –0.0417 | –0.0608 | –0.0786* | –0.0655 |
| | (0.0630) | (0.0616) | (0.0443) | (0.0426) |
| $Open*Inc^2$ | 0.0043 | 0.0064 | 0.0042* | 0.0033 |
| | (0.0060) | (0.0059) | (0.0024) | (0.0023) |
| Agr*Inc | 0.1040 | 0.0635 | 0.0708 | 0.0908* |
| | (0.0776) | (0.0726) | (0.0514) | (0.0488) |
| $Agr*Inc^2$ | –0.0069 | –0.0027 | –0.0037 | –0.0049* |
| | (0.0074) | (0.0068) | (0.0028) | (0.0026) |
| Neuroticism | –1.4261*** | –1.3345*** | –2.0728*** | –2.1038*** |
| | (0.1373) | (0.1213) | (0.1526) | (0.1373) |
| Extraversion | 0.0971 | 0.1546 | 0.6588*** | 0.6280*** |
| | (0.1590) | (0.1528) | (0.1766) | (0.1685) |
| Conscientiousness | 0.0983 | 0.1791 | 0.7604*** | 0.7433*** |
| | (0.1913) | (0.1848) | (0.1934) | (0.1865) |
| Openness | 0.3361** | 0.3718*** | 0.1014 | 0.0914 |
| | (0.1463) | (0.1443) | (0.1832) | (0.1793) |
| Agreableness | 0.2861 | 0.3640** | 0.5214** | 0.4408** |
| | (0.1824) | (0.1749) | (0.2145) | (0.2080) |
| Wave effects | Yes | Yes | No | Yes |
| Region effects | Yes | Yes | No | Yes |
| Number of children | Yes | Yes | Yes | Yes |
| Marital status | Yes | Yes | No | No |
| Education | Yes | Yes | Yes | Yes |
| Employment status | Yes | Yes | Yes | Yes |
| Occupation type | Yes | Yes | Yes | Yes |
| Health Status | Yes | Yes | No | No |
| Worked Hours | Yes | Yes | No | No |
| $Worked\ Hours^2$ | Yes | Yes | No | No |
| N | 177562 | 177562 | 91777 | 91092 |

Table 6: **Life Satisfaction, Income and Personality Traits in the UK and Germany with Gender differences.** Panel data using an OLS estimator with Individual Random Effects. Dependent variable is life satisfaction; all regressions include control for age, age$^2$, gender (omitted from the table). Income is in 10K USD, (standard errors clustered at individual levels are in brackets).

| | Germany 1984-09 b/se | UK 1996-08 b/se | UK 1996-08 b/se |
|---|---|---|---|
| Income | 0.0115 | –0.0100 | –0.0035 |
| | (0.0260) | (0.0162) | (0.0049) |
| Income$^2$ | 0.0035 | 0.0005 | |
| | (0.0023) | (0.0008) | |
| Neur*Inc | 0.1397*** | 0.0874*** | 0.0362*** |
| | (0.0416) | (0.0286) | (0.0125) |
| Neur*Inc$^2$ | –0.0139*** | –0.0036** | –0.0011** |
| | (0.0038) | (0.0015) | (0.0005) |
| Male*Neur*Inc | 0.0531*** | 0.0341** | 0.0272* |
| | (0.0192) | (0.0163) | (0.0153) |
| Male*Neur*Inc$^2$ | –0.0043** | –0.0016* | –0.0012 |
| | (0.0018) | (0.0009) | (0.0008) |
| Neuroticism | –1.3586*** | –2.2462*** | –1.8628*** |
| | (0.1070) | (0.1329) | (0.0972) |
| Male*Neuroticism | –0.2462*** | –0.1601 | –0.1690 |
| | (0.0847) | (0.1309) | (0.1246) |
| Extraversion | 0.2784*** | 0.4041*** | 0.4688*** |
| | (0.0421) | (0.0648) | (0.0614) |
| Conscientiousness | 0.3818*** | 1.0746*** | 0.9537*** |
| | (0.0538) | (0.0750) | (0.0716) |
| Openness | 0.2576*** | –0.1031 | –0.1328** |
| | (0.0400) | (0.0662) | (0.0649) |
| Agreableness | 0.4703*** | 0.6486*** | 0.6904*** |
| | (0.0488) | (0.0780) | (0.0747) |
| Individual random effects | Yes | Yes | Yes |
| Wave effects | Yes | Yes | Yes |
| Region effects | Yes | Yes | Yes |
| Number of children | Yes | Yes | Yes |
| Marital status | Yes | No | Yes |
| Education | Yes | No | Yes |
| Employment status | Yes | No | Yes |
| Occupation type | Yes | No | Yes |
| Health Status | Yes | No | Yes |
| Worked Hours | Yes | Yes | Yes |
| Worked Hours$^2$ | Yes | Yes | Yes |
| N | 177562 | 90026 | 88961 |

Table 7: **Life Satisfaction, Household Income and Personality Traits in a structural model using the entire panel of Germany and UK data.** Dependent variable is life satisfaction, income is in 10K USD, traits are normalized between 0 and 1. Estimates of the structural model using a 3SLS estimator with pooled data (standard errors in brackets).

| | Germany (1) 1984-09 b/se | UK (2) 1984-09 b/se |
|---|---|---|
| lfsato | | |
| Income | –0.059 | –0.030 |
| | (0.072) | (0.021) |
| Income$^2$ | 0.005 | 0.001 |
| | (0.006) | (0.001) |
| Neur.× Income | 0.584*** | 0.328*** |
| | (0.119) | (0.036) |
| Neur.× Income$^2$ | –0.037*** | –0.014*** |
| | (0.010) | (0.002) |
| Neuroticism | –3.874*** | –3.364*** |
| | (0.274) | (0.118) |
| Extraversion | 0.549*** | 0.565*** |
| | (0.032) | (0.029) |
| Age | –0.070*** | –0.063*** |
| | (0.002) | (0.002) |
| Age$^2$ | 0.001*** | 0.001*** |
| | (0.000) | (0.000) |
| Male | –0.194*** | –0.184*** |
| | (0.009) | (0.008) |
| nhinc | | |
| Agreeableness | 0.062 | –0.188*** |
| | (0.044) | (0.051) |
| Conscientiousness | 0.762*** | 0.393*** |
| | (0.043) | (0.050) |
| Openness | 0.052 | 0.217*** |
| | (0.038) | (0.044) |
| Extraversion | 0.413*** | 0.348*** |
| | (0.036) | (0.042) |
| Neuroticism | –0.808*** | –0.409*** |
| | (0.041) | (0.048) |
| Age | –0.004*** | –0.005*** |
| | (0.000) | (0.000) |
| Male | 0.193*** | 0.118*** |
| | (0.011) | (0.013) |
| Income at t−1 | 0.542*** | 0.723*** |
| | (0.002) | (0.002) |
| Education | 0.101*** | 0.106*** |
| | (0.002) | (0.002) |
| N | 74050 | 83689 |

Figure 1: **Life Satisfaction, Income and Personality Traits in the UK and Germany.** Quadratic Interpolations. Bold line = Individuals in the top 5 percentiles in neuroticism score. Dashed line = Individuals in the bottom 5 percentiles in neuroticism score.

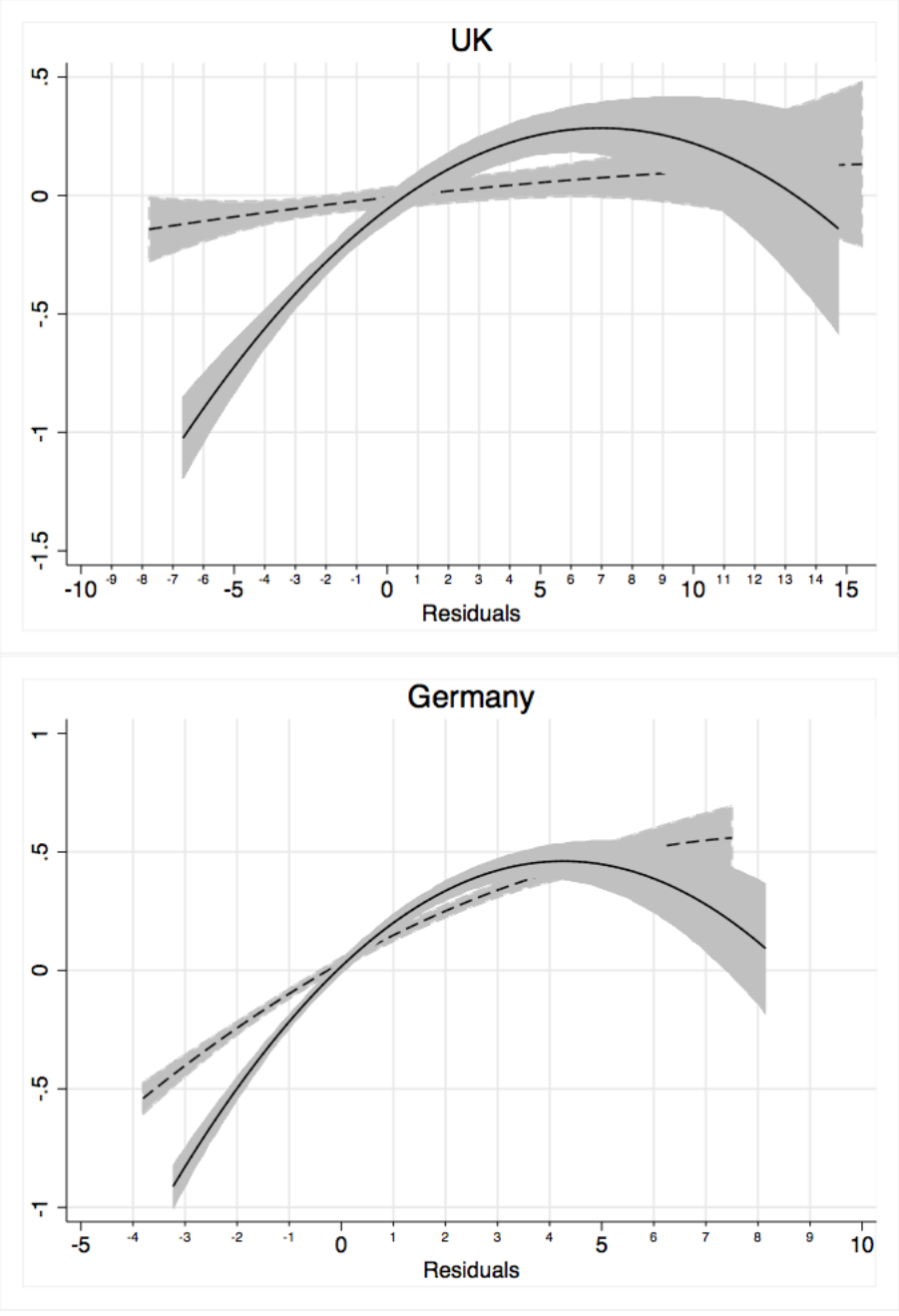
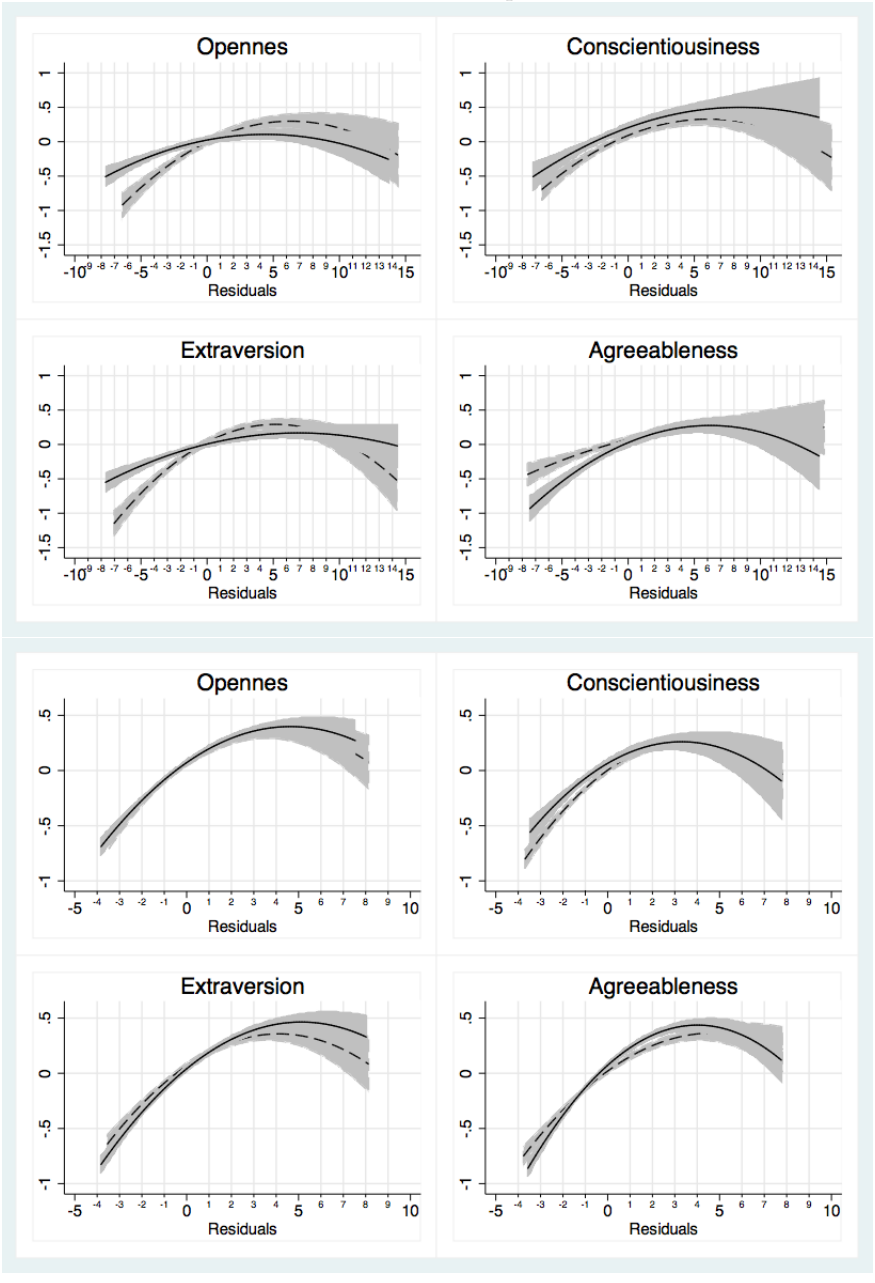


Figure 2: **Life Satisfaction, Income and Personality Traits in the UK and Germany.** Quadratic Interpolations. Bold line = Individuals in the top 5 percentiles in neuroticism score. Dashed line = Individuals in the bottom 5 percentiles in neuroticism score.



**APPENDIX**

# A The "Big Five" in the SOEP and BHPS datasets

I see myself as someone who:

1. (A) Is sometimes rude to others (*reverse-scored*).
2. (C) Does a thorough job.
3. (E) Is talkative.
4. (N) Worries a lot.
5. (O) Is original, comes up with new ideas.
6. (A) Has a forgiving nature.
7. (C) Tends to be lazy (*reverse-scored*).
8. (E) Is outgoing, sociable.
9. (N) Gets nervous easily.
10. (O) Values artistic, aesthetic experiences.

# B Estimating the Structural Model

We now determine the correct estimator for the model represented by equations 9 and 10. The error term of the latter, $\epsilon^y_{it} = \beta_2 v_{it} + u_{it}$, poses no problem, given that both 2SLS and 3SLS are non-biased estimators when standard errors are cross-correlated between equations.

Considering equation 9, this can be rewritten as:

$$\begin{aligned} h_{it} = \alpha_1 + \beta_1 y_{it} + \delta y^2_{it} - \gamma \left(\frac{1-\beta_2}{\beta_2}\right)^2 N_i y^2_{it} - (Cu_{it} + B) N_i y_{it} + \\ - N_i \left(FE(u^2) + Gu_{it} + D\right) + FN_i \left(u^2_{it} - E(u^2)\right) + \Gamma_1 z_{hit} + \lambda_E E_i + e_{it}. \end{aligned} \tag{A-1}$$

Its error term can be written as:

$$\epsilon^h_{it} = -GN_i u_{it} - CN_i y_{it} u_{it} + e_{it}. \tag{A-2}$$

Given equation 3, $y_{it}$ and $u_{it}$ are correlated by construction. Substituting 10 in A-2, we obtain:

$$\begin{aligned}\underline{\epsilon}_{it}^{h} = &- GN_i u_{it} - CN_i(A_2 + B_2 y_{it-1} + C_2 z_{ait} + \\ &D_2\theta_{ai} + \beta_2 v_{it} + u_{it})u_{it} + FN_i\left(u_{it}^2 - E(u^2)\right) + e_{it}.\end{aligned} \tag{A-3}$$

from which we note that

$$E(\underline{\epsilon}_{it}^{h}) - CN_i E(u^2) = 0. \tag{A-4}$$

Therefore, we define $\epsilon_{it}^{h} = \underline{\epsilon}_{it}^{h} + CN_i E(u^2)$ and we rewrite equation A-1, as:

$$\begin{aligned}h_{it} = &\alpha_1 + \beta_1 y_{it} + \delta y_{it}^2 - \gamma\left(\frac{1-\beta_2}{\beta_2}\right)^2 N_i y_{it}^2 - BN_i y_{it} + \\ &- N_i\left((F+C)E(u^2) + D\right) + \Gamma_1 z_{hit} + \lambda_E E_i + \epsilon_{it}^{h},\end{aligned} \tag{A-5}$$

whose errors satisfy the conditional mean condition: $E(\epsilon_{it}^{h}|N_i, E_i, y_{it}, z_{it}) = 0$.

More precisely:

$$\begin{aligned}B &= \frac{(1-\beta_2)(\beta_2\gamma_1 - 2\alpha_2\gamma_2)}{\beta_2^2} \\ C &= -\frac{2(1-\beta_2)\gamma_2}{\beta_2^2} \\ D &= \lambda_N - \frac{\alpha_2^2\gamma_2}{\beta_2^2} - \frac{\alpha_2\gamma_1}{\beta_2} \\ F &= -\frac{\gamma_2}{\beta_2^2} \\ G &= \frac{\beta_2\gamma_1 - 2\alpha_2\gamma_2}{\beta_2^2}.\end{aligned}$$

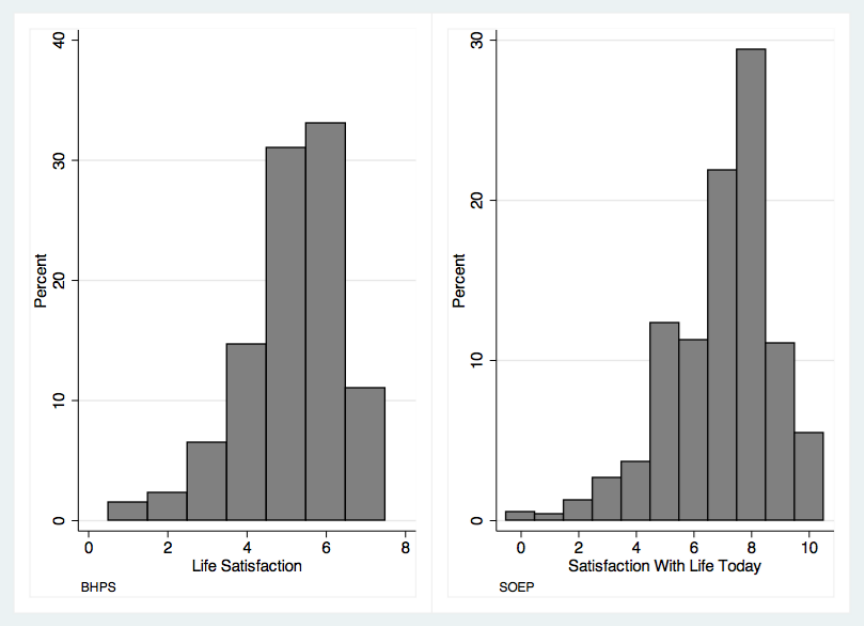
Moreover, substituting equation 3 in equation 5 we have:

$$\begin{aligned} A_2 &= \alpha_2 + \alpha_0\beta_2 \\ B_2 &= \beta_2\eta_0 \\ C_2 &= \beta_2\Gamma_0 \\ D_2 &= \beta_2\Lambda_0. \end{aligned}$$

Table A.1: **Income, Job Motivation and Personality Traits in Germany.** 3SLS estimation; dependent variable is household income (standard errors in brackets).

| | Germany 2004 b/se | Germany 2004 b/se | Germany 2004 b/se | Germany 2004 b/se |
|---|---|---|---|---|
| **Income** | | | | |
| Success Important | 1.453*** | 0.190* | 2.616*** | 0.193*** |
| | (0.114) | (0.110) | (0.144) | (0.064) |
| Education | | 0.162*** | 0.115*** | |
| | | (0.006) | (0.008) | |
| Age | 0.113*** | 0.058*** | 0.056*** | 0.029*** |
| | (0.010) | (0.009) | (0.013) | (0.006) |
| $Age^2$ | –0.001*** | –0.001*** | –0.000 | –0.000*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Male | –0.121** | 0.146*** | –0.429*** | 0.010 |
| | (0.047) | (0.043) | (0.058) | (0.026) |
| Income at t−1 | | | | 0.810*** |
| | | | | (0.005) |
| **Success important** | | | | |
| Education | 0.034*** | 0.017*** | –0.008*** | 0.019*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Age | –0.007** | –0.000 | –0.007** | –0.000 |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| $Age^2$ | –0.000*** | –0.000*** | –0.000*** | –0.000*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Male | 0.246*** | 0.268*** | 0.224*** | 0.268*** |
| | (0.012) | (0.013) | (0.013) | (0.013) |
| Neuroticism | –0.114*** | 0.049 | –0.001 | 0.041 |
| | (0.040) | (0.044) | (0.033) | (0.044) |
| Extraversion | 0.270*** | 0.285*** | 0.163*** | 0.286*** |
| | (0.045) | (0.049) | (0.037) | (0.050) |
| Conscientiousness | 0.773*** | 1.016*** | 0.542*** | 1.028*** |
| | (0.058) | (0.061) | (0.053) | (0.063) |
| Agreeableness | –0.240*** | –0.124** | –0.108*** | –0.136** |
| | (0.051) | (0.056) | (0.042) | (0.057) |
| Openness | 0.499*** | 0.526*** | 0.265*** | 0.510*** |
| | (0.043) | (0.047) | (0.037) | (0.048) |
| Income at t−1 | | | 0.155*** | |
| | | | (0.002) | |
| N | 13615 | 13615 | 12996 | 12996 |

Figure A.1: **Life Satisfaction Distribution in the UK and Germany. Data in Percentage of All Responses.**



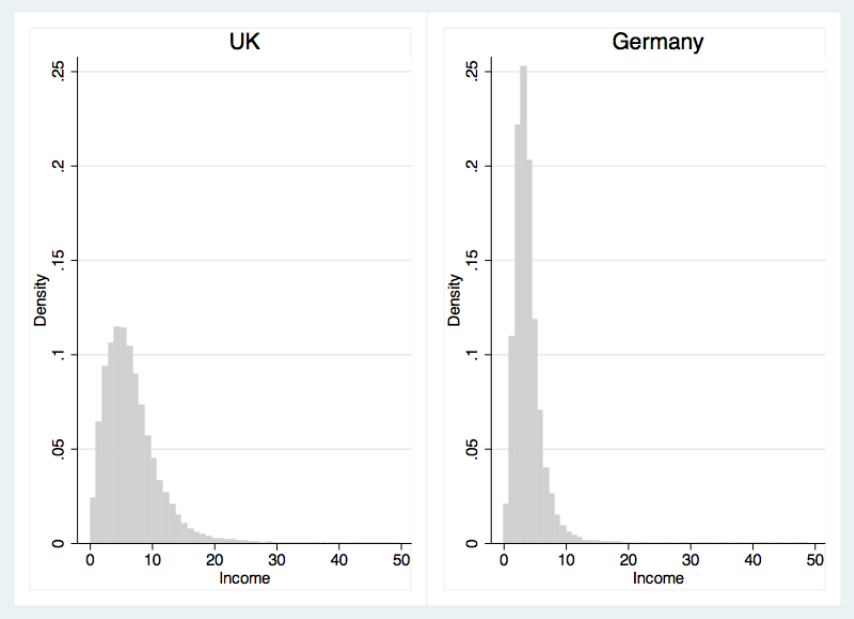


Figure A.2: **Household Income distribution. UK and Germany. Income in 10K 2005 USD.**