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Personality, well-being and the marginal utility of income: What can we learn from random coefficient models?*

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Abstract

Fixed effects models are the gold standard in empirical well-being research, however, their applicability is limited to controlling for intercept heterogeneity and identifying effects of time-varying variables. This paper investigates the usefulness of random coefficient models in controlling for heterogeneity in well-being and the marginal utility of income, and explores whether these forms of heterogeneity depend on the Big-Five personality traits. Using unique Australian longitudinal data that have personality measures available in two time periods we show that a Mundlak-adjusted random coefficient model yields almost identical results as the fixed effects model, making it a powerful modelling alternative when interest lies in multiple forms of heterogeneity. Big-Five personality explains 10 percent of the variation in intercept heterogeneity and 6-7 percent of the variation in the marginal utility of income. For women, we suggest that the marginal utility of income is significantly linked to personality, implying important gender-differences in the expected effectiveness of financial incentives to influence behaviour.

JEL classification: I31, D00, C23.

Keywords: Subjective well-being, Marginal utility of income, Heterogeneity, Personality, Random coefficient models.

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1 Introduction

Modelling heterogeneity in self-reported well-being data has become an industrious field, with a growing number of studies trying to devise statistical solutions to the many problems unobserved heterogeneity can cause (e.g. Anand et al., 2011; Jones and Schurer, 2011; Ferrer-i-Carbonell and Frijters, 2004). This is so because of the large unexplained component in self-reported well-being, that may be either due to reporting heterogeneity or omitted variables such as personality or cognitive ability. Since Ferrer-i-Carbonell and Frijters (2004), fixed effects (FE) models have become the gold standard in the literature to identify a causal effect of income on well-being (e.g. Powdthavee, 2010; Clark et al., 2008; Frijters et al., 2004), sometimes referred to as the marginal utility of income (Boyce and Wood, 2011; Layard et al., 2008).[1] Its major attraction is that it allows for correlation of traditionally unobserved factors and the right-hand-side variables of interest. Even though it comes closest to identifying unbiased parameter estimates, the FE model remains agnostic about the determinants of heterogeneity. Also, it does not allow to estimate the effect of individual-specific, time-invariant factors, as it uses only the within-group variation from the data.

Further, the FE model would estimate the marginal effect/utility of income for the average person in the sample. This is not unusual, as most econometric models provide an average effect. However, just as much as it is possible to have variation in life satisfaction, there may be variation in how individuals transform income into well-being, either due to differences in preferences over consumption (e.g. Barsky et al., 1997) or motivations in life (Fehr and Falk, 2002). Even though this idea has not permeated mainstream economics yet, it is fairly accepted in psychology. Diener and Fujita (1995) argue that a person's resources have an impact on subjective well-being only when they are useful to attain important goals, but people differ in these goals. Kasser and Ryan (1996) hypothesise that people with extrinsic values attach greater importance to material success, while people with intrinsic values focus on self-acceptance and community feelings. This heterogeneity

[1] The term marginal utility of income is used here to denote the contribution of an additional dollar of income to experienced or *ex-post* utility. This concept is distinct from unobserved or *ex-ante* utility, on which the traditional notion of marginal utility of income is based. The transformation of unobserved utility into experienced utility is a non-trivial issue, see the discussion in Layard et al. (2008) and Oswald (2008).

may be the reason for why the empirical happiness literature, with some exceptions (e.g., Layard et al., 2008; Frijters et al., 2004), usually finds on average a small marginal utility of income (see Clark et al., 2008); some groups of individuals may have very large positive valuations of income while others have negative or zero valuations which would, in arriving at the average effect, offset each other. The existence of substantial variations in the marginal utility of income would have powerful implications for how monetary incentives are designed, as the average individual may not respond to them in the way economists and policymakers had hoped for (see e.g., Borghans et al., 2008). The crucial question, therefore, is how wide are these variations and what determines them? We could only find three studies which explicitly address this concern (Boyce and Wood, 2011; Rojas, 2007; Clark et al., 2005).

In this study, we are particularly interested in whether personality traits, enduring patterns of thoughts, feelings, and behaviours (Roberts et al., 2000), are an important factor in explaining heterogeneity in both subjective well-being and the marginal utility of income. Our interest in personality stems, on the one hand, from a growing interest by economists in understanding the influence of personality on e.g. wages, occupational choice, or job matching, and finding possible interventions to improve economically-relevant personality traits (See Almlund et al., 2011, for an overview). On the other hand, personality traits are usually named as one of the prime suspects for the time-invariant, individual-specific heterogeneity that justify the use of FE models. However, whether personality traits are actually the main determinant of this heterogeneity is not empirically validated, apart from Boyce (2010) who shows that a battery of personality measures explain up to 20 percent of the variation in individual unobserved heterogeneity of life satisfaction. In addition, there are conflicting opinions on whether personality traits are stable enough to assume them to be fixed (Cobb-Clark and Schurer, 2011a; Lucas and Donnellan, 2011; Specht et al., 2011). Equally under-researched is the hypothesis that heterogeneity in the marginal utility of income depends on personality. Recently, Boyce and Wood (2011) find evidence that especially for women the marginal utility of income differs by the Big-Five personality traits, a widely used and validated instrument of five dimensions (Extraversion, Agreeableness, Conscientiousness, Neuroticism, Openness to Experience) to measure personality at the broadest level (John et al., 2009). Rojas (2007) distinguishes the marginal utility of income by eight personality types derived from philo-

sophical concepts such as stoicism, carpe diem, or virtue. His study finds that individuals who pursue goals in life such as carpe diem and personal fulfillment have the highest marginal utility of income, whereas tranquil and stoic personalities derive no utility from income.

Nevertheless, attributing the heterogeneity in the marginal utility of income exclusively to personality differences may be too restrictive. The potential for additional sources of heterogeneity beyond intercept heterogeneity and interaction effects of income with personality leads us to the random coefficient (RC) model, which is increasingly becoming popular as it allows simultaneous estimation of both intercept and slope heterogeneity (Hsiao and Pesaran, 2008). RC models can be viewed as a generalisation of random effects (RE) models, which are often compared to the FE model (e.g. Jones and Schurer, 2011; Ferrer-i-Carbonell and Frijters, 2004). RC models are common in the discrete choice literature where they are referred to as mixed logit models (McFadden and Train, 2000; Revelt and Train, 1998) and in the biomedical, education, and marketing literature, where they are called hierarchical/multilevel models (See Browne and Steele, 2009, for an overview). RC models are also similar to latent class (LC) models, a non-parametric estimation method that identifies a finite number of types across which both intercept and slopes may vary. In contrast to FE models, the RC model is more efficient because it uses both within- and across-individual variation from the data, and it allows for more flexibility in the forms of heterogeneity. On the negative side, as all random effects based models, the RC model makes the identifying assumption of no correlation between the unobserved heterogeneity in both intercept and slope and the regressors of interest. Whether this assumption in the RC model is of any practical relevance, has not been researched yet.[2]

For these reasons, we explore the following questions: (1) How much heterogeneity can we find in well-being and in the marginal utility of income? (2) How much of this heterogeneity can be explained by the Big-Five personality traits? and (3) To what extent yield RC models different answers than FE models? These questions are explored by analysing nine waves of an Australian longitudinal data-set. We specify a RC model

[2]The evaluation literature relaxes this assumption, since e.g. heterogeneous returns to education may correlate with the level of schooling. This problem is dealt with an instrumental variables approach to identify an average causal treatment effect (Heckman and Vytlacil, 1998). This so-called correlated random coefficient model is not studied in our paper.

that allows for heterogeneity in the level of well-being and in the coefficient of income. Big-Five personality traits are included in the model in levels and as interactions with income. To allow for some correlation between unobserved heterogeneity and the right-hand-side regressors, we extend the RC model with a Mundlak-type adjustment of the error term (Mundlak, 1978). A unique feature of our data set is that it contains the Big-Five personality data in two distinct time periods that are four years apart. This feature does not only allow us to compare estimates of level and interaction effects of personality between RC and FE models, but also to show in a robustness check that all our conclusions hold no matter whether we use time-averaged, lead, lagged or age-adjusted personality measures.

One main finding is that RC and FE models yield surprisingly similar estimated effects of the influence of personality on well-being, and the marginal utility of income. From a practitioner's perspective this suggests that the RC model may be a flexible and possibly preferable estimation framework to the more common FE model, when interest lies in estimating the effects of time-invariant variables such as personality traits. On the basis of RC model estimates, we further find that about 10 percent of the variation in the heterogeneity of well-being and 6-7 percent of the variation in the marginal utility of income can be explained by the Big-Five personality traits. About 9 and 14 percent of respectively men and women in our sample have well-being scores that are statistically different from the sample average, and correspondingly 4 to 7 percent have marginal utilities of income that are statistically different from zero. The marginal utilities of income differ substantially for women across the personality traits of Openness to Experience and Conscientiousness, but for men we find little robust evidence that personality explains marginal utilities of income.

The plan of this paper is as follows. Section 2 outlines the RC and alternative modeling frameworks. Section 3 introduces the data and gives insight into the psychometric properties of the personality data. Section 4 discusses the estimation results, while Section 5 presents robustness checks. Section 6 concludes.

2 Econometric specification

2.1 Model

We build our econometric model with the aim of testing two hypotheses: (1) individuals differ in their baseline well-being by observable (e.g., personality) and unobservable characteristics; (2) the marginal utility of income differs by personality and other (unobservable) factors. Thus, the estimation method needs to account for the unobserved variation in both baseline well-being and the marginal utility of income. Random coefficient (RC) models are a convenient tool for our purposes (Hsiao and Pesaran, 2008). A similar framework has been used in Clark et al. (2005) to model heterogeneity in the effect of income on well-being.[3]

Let there be N individuals and an individual i is observed T_i times in the data. We begin with a utility function of the form:

$$U_{it} = U_i(y_{it}, X_{it}), \tag{1}$$

i.e., the utility of individual i at time t depends on his current income, y_{it}, and his socio-economic and demographic characteristics, X_{it}.

The subscript to the function $U_i(\cdot)$ allows for the possibility that individuals derive different levels of utility for the same level of income and other characteristics. A linear utility function is specified as:

$$U_{it} = \mu_{1i} + \mu_{2i} y_{it} + X'_{it}\beta + \varepsilon_{it}, \tag{2}$$

where μ_{1i} and μ_{2i} are random variables that vary between individuals and ε_{it} is an i.i.d. error term. We refer to μ_{1i} as the baseline well-being, and to μ_{2i} as the marginal utility of income. These random coefficients depend on observed as well as unobserved charac-

[3] Clark et al. (2005) use latent class models to estimate heterogeneous slope parameters. These non-parametric models are similar in structure to the RC models, but they estimate a finite number of latent groups with no intra-group heterogeneity, whereas RC models assume one group with intra-group heterogeneity.

teristics of individual i as follows:

$$\mu_{1i} = \alpha_1 + Z'_{1i}\gamma_1 + v_{1i}, \tag{3}$$

$$\mu_{2i} = \alpha_2 + Z'_{1i}\gamma_2 + v_{2i}. \tag{4}$$

The vector Z_{1i} contains time-invariant variables that explain individual differences. We assume that μ_{1i} and μ_{2i} are a function of an individual i's personality traits (as suggested in Boyce and Wood, 2011). The disturbances $v = [v_{1i}, v_{2i}]'$ are assumed to follow a bivariate normal distribution with zero conditional mean ($E(v_i|X_{it}, Z_i) = 0$) and covariance matrix Ψ, where

$$\Psi = \begin{bmatrix} \psi_{11} & \psi_{12} \\ & \psi_{22} \end{bmatrix}.$$

Substituting (3) and (4) into (2), we obtain our main estimating equation:

$$U_{it} = \alpha_1 + Z_{1i}\gamma_1 + \alpha_2 y_{it} + X'_{it}\beta + (Z_{1i}y_{it})'\gamma_2 + \lambda_{it}, \tag{5}$$

where the composite error, λ_{it}, is given by

$$\lambda_{it} = v_{1i} + v_{2i}y_{it} + \varepsilon_{it},$$

with $\varepsilon_{it} \sim N(0, \sigma^2)$. Estimating (5) means in practical terms to include personality measures as levels (Z_{1i}) and interactions with income ($Z_{1i}y_{it}$). How U_{it} and these personality measures are constructed will be explained in Section 3.

To deal with the potential correlation between any unobserved individual characteristics such as intelligence and the error term of the regression, we extend the RC model using Mundlak's approach (Mundlak, 1978), which assumes that the individual-specific heterogeneity is a linear function of the time-varying regressors of the model.[4] In our case, these would be income y_{it} and all other time-varying elements in X_{it}. Hence, $E(v_{1i} \mid y_{it}, X_{it}) = \delta_y \bar{y}_i + \bar{X}_i\delta_x$. The extended estimating equation can now be written as:

$$U_{it} = \alpha_1 + Z'_{1i}\gamma_1 + \alpha_2 y_{it} + X'_{it}\beta + (Z_{1i}y_{it})'\gamma_2 + \delta_y \bar{y}_i + \bar{X}'_i\delta_x + v_{2i}y_{it} + \varepsilon_{it}. \tag{6}$$

[4] In the linear case, Mundlak (1978) has shown that the random effects and fixed effects estimates are equivalent as long as $E(v_{1i} \mid y_{it}, X_{it}) = \delta_y \bar{y}_i + \bar{X}_i\delta_x$ strictly holds.

Let $\delta = [\delta_y \quad \delta_x]'$, then we can use the variable addition test for fixed versus random effects (p. 421 Greene, 2012). The test statistic under the null hypothesis (i.e., $\delta = 0$) is distributed χ^2 with k, i.e. the number of added variables, degrees of freedom. If this test statistic is large, one rejects the random effects in favour of the fixed effects (FE) model.

Maximum likelihood estimation is used to obtain the model parameters of interest ξ and the likelihood function for every individual i is:[5]

$$l_i(\xi) = \int g(\upsilon_i; \Psi) f(U_i|\upsilon_i, X_i, Z_i; \xi^f) d\upsilon_i = \int g(\upsilon_i; \Psi) \prod_{t=1}^{T_i} f(U_{it}|\upsilon_i, X_{it}, Z_i; \xi^f) d\upsilon_i, \quad (7)$$

The first term in (7) is the random components density and the second term is the conditional density of the outcome, given the random components and covariates. The expression ξ^f denotes the vector of parameters appearing in the conditional response distribution, so that ξ consists of ξ^f and the unique elements in Ψ (See Skrondal and Rabe-Hesketh, 2009, p. 662). The individual observations i are independent of each other and thus $l(\xi) = \prod_{i=1}^{N} l_i(\xi)$. To solve the integrals, we use the EM algorithm.

One can test whether controlling for the potentially confounding effects due to individual-specific, unobserved factors in both the intercept and the slope is important in a statistical sense. A test of the hypothesis that there is no random effect in respectively the intercept and the slope takes the form:

$$H_0 : \psi_{11} = 0 \text{ vs } H_a : \psi_{11} > 0, \quad (8)$$

$$H_0 : \psi_{22} = 0 \text{ vs } H_a : \psi_{22} > 0. \quad (9)$$

These tests are one-sided since variances cannot assume negative values. An easy implementation of these tests is via the likelihood ratio test, since the model under the null hypothesis can be nested in a broader model that contains the random effects.

The estimation results from the RC model are compared to the FE model that is widely used in the empirical happiness literature (see e.g., Boyce and Wood, 2011; Layard et al., 2008; Ferrer-i-Carbonell and Frijters, 2004). If one is willing to assume personality to be

[5]This maximum likelihood approach is used in the linear mixed models literature (See Skrondal and Rabe-Hesketh, 2009), which is implemented in STATA 11.2 – xtmixed – command that is used in our analysis. Alternatively, one could estimate the parameters of interest with the GLS or the Bayes mode estimator. See Hsiao (2003, pp. 141-147) for an overview of the literature and derivations of the estimators.

sufficiently stable, so that personality measures can be included as time-invariant variables into (6) (Cobb-Clark and Schurer, 2011a), then the FE model will not provide estimates for the level effects of personality traits on well-being, but only for the coefficients on the interaction terms of income with personality measures.

In a robustness check, we conduct the same analysis by estimating RC and FE models for the two time-periods when personality data are available (2005 and 2009). In this set-up, personality is allowed to change over time, and so we obtain estimates for both the level and the interaction effects of personality. The FE model identifies parameter of interests only for changes within individuals, and ignores the variation across individuals, making it less efficient than the RC model.

2.2 Marginal effects

Of particular interest for a quantitative interpretation of the parameter estimates are the marginal effects for the change in a given dimension of personality. To do so in the RC model, it is necessary to predict first the random coefficients $\upsilon = [\upsilon_{1i}, \upsilon_{2i}]'$ for each individual. The random components υ can be obtained by using an empirical likelihood approach as outlined in Skrondal and Rabe-Hesketh (2009). The Bayes prediction method makes use of the observed values of U_{it} (i.e., the likelihood as in (7)) as well as the prior distribution of υ. Combining the prior distribution with the likelihood yields the posterior distribution:

$$\text{Posterior}(\upsilon \mid (U_{i1}, \ldots, U_{it})) \propto \text{Prior}(\upsilon) \times \text{Likelihood}(U_{i1}, \ldots, U_{it} \mid \upsilon). \tag{10}$$

The empirical Bayes prediction of $\hat{\upsilon}_{1i}$ and $\hat{\upsilon}_{2i}$ are the mean of (10) after substituting maximum likelihood estimates of the model parameters, β, α, γ and Ψ.

The predicted $\hat{\upsilon}_{1i}$ and $\hat{\upsilon}_{2i}$ can then be used to calculate the marginal utility of income (for a unit change in income) for each individual, given his or her observed personality traits and an individual-specific effect:

$$\hat{\mu}_{2i} = \hat{\alpha}_2 + Z'_{1i}\hat{\gamma}_2 + \hat{\upsilon}_{2i}. \tag{11}$$

Similar calculations are made for predicting baseline well-being:

$$\hat{\mu}_{1i} = \hat{\alpha}_1 + Z'_{1i}\hat{\gamma}_1 + \hat{v}_{1i}. \tag{12}$$

Standard errors for $\hat{\mu}_{1i}$ and $\hat{\mu}_{2i}$ are obtained as:[6]

$$\hat{\sigma}_{\hat{\mu}_{li}} = \sqrt{\hat{\sigma}^2_{\hat{\alpha}_l} + Z'_{1i}V(\hat{\gamma}_l)Z_{1i} + \hat{\psi}_{lli}}, \quad l = 1, 2, \tag{13}$$

where $V(\hat{\gamma}_1)$ and $V(\hat{\gamma}_2)$ are the variance-covariance matrices of the estimated effects of respectively the Big-Five personality traits and the interaction of income with the Big-Five personality traits. Using the estimates of the random intercepts and slopes and their standard errors, we graph the distribution of the marginal utility of income and the baseline level of well-being and their 90 percent confidence intervals. To compare the estimates of the relationship between personality and baseline well-being, and between personality and the marginal utility of income, we construct for each model the following marginal effects: (1) The effect of a one standard deviation change in a particular personality trait evaluated at the sample average of household income; (2) the marginal utility of income evaluated at the average of each personality trait and the random effects in the sample; and (3) the difference in the marginal utility of income for individuals in the first and ninth deciles of the distribution of one particular personality trait, evaluated at the average value of all other personality traits and the random effects. Formulas for marginal effects in (1) to (3) are presented in Table A.1 in the Appendix.

3 Data and descriptive statistics

For the analysis we rely on data from 2001–2009 data from the Household, Income, and Labour Dynamics of Australia Survey (HILDA). HILDA is a broad, general purpose longitudinal survey designed to obtain detailed information about household structure and formation, income, well-being, employment and labour force participation. It consists of a nationally representative sample of Australian households; the data are collected via both face-to-face interviews and self-completion questionnaires covering all household members aged 15 years and older. In wave 1 of the survey, 7,682 households were interviewed and

[6]STATA 11.2 provides standard errors for $\hat{v}_{1i}$ and $\hat{v}_{2i}$. Since the model assumes zero correlation between the random components and the estimates of α and γ the standard errors contain no covariances.

a sample of 13,969 successful interviews were obtained. These individuals were followed in subsequent waves.[7]

After restricting the sample to individuals aged between 20 and 60 to ensure that personality traits can be assumed as relatively stable, and only keeping individuals for whom personality information is available in both waves 5 and 9, we end up with an unbalanced panel of 3,268 men and 3,890 women, generating respectively 23,144 and 27,725 person-year observations over nine years.[8] In this sample, more than half of all individuals (53 percent) were observed in all nine waves of the panel, another 31 percent were observed for seven or eight waves, and no more than 16 percent stayed in the sample for fewer than seven waves.

3.1 Subjective well-being

In common with most happiness studies, we made two assumptions about measures of subjective well-being: (1) they contain genuine information about the quality of human lives (Oswald and Wu, 2010; Krueger and Schkade, 2008), and (2) they are a good proxy for experienced, i.e. ex-post, utility and so they are valid to estimate the marginal utility of income (Oswald and Wu, 2010; Layard et al., 2008). The dependent variable of our regression equation is taken from the single-item measure of "overall life satisfaction." The exact wording of the question, asked in every wave of HILDA, is as follows:

> "All things considered, how satisfied are you with your life? Again, pick a number between 0 and 10 to indicate how satisfied you are."

For ease of interpretation, we standardise this well-being measure to mean zero and one standard deviation. All parameter estimates are interpreted in terms of standard-deviation change in well-being.

Table 1 presents the distribution of the the well-being measure separately for men and women. Almost 71 percent of men and 68 percent of women reported well-being scores of 8 and above, while very few (2.61 percent of men and 2.37 percent of women) reported a score of 4 or less. The average well-being score for men in the sample is 7.8 with a

[7] A more detailed description of HILDA can be found in Wooden and Watson (2002) and various issues of HILDA Annual Reports, which are available from www.melbourneinstitute.com/hilda/areport.html.

[8] Of the original 13,969 individuals, 20 percent were lost for not completing the 2005 personality questionnaire, and of these 11,225 individuals, 34 percent were lost either because they did not complete the 2009 personality questionnaire or they dropped out of the panel after 2005.

standard deviation across individuals of 1.4 points (7.9 and 1.4 for women). Our sample averages of well-being scores are slightly higher, but still in line with values of 7.6 reported for Australia (World Values Survey) by Leigh and Wolfers (2006).

[Insert Table 1 here]

3.2 Personality variables

Personality psychologists understand personality traits as relative enduring patterns of thoughts, feelings, and behaviours that reflect the tendency to respond in certain ways under certain circumstances (Roberts, 2009, p. 140). One of the most widely accepted taxonomies to measure these enduring patterns is the Five-Factor model. The so-called Big-Five personality inventory (Goldberg, 1981) is obtained from factor analysis of measures of different domains of personality based on self-reports. The five dimensions Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience represent personality at the broadest level of abstraction, from which more specific personality characteristics can be distinguished. Although the Five-Factor model is not free of criticism, it has been the most widely used in both psychology and economics research (See Almlund et al., 2011; John et al., 2009).

The Big-Five measurement instrument in HILDA (waves 5 and 9) is derived from Saucier (1994), as it consists of 30 of Saucier's original 40 items plus an additional six items identified by the HILDA team. Ultimately, 28 of these 36 items are used to construct the five aggregate scores of personality; eight items were discarded due to their ambiguity by loading onto several dimensions (Losoncz, 2009). Each survey respondent is asked to score how well a particular trait describes him or her ranging from from 1 (does not describe me at all) to 7 (describes me very well). The five scales are composed by taking the average of the following items listed in Table 2, where (R) indicates the reverse score:

[Insert Table 2 here]

An extrovert is characterised by being talkative, lively and bashful. Extraversion refers to positive affect and sociability. An emotionally instable individual tends to be envious, moody, and fretful, thus is characterised by proneness to psychological distress. Conscientious individuals are characterised as being efficient, organised, and systematic

and they are often referred to as norm-adherent or hard working. An open person is described as being deep, creative, and complex and some evidence in the literature suggests that it is strongly correlated with intelligence. An agreeable person is described as being sympathetic, kind, and cooperative, traits that are often summarised as altruism.

Psychologists have developed and validated over many decades the reliability of this self-assessed instrument (e.g. John et al., 2009). A detailed analysis of the psychometric properties for the HILDA data by Losoncz (2009) shows that the five dimensions have adequate internal consistency with Cronbach's α beyond 0.7.[9]

One important question is how to best make use of the multiple time-period data available on the Big-Five. If personality in adulthood was perfectly stable then one could use either wave 5 or 9, assuming it to be a fixed component such as gender or human capital. Past research in psychology supports this claim, arguing that personality traits are enduring behavioural dispositions, as dramatic rank-order or mean-level changes in personality appear to be unlikely after early adulthood and changes usually occur over a long period of time that may span decades (Roberts and DelVecchio, 2000). On the basis of these claims previous studies used lead personality data to estimate the effect of personality on life satisfaction (Headey et al., 2010), wages (Heineck and Anger, 2010) or occupational choice (e.g. Cobb-Clark and Tan, 2011).

Zero rank-order or mean-level changes however do not rule out intra-individual changes due to unanticipated life events. Indeed, the claim of stability is not uncontested over longer time periods (see.g., Roberts et al., 2000; Helson et al., 2002). Empirical evidence over a four-year time-period suggests that for age-groups between 25 and 60 mean-level changes are relatively small (Cobb-Clark and Schurer, 2011a; Lucas and Donnellan, 2011; Specht et al., 2011). Even though some life events may induce changes in personality measures, they appear to be so small in magnitude to be of little economic importance (Cobb-Clark and Schurer, 2011a; Specht et al., 2011). The latter suggests that observed variations in personality are possibly due to measurement error (Cobb-Clark and Schurer, 2011a) or panel-conditioning effects (Lucas and Donnellan, 2011). We therefore construct the benchmark personality measure as an average score over two time-periods to reduce the possibility that period-specific fluctuations dominate the personality score. In a robustness

[9] We have verified the internal consistency of the personality measures for our sample and overall the reliability statistics are adequate as in Losoncz (2009).

check, we are able to show that our conclusions do not change whether we use averaged, lead or lagged data.

Figure 1 shows the distribution of the Big-Five personality traits by gender. Agreeableness, Conscientiousness, and Emotional Stability are highly left skewed, indicating that a large proportion of individuals consider themselves as agreeable, conscientious, and emotionally stable. The distributions of Extraversion and Openness to Experience are approximately normal. The distributions of all five personality traits differ significantly between men and women (p-values of Kolmogorov-Smirnov test of the hypothesis of an equal distribution are less than 0.001 in all cases). Women tend to be more extraverted, agreeable, and conscientious.

[Insert Figure 1 here]

3.3 Income and other covariates

The income measure used in the estimation is the natural logarithm of household disposable income (AUS$).[10] Household disposable income in HILDA is the difference between two aggregate components: gross income (i.e., income from market and non-market, e.g., welfare payments, sources) and estimated taxes, the latter were computed based on the particular circumstances of each household. In 418 cases this difference results in non-positive values, which we deleted from our sample.

In addition to personality and income, we control for age, marital status, number of children in a household, number of individuals in a household, health status, education, employment status, total weekly work-hours, and regional indicators. Time fixed effects are included in each model to capture year-specific macro-effects that are common to all individuals at a given point in time. Summary statistics for these variables are presented in Table A.2 in the Appendix, and appear reasonable and within expectations.

[10] As a sensitivity check we also estimated the model using disposable income in dollar amounts and equivalised household income. The latter is computed using the modified OECD scale: weights of 1 for the first adult, 0.5 for subsequent adults (aged over 14) and 0.3 for each child (see e.g., Clark et al. (2005)); the results, available upon request, are robust against these alternative measures.

4 Results

4.1 Is intercept and slope heterogeneity linked with personality?

We first show the degree of heterogeneity in subjective well-being scores ignoring for the moment the influence of personality. Figures 2(a) and 2(b) graph the distribution of the predicted individual fixed effects obtained from a FE model that controls for all covariates described in Table A.2, but not for personality traits. There exists a wide distribution of baseline well-being across individuals; a non-trivial fraction of individuals lies below the estimated average well-being, and an even larger fraction lies strictly above. One disadvantage of the FE model is that it does not allow us to infer whether these variations are statistically significant.

[Insert Figure 2 here]

Whether this heterogeneity depends on the Big-Five personality traits can be assessed by regressing the individual fixed effects on personality traits. Table 3 reports the proportion of variation in the individual fixed effect that is explained by personality (adjusted R-squared). About 12 percent for men and 7 percent for women of the variation in unobserved heterogeneity is explained by personality. A similar picture emerges when using instead of the predicted residuals from a FE estimation the predicted random component in well-being obtained from a random intercept model. About 10 percent of the total variation in the unobserved heterogeneity is explained by the Big-Five personality traits for both men and women. These two figures are slightly smaller than those reported in Boyce (2010), who finds that personality accounts for 18 percent of the variation in the well-being heterogeneity. However, Boyce (2010) included apart from the Big-Five personality traits also locus of control and optimism/pessimism.

Just for comparison, we present in Table 3 also the explained variation in the random component of the income coefficient that is due to personality. This random component is obtained from a random coefficient model that does not include personality traits and interactions of personality with income. This random component is then regressed on the Big-Five personality indicators. For men 7 percent and for women 6 percent of the variation in this slope heterogeneity is explained by personality. Once allowing for slope

heterogeneity, the explained variation in the intercept component due to personality is halved.

[Insert Table 3 here]

These numbers indicate that personality plays an important role in determining heterogeneity in well-being and the marginal utility of income. If observed, personality measures may as well be included directly as levels and interactions with income in an estimation equation. We will do so in the next section.

4.2 The effect of personality on well-being and the marginal utility of income

To test whether personality has a direct effect on well-being and the marginal utility of income, we estimate numerous variants of (5), including pooled ordinary least squares (OLS), random effects models (RE), random coefficients (RC), Mundlak-adjusted random coefficient models (RC-M). For both men and women the preferred model is the Mundlak-adjusted random coefficient (RC-M) model according to information criteria and likelihood ratio tests.[11]

The statistical significance of personality variables in explaining well-being is tested using a likelihood ratio test comparing a restricted RC-M model that excludes personality against the unrestricted model that includes personality variables. For both men and women, the unrestricted model is preferred (χ^2 test statistics for men and women are respectively 364 and 416, p-values < 0.001). The model including personality measures is then tested against an unrestricted model that includes both personality measures and their interactions with income. Only for women the latter model is preferred. According to Table A.3 in the Appendix the χ^2 test statistics for men and women are, respectively, 1.94 (p-value 0.857) and 17.86 (p-value 0.003).

Table 4 presents selected marginal effect estimates obtained from the preferred models (RC-M) for men and women separately. For comparison, we also include estimates

[11] We test the Mundlak-adjusted RC model against the non-adjusted model using an added-variable test. The result, with χ^2 test statistics of 155 and 224 for respectively men and women, overwhelmingly rejects the RC model without Mundlak adjustment. We further tested the RC-M specification against the FE specification using a Hausman-type test. The result suggests that the RC-M is preferred for men; for women the test is invalid because of a negative χ^2 test statistic. Incidentally, the same test on the RC model without Mundlak adjustment favors the fixed effects specification for both men and women, with p-values of < 0.001. This result appears to support the use of Mundlak adjustment in our context. See Table A.3 in the Appendix

obtained from pooled OLS (OLS) and fixed effects (FE) models, where applicable. The marginal effects presented are those of personality traits, income, and the differences in the marginal utilities of income between the top and bottom deciles in the distribution of each personality trait. These are calculated according as reported in Section 2 and Table A.1 in the Appendix. Each marginal effect presented is a linear combination of two or more coefficients due to the inclusion of interaction terms between income and personality traits. The reported standard errors refer to these linear combinations. Since the dependent variable is standardised to mean 0 and standard deviation 1, all marginal effects are to be interpreted in terms of standard deviations (SD). Full estimation results of coefficients are provided in Table A.4 in the Appendix.

Also reported in Table 4 are estimates of the random components for the RC-M model. Straightforward likelihood ratio tests show that these random components are jointly statistically different from zero, thus are preferred to OLS (no random components) and random effects models (random intercepts only).

[Insert Table 4 here]

Our results suggest that personality and well-being are strongly related. Emotional Stability and Agreeableness are the strongest predictors of well-being among the five dimensions of personality for both men and women. A one standard-deviation increase in Agreeableness is associated with a 0.11 standard-deviation increase in well-being for men and women in both OLS and RC-M models. Similar magnitudes and levels of significance are obtained for Emotional Stability (0.10 for men and 0.12 for women). Also, more conscientious and extraverted individuals are happier, but the effects are relatively small.

These estimates are consistent with findings in the psychology literature on all personality traits except for the negative correlation of Openness to Experience with well-being for men. However, other studies too could not replicate the positive relationship reported in DeNeve and Cooper (1998).[12]

The estimates of the average marginal utility of income are statistically significant for both sexes, although the magnitude is small compared to the effects of changes in personality traits. A doubling of income is associated with an increase in well-being of 0.05 SD (SE 0.016) for men and 0.03 SD (SE 0.013) for women, an effect that is statistically

[12]Diener and Seligman (2002) find no association and Headey et al. (2010) find a negative association.

significant at the 5 percent level or better. Similar magnitudes and levels of significance are obtained from the FE models.

The marginal utility of income varies significantly by personality in both RE and FE models for women. As can be seen from Table A.4 in the Appendix the interaction terms with income are positive for Conscientiousness and Openness to Experience, which means that the marginal utility of income is increasing the more an individual is associated with these two traits. The interaction effects are negative for Extraversion and Emotional Stability, and positive for Agreeableness, but they are not statistically significant.

In terms of magnitude, we compare the marginal utility of income for women who are low on Openness to Experience and Conscientiousness (lowest decile in distribution) against women who are high on these two traits (highest decile in the distribution). Column 5 and 6 of Table 4 report that the estimated difference in the marginal utility of income across the distribution of Openness to Experience is around -0.10 standard deviations (SD) in terms of higher well-being for a doubling of household income (RC-M: -0.083 SD, SE 0.028; FE: -0.103 SD, SE 0.028) models. Similarly, for Conscientiousness, we find a -0.047 SD difference (SE 0.028) in the RC-M and - 0.043 SD (0.027 SE) in the FE model. To better understand where this negative difference stems from, have in mind that for women low on Openness to Experience the marginal utility of income is not different from zero (-.011 SD, SE .019), whereas for women at the highest end it is .072 SD (.020), hence more than twice the average in the sample (0.034 SD, SE 0.014). The respective differences for Conscientiousness are .005 SD (SE .020) at the lowest decile and .052 SD (SE .020) at the highest decile.[13]

For men, almost none of the interaction effects of income with the Big Five personality traits are statistically significant, except for Emotional Stability in the FE model. The interaction effect of income with Emotional Stability (see Table A.4 in the Appendix) are negative in both RC-M and FE model, suggesting that the marginal utility of income is smaller for individuals associated with emotional stability. In the FE model (column 3 of Table 4), this difference in marginal utility of income between men and the lower and higher end of Emotional Stability is 0.056 SD (SE 0.030). Again, to give you an idea of what this means consider that men at the lowest decile of the distribution of Emotional Stability derive a well-being gain for a doubling of income of 0.063 SD (SE 0.021), whereas

[13]These calculations are provided upon request for all marginal effect calculation.

men at the highest decile derive no wellbeing gains (0.007 SD, SE 0.019).

In Table A.4 in the Appendix one can also see that the interaction effects of income with personality are positive for Extraversion and negative for Agreeableness and Openness to Experience, i.e. the opposite to what we found for women. The differences in signs between men and women, however, cannot be distinguished from random variation in the sample and thus they may not imply that men and women transform income gains into wellbeing differently along these three traits.

How do our results compare to Boyce and Wood (2011), who use a very similar FE specification and the same Big-Five personality inventory? On the one hand, our results of stronger differences in marginal utilities of income by personality for women are in line with their estimates. Whereas we find no significant effects for men (except for Emotional Stability in the FE model), we do find strong effects for women with respect to Openness to Experience and Conscientiousness. Boyce and Wood (2011) find only a significant effect for men for Conscientiousness, and significant effects for women on four out of five traits (no effects for Agreeableness). Our results for women are also in sync with respect to the positive effect of Conscientiousness on the marginal utility of income for women. Our results differ, however, qualitatively with respect to Openness to Experience. Whereas we find that Openness to Experience is positively linked to the marginal utility of income, Boyce and Wood (2011) find the opposite. One explanation for this dissonance could be that in HILDA Openness to Experience is measured slightly different than in the German Socio-Economic Panel data (GSOEP).

4.3 Distribution of heterogeneity in well-being and marginal utility of income

Using our preferred RC-M model, we next document the degree of heterogeneity in baseline well-being and marginal utility of income. Figure 3 shows the distribution of the random component in well-being, which are calculated on the basis of (11) including personality measures, and its 90 percent confidence interval; each graph shows ordered values from the lowest to the highest. Approximately 9 percent of men (309 individuals) and 14 percent of women (546 individuals) in the sample have well-being scores that are statistically significantly below or above the sample average. It is worth noting that the distributions are similar to those obtained using fixed effects estimation (see Figures 2(a) and 2(b) above). The RC-M model has the important advantage of allowing confidence

intervals to be placed on the estimated individual effect, thereby allowing us to make statistical inference.

[Insert Figure 3 here]

The distribution of the random component in the marginal utility of income, which is calculated on the basis of (12), is depicted in Figures 4(a) and 4(b). For most people this random component is scattered around zero, except for a small proportion. About 7 percent of men (219 individuals) and 4 percent of women (163 individuals) the marginal utility of income lies strictly above or below zero in a statistical sense. These figures underscore the point that not all individuals value additional income in the same way; some people respond more or less to income gains than the average person which does not respond at all in our sample. The small number of individuals whose wellbeing scores are positively elastic to changes in income maybe the group of main interest to policymakers when designing programs with financial incentives to change behaviour.

[Insert Figure 4 here]

5 Robustness

So far, we have shown that personality measures are strongly linked with heterogeneity in well-being and in the marginal utility of income, that Emotional Stability and Agreeableness are the strongest correlates of well-being among the Big-Five personality traits, and that women high on Openness to Experience and Conscientiousness report larger well-being gains from increases in income than women low on these traits. For men, we found no significant interactions of income with personality, except for Emotional Stability, that was significant in the FE model only. In this section, we address two potential problems with our model specification that may lead erroneously to these conclusions.

The first concern is that the RC-M model, despite some flexibility allowing for a linear correlation between unobserved heterogeneity and time-varying regressors of the model (including income), may still yield biased estimates of $\hat{\gamma}_1$ and $\hat{\gamma}_2$. This is so because the Mundlak-adjusted RC-M model yields only the same estimates as the FE model for the coefficients on time-varying variables, and for these only if the linearity assumptions holds. However, personality is not allowed to vary over time in our main specification. The only

way to test whether this concern is valid is to re-estimate our benchmark model (RC-M) on a sample restricted to waves 5 and 9 so that personality measures vary, and compare these estimates to the FE model that is estimated on the same sample. If the results are comparable between the two models, then our concern about the strong assumptions made in the Mundlak-adjusted RC model is of no practical importance.

The FE estimation above requires the availability of personality measures in at least two time periods, a luxury rarely available to applied researchers. In some previous work it has been common to attach the single measure of personality available to past outcome data (e.g. Cobb-Clark and Tan, 2011; Heineck and Anger, 2010; Headey et al., 2010). However, personality may be endogenous to changes in well-being and thus the use of our averaged personality measure over two time-periods, which de facto uses a lead indicator for at least some observations, may be misleading. If a shock to well-being, let's say in 2001, has an effect on personality recorded in 2005, then any significant correlation between personality and well-being will be due to reverse causality. If personality does not change in an economically meaningful way with unmeasured life events as, for instance, reported in Cobb-Clark and Schurer (2011a), then using lead, lagged, or age-adjusted indicators of personality should not change our benchmark results. This concern will be addressed in a second robustness check.

5.1 Comparing RC-M and FE models over two time-periods

We re-estimate our benchmark model restricting the sample to years 2005 and 2009 and allowing personality to vary over time. Table 5 reports the marginal effect estimates obtained from the RC-M and the FE model using this restricted sample. For comparison, we also include the main results from the RC-M model discussed earlier (see Table 4). Note that this analysis is based on a sample of about one-quarter of the main estimation sample, from which more than 220 men and 260 women were dropped. The overall results will therefore slightly differ from the benchmark model. Also note that the FE model with T=2 is de facto a first difference FE model, but it can be interpreted in the same way as the within-fixed effects estimator. The two estimators are equivalent in the T=2 case. The within-group fixed effects estimator would be more efficient for T> 2 (Greene, 2012).

Table 5 shows that the FE model (columns 3 and 6) yields broadly similar marginal effect estimates for personality as the RC-M models (columns 2 and 4), but some differences

in the magnitude of these effects can be observed. For men, the effects of Extraversion and Agreeableness have decreased in the FE model by 35 percent and 58 percent, respectively, the effects of Conscientiousness and Emotional Stability have increased by around 30 percent, while the effect of Openness to Experience has gone from negative (-0.036) to positive (0.041). For women, the FE model yields estimates that are similar, except for the effect of Extraversion, which has more than doubled. Estimated effects of Agreeableness and Emotional Stability have changed by less than 30 percent.

[Insert Table 5 here]

The average marginal utility of income is lower for men by less than 30 percent, and slightly larger for women in the FE than in the RC-M model, thus these effects are reasonably similar. With respect to the differences in the marginal utility of income by personality, if anything, the RC-M model appears to underestimate this heterogeneity, especially so for men. The only two notable differences where a FE model would find a strong difference in marginal utilities of income by personality, whereas the RC-M model would not, is for the trait of Extraversion for men and Agreeableness for women. One explanation for why only the FE model picks up on these differences is that for both Extraversion for men and Agreeableness for women may have more within-individual than across-individual variation. Since the FE model identifies the estimates of interest via within-individual variation, whereas the RC-M attaches also some weight to cross-individual variation, it appears possible that only the FE model reveals these differences.

5.2 Does it matter which personality measure to use?

To investigate whether a potential endogeneity in personality measures may bias our results, we re-estimate our preferred model (RC-M) using seven alternative constructs of the personality variables and/or samples. These constructs are based on personality information: (1) recorded in 2005 only and attached to a sample 2001-09; (2) recorded in 2009 only and attached to the sample 2001-09; (3) recorded in 2005, but adjusted by age, and attached to the sample 2001-09;[14] (4) recorded in 2009, but adjusted by age recorded

[14]The idea of age-adjusting personality measures is based on the idea that personality changes equally for individuals of similar age-groups. Each personality indicator is regressed on four polynomials of age. The standardised residuals from this regression are then used as personality measures in the benchmark model; see Heineck and Anger (2010)

in 2009, and attached to the sample 2001-09; (5) recorded in 2005 and attached to a restricted sample 2006-09; (6) recorded in 2005, age-adjusted and attached to the sample 2006-09; and (7) recorded in 2009 and attached to the sample of (5). The specifications in (5) and (6) should yield the least biased results as personality was measured before well-being and income. In addition, the personality variables have been adjusted for age in (6), thus allowing for potential age differences in personality. We include (7) to illustrate that potential changes in the estimates of (5) are not due to sample size changes.

For comparison, the same marginal effects are calculated in each case; the results are reported in Tables 6 for men and 7 for women. In a nutshell, our main findings for both men and women remain with no qualitative changes. It makes no difference for the estimates of the effect of personality on well-being whether the personality measure is constructed with lead, lagged, or age-adjusted personality information—even if we use personality information from 2009, the same conclusions would remain. More importantly, using 2005 personality information and restricting the sample to 2006 onwards makes no difference to the results, even when adjusting for age. Comparing the marginal effects of personality traits between this latter and the benchmark model yields differences of less than 20 percent (with one exception of Emotional Stability of 35 percent).

Even the estimated differences in the marginal utilities of income by Conscientiousness and Openness to Experience that stood out so strongly for women remain the same across all model. The only exception is that when using lagged measures of personality the differences are about 60 percent larger for Conscientiousness and about 25 percent smaller for Openness to Experience, relative to the benchmark model, which uses averaged personality information.

One could argue that the sign changes for the interaction effect of Emotional Stability with income for men between models (1) and (5) and (7) may be problematic. For instance, in the benchmark model, which uses an averaged personality measure, the interaction effect is negative, whereas is model (5), which uses a lagged measure of personality, it is positive on a restricted sample. The sign change is not caused by the sample restrictions, because model (7), which uses a lead measure of personality (2009) shows yet again a negative sign. We discard these worries by referring to Table 5; both the RC-M and FE model in which personality was allowed to change between 2005 and 2009, also found a negative interaction effect, so that the difference in wellbeing gains between men at the

lowest and highest decile of Emotional Stability is 0.056 SD and 0.116 SD respectively. Hence, the difference of 0.045 SD is at worst an underestimate of the effect found above.

Similarly, we discard the potential concerns over the two sign changes in the estimates of the interaction effects of Extraversion and Agreeableness with income across models (1), (5), and (6) for women. For women these interaction effects are statistically insignificant in all specifications, and we refrained from interpreting these effects. It may well be that for women Agreeableness is rather malleable over time and therefore the estimated interaction effects are more fluky.

Overall, we deduce from this robustness check that even though the Big Five personality measures may vary over time, assuming them as sufficiently stable and use retrospective measures does not lead to severely biased conclusions in our setting. This result goes beyond Cobb-Clark and Schurer (2011a), who made this claim only for lagged and contemporaneous measures of personality measures.

[Insert Table 6 here]

[Insert Table 7 here]

6 Conclusion

This paper investigates the role of personality in explaining the heterogeneity observed in individual subjective well-being and the marginal utility of income. It also assesses to what extent the random coefficient model may be useful to understand these relationships in comparison to the fixed effects model. Using nine years of HILDA data, we find indeed a large degree of heterogeneity across individuals in their subjective well-being. We show that personality measured by the five factor model provides significant explanatory power, in both statistical and practical sense, for the observed heterogeneity in both baseline well-being and the marginal utility of income. Approximately 10 percent of the variation in the heterogeneity of well-being and 6-7 percent of the variation in the marginal utility of income are explained by the Big-Five personality. Among these, Emotional Stability and Agreeableness appear to be the most influential in determining well-being for both men and women and Conscientiousness and Openness to Experience are robustly linked with differences in the marginal utility of income for women. The estimated models allow us

to examine the distributions of the heterogeneity in well-being and the marginal utility of income. Although the majority of individuals in the sample appear to derive little well-being gains from income increases, a small number of individuals (4-7 percent) appear to respond very strongly.

Our results are found to be particularly robust. Both random coefficient and fixed effects models yield almost identical conclusions. The unique feature of our longitudinal data, in which personality is measured at two distinct time-periods, allows us to compare the two models in a straightforward way. This feature also enables us to experiment with alternative constructs of personality measures, including using lead, lagged and age-adjusted personality measures.

So what can we learn from these results? On the one hand, our study highlights the usefulness of random coefficient in comparison to fixed effects models when interest lies in understanding the heterogeneity in both intercept and slopes, and the role of time-invariant regressors. While fixed effects estimation can be applied to study the interaction effects between income and personality, as demonstrated in Boyce and Wood (2011), the assumption of independence between the slope and intercept heterogeneity in this context appears to be a very strong one. Our study also provides a context that illustrates the technically complex computation (See Skrondal and Rabe-Hesketh, 2009) and interpretation of the marginal effects obtained from random coefficient models.

On the other hand, the evidence on the large degree of heterogeneity in the marginal utility of income may not only imply that monetary incentives to induce behavioural change may be less effective for the average individual (see e.g., Borghans et al., 2008), but also that human motivations go beyond material success (Fehr and Falk, 2002). Knowing which type of personalities gain from increases in income may serve as a starting point for policymakers to design tax and transfer systems.

Surprisingly few studies have attempted to link well-being with personality (Boyce and Wood, 2011; Headey et al., 2010; Verme, 2009; Phelps, 2001), despite the numerous contributions economists have made to happiness research. Economists traditionally have had little interest in whether personality shapes economic behaviour, but recently more and more research is conducted on understanding the influence of these enduring patterns of thoughts, feelings, and behaviours on traditionally more objective outcomes such as wages and occupational choice. This upcoming literature even goes that far to speculate

on the possible interventions to manipulate economically-relevant personality traits (See Almlund et al., 2011, for an overview).

From a practitioner's perspective, the outcomes of our robustness checks weaken theoretical concerns over using lead measures of personality as explanatory variables (See Cobb-Clark and Schurer, 2011a,b, for a discussion). Such a strategy is employed by Heineck and Anger (e.g. 2010) and Cobb-Clark and Tan (2011) to explain wages and wage gaps, and by Headey et al. (2010) to explain life satisfaction. Short supply of personality measures in longitudinal surveys is one of the challenging realities for practitioners, hence, our results provide some certainty that this modelling approach may not lead to large biases.

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Wooden, M. and N. Watson (2002). The Household, Income and Labour Dynamics in Australia (HILDA) Survey: An introduction. *Australian Social Policy 2001–02*, 79–100.

Table 1: Distribution of subjective well-being scores

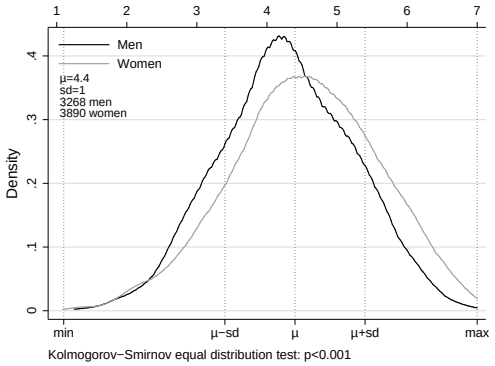
	Men			Women		
Subjective well-being	Obs.	Percent	Cumul	Obs.	Percent	Cumul
0 Totally dissatisfied	19	0.08	0.08	27	0.1	0.1
1	40	0.17	0.25	45	0.16	0.26
2	77	0.33	0.59	103	0.37	0.63
3	182	0.79	1.37	194	0.7	1.33
4	287	1.24	2.61	287	1.04	2.37
5 Neither satisfied/dissatisfied	932	4.03	6.64	1,201	4.33	6.7
6	1,543	6.67	13.31	1,618	5.84	12.53
7	5,268	22.76	36.07	5,611	20.24	32.77
8	8,298	35.85	71.92	9,605	34.64	67.42
9	4,607	19.91	91.83	6,067	21.88	89.3
10 Totally satisfied	1,891	8.17	100	2,967	10.7	100
Total	23,144	100		27,725	100	

HILDA estimation sample 2001-2009.

Table 2: 'Big Five' personality traits and their component items

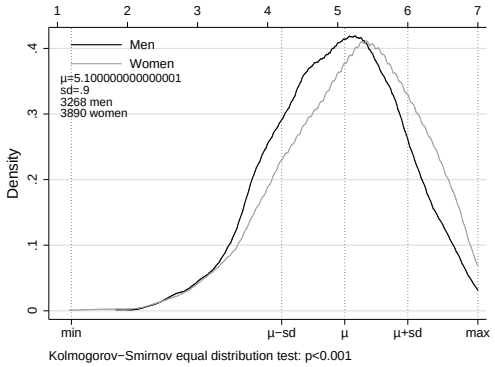
Extroversion	**Emotional stability**	**Conscientiousness**	**Openness**	**Agreeableness**
Talkative	Envious (R)	Orderly	Deep	Sympathetic
Quiet (R)	Moody (R)	Systematic	Philosophical	Kind
Extroversion	Jealous (R)	Inefficient (R)	Creative	Cooperative
Shy (R)	Temperamental (R)	Sloppy (R)	Imaginative	Warm
Bashful (R)	Fretful (R)	Disorganized (R)	Complex	
Lively	Touchy (R)	Efficient	Intellectual	

The above items are taken from the HILDA 36 item questionnaire collected in wave 5 and 9.

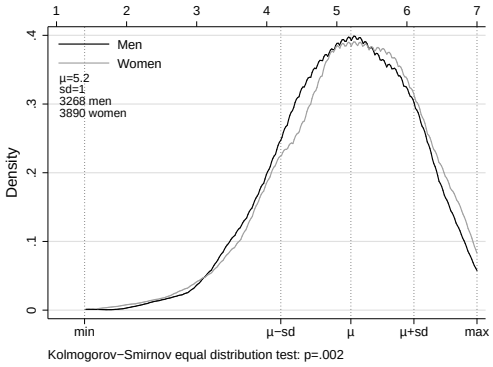


(a) Extraversion

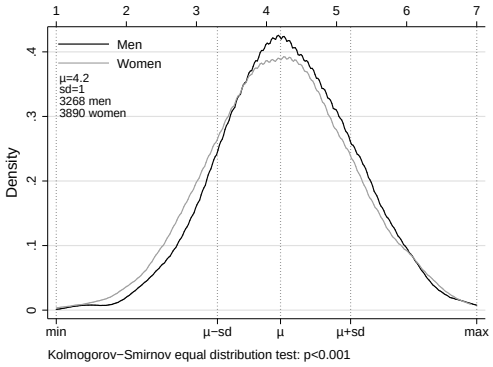
(b) Agreeableness



(c) Conscientiousness

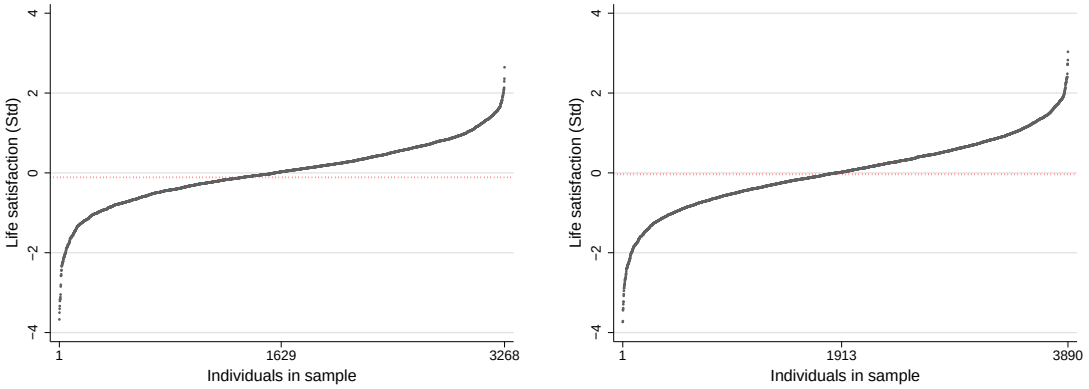


(d) Emotional Stability



(e) Openness to Experience

Figure 1: Distribution of Big Five personality by gender



(a) Men (b) Women

Figure 2: Individual-specific heterogeneity in well-being (fixed effects model)

Table 3: Proportion of total variation in heterogeneity explained by personality

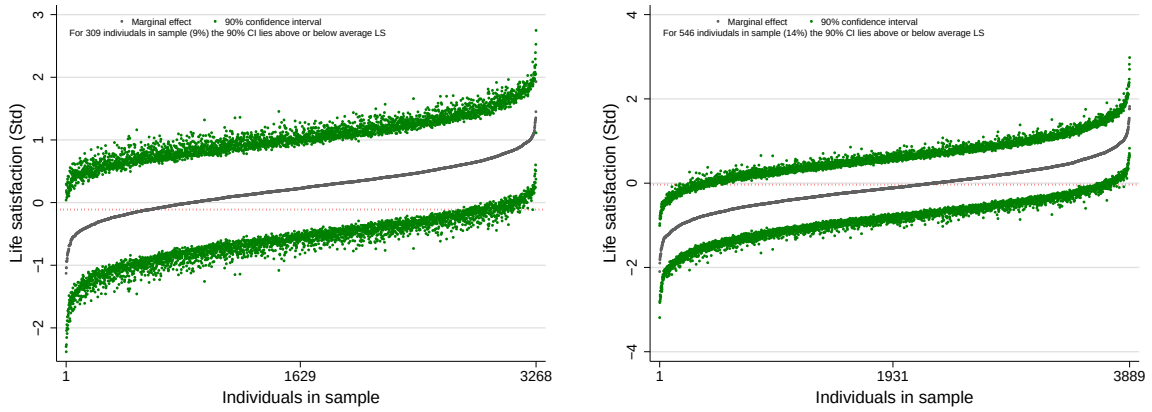
	Adjusted R^2		
	Men	Women	Boyce (2009)[a]
Fixed effects			
Predicted residual	0.12	0.07	0.18
Random effects: intercept heterogeneity			
Random component intercept	0.10	0.10	–
Random coefficient: intercept and slope heterogeneity			
Random component intercept	0.05	0.04	–
Random component income	0.07	0.06	–

The adjusted R^2 figures are taken from regressions of the predicted individual fixed effect or random intercept or slope component on the Big-Five personality indicators. [a] Boyce (2009) estimates the individual heterogeneity in well-being as the residual from a fixed effects estimation using six waves of the German Socio-Economic Panel and explained the heterogeneity with 31 personality variables including Big-Five personality traits, locus of control, autonomy and optimism/pessimism.

Table 4: Marginal effect of personality and income on well-being

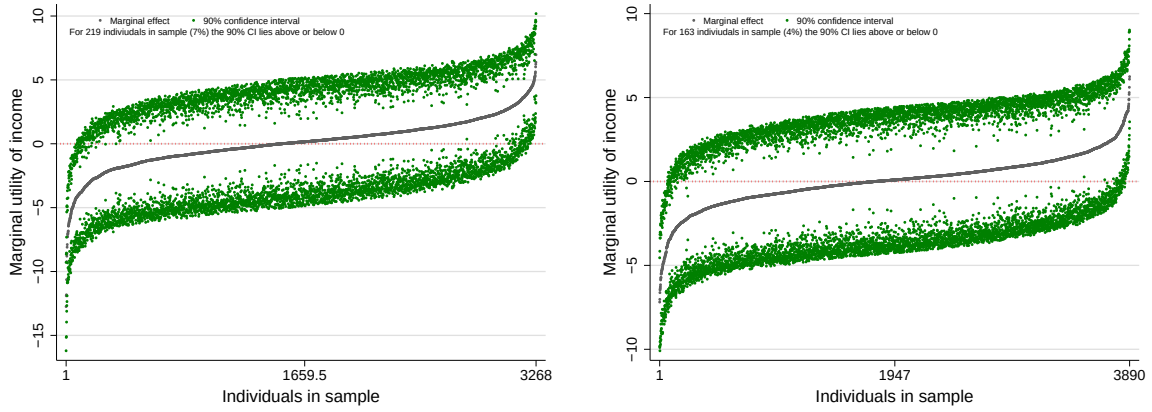
	Men			Women		
	OLS	RC-M	FE	OLS	RC-M	FE
	(1)	(2)	(3)	(4)	(5)	(6)
Marginal effect of personality trait at mean income (unit: 1 standard deviation change)						
Extraversion	0.075*	0.069*		0.043*	0.042*	
	(0.013)	(0.012)		(0.010)	(0.010)	
Agreeableness	0.106*	0.106*		0.113*	0.112*	
	(0.014)	(0.013)		(0.014)	(0.012)	
Conscientiousness	0.046*	0.035*		0.022*	0.018*	
	(0.014)	(0.013)		(0.011)	(0.011)	
Emotional Stability	0.104*	0.093*		0.124*	0.119*	
	(0.014)	(0.013)		(0.013)	(0.012)	
Openness to Experience	-0.057*	-0.061*		-0.025*	-0.026*	
	(0.014)	(0.013)		(0.012)	(0.011)	
Marginal utility of income at mean personality traits (unit: 100 percent change)						
Log income	0.069*	0.051*	0.035*	0.080*	0.030*	0.034*
	(0.020)	(0.016)	(0.014)	(0.016)	(0.014)	(0.013)
Differences in marginal utility of income[a] (between 10th and 90th percentile of personality trait)						
Extraversion	0.026	-0.002	-0.015	-0.008	0.014	0.046
	(0.044)	(0.031)	(0.029)	(0.036)	(0.028)	(0.028)
Agreeableness	0.018	0.019	0.018	-0.015	-0.026	-0.020
	(0.045)	(0.032)	(0.031)	(0.041)	(0.028)	(0.027)
Conscientiousness	0.058	0.001	-0.018	-0.048	-0.047**	-0.043**
	(0.049)	(0.032)	(0.029)	(0.040)	(0.028)	(0.027)
Emotional Stability	0.022	0.031	0.056**	0.065	0.028	-0.002
	(0.048)	(0.033)	(0.030)	(0.043)	(0.029)	(0.030)
Openness to Experience	-0.068	0.002	0.025	-0.053	-0.083*	-0.103*
	(0.045)	(0.031)	(0.028)	(0.038)	(0.028)	(0.028)
Random components						
Income		0.250*			0.219*	
		(0.016)			(0.016)	
Intercept		3.053*			2.638*	
		(0.172)			(0.168)	
Correlation (Income, Intercept)		-0.989*			-0.984*	
		(0.001)			(0.002)	
Person-year observations	23,144	23,144	23,144	27,725	27,725	27,725
Number of individuals	3,268	3,268	3,268	3,890	3,890	3,890

Dependent variable is life satisfaction standardised to mean 0 and standard deviation 1. Standard errors are reported in parentheses (robust in case of OLS regression). a: Differences in marginal utility of income are the difference in marginal utility of income for individuals at lowest decile of respective trait and the marginal utility of income for individuals at highest decile of respective personality trait (setting all remaining personality traits at sample average). A positive (negative) difference implies that the interaction effect between income and respective personality trait is negative (positive). * significant at 5 %, ** significant at 10 %.



(a) Men (b) Women

Figure 3: Individual-specific heterogeneity in well-being (Mundlak-adjusted random coefficient model)



(a) Men (b) Women

Figure 4: Individual-specific heterogeneity in marginal utility of income (Mundlak-adjusted random coefficient model)

Table 5: Robustness Check I: Marginal effect of personality and income on well-being for men and women

	Men			Women		
	RC-M 2001-09[a]	RC-M 2005,09[b]	FE 2005,09	RC-M 2001-09	RC-M 2005,09	FE 2005,09
	(1)	(2)	(3)	(4)	(5)	(6)
DV: Life satisfaction (Mean 0, standard deviation 1)						
Marginal effect of personality trait at mean income (unit: 1 standard deviation change)						
Extraversion	0.069*	0.066*	0.039*	0.042*	0.061*	0.124*
	(0.012)	(0.012)	(0.024)	(0.010)	(0.011)	(0.026)
Agreeableness	0.106*	0.095*	0.040*	0.112*	0.104*	0.073*
	(0.013)	(0.012)	(0.021)	(0.012)	(0.011)	(0.021)
Conscientiousness	0.035*	0.057*	0.076*	0.018**	0.015	-0.024
	(0.013)	(0.012)	(0.023)	(0.011)	(0.011)	(0.024)
Emotional Stability	0.093*	0.105*	0.137*	0.119*	0.127*	0.098*
	(0.013)	(0.012)	(0.021)	(0.012)	(0.012)	(0.022)
Openness to Experience	-0.061*	-0.036*	0.041**	-0.026*	-0.015	-0.008
	(0.013)	(0.013)	(0.025)	(0.011)	(0.012)	(0.026)
Marginal utility of income at mean personality traits (unit: 100 percent change)						
Log income	0.051*	0.086*	0.061**	0.030*	0.015	0.025
	(0.016)	(0.032)	(0.034)	(0.014)	(0.031)	(0.034)
Differences in marginal utility of income[c] (between 10th and 90th percentile of personality trait)						
Extraversion	-0.002	0.006	-0.107**	0.014	0.057	0.067
	(0.031)	(0.047)	(0.061)	(0.028)	(0.046)	(0.068)
Agreeableness	0.019	-0.014	0.002	-0.026	0.000	0.087
	(0.032)	(0.047)	(0.061)	(0.028)	(0.046)	(0.062)
Conscientiousness	0.001	0.034	-0.027	-0.047**	-0.031	-0.037
	(0.032)	(0.048)	(0.059)	(0.028)	(0.045)	(0.062)
Emotional Stability	0.031	0.056	0.116*	0.028	0.084**	0.061
	(0.033)	(0.049)	(0.059)	(0.029)	(0.045)	(0.062)
Openness to Experience	0.002	0.132*	0.234*	-0.083*	-0.051	-0.157*
	(0.031)	(0.049)	(0.060)	(0.028)	(0.046)	(0.065)
Person-year observations	23,144	5,498	5,498	27,725	6,574	6,574
Number of individuals	3,268	3,043	3,043	3,890	3,630	3,630

Dependent variable is life satisfaction standardised to mean 0 and standard deviation 1. Standard errors are reported in parentheses (robust in case of OLS regression). a: 2001-2009 refers to using all nine waves and a time-invariant personality measure that is averaged over 2005 and 2009. b: 2005,09 refers to using wave 5 and 9 only and allowing personality to change over the two time periods. c: Differences in marginal utility of income are the difference in marginal utility of income for individuals at lowest decile of respective trait and the marginal utility of income for individuals at highest decile of respective personality trait (setting all remaining personality traits at sample average). A positive (negative) difference implies that the interaction effect between income and respective personality trait is negative (positive). * significant at 5 %, ** significant at 10 %.

Table 6: Robustness II: Alternative constructs of personality measures for men

	Personality variable constructed based on:							
	Original Avg 2005 & 2009	(1) 2005	(2) 2009	(3) 2005 age-adj.	(4) 2009 age-adj.	(5) 2005	(6) 2005 age-adj.	(7) 2009
	Sample for analysis from year onwards:							
	2001	2001	2001	2001	2001	2006	2006	2006
DV: Life satisfaction (Mean 0, standard deviation 1)								
Effect of personality trait evaluated at mean income								
Extraversion	0.069*	0.059*	0.069*	0.057*	0.065*	0.063*	0.061*	0.071*
	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)	(0.013)	(0.012)	(0.012)
Agreeableness	0.106*	0.090*	0.094*	0.090*	0.093*	0.090*	0.089*	0.102*
	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Conscientiousness	0.035*	0.034*	0.027*	0.033*	0.025*	0.028*	0.028*	0.034*
	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Emotional Stability	0.093*	0.080*	0.081*	0.076*	0.078*	0.076*	0.071*	0.095*
	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Openness to Experience	-0.061*	-0.055*	-0.051*	-0.053*	-0.048*	-0.056*	-0.054*	-0.0464*
	(0.013)	(0.012)	(0.013)	(0.012)	(0.012)	(0.014)	(0.013)	(0.014)
Marginal utility of income at mean personality traits								
Log income	0.051*	0.052*	0.049*	0.053*	0.050*	0.064*	0.063*	0.063*
	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.025)	(0.024)	(0.025)
Differences in marginal utility of income[a] (between 10th and 90th percentile of personality trait)								
Extraversion	-0.002	-0.025	0.015	-0.018	0.020	-0.003	0.006	0.021
	(0.031)	(0.031)	(0.032)	(0.031)	(0.031)	(0.045)	(0.045)	(0.044)
Agreeableness	0.019	0.010	0.019	0.006	0.012	0.004	0.000	0.002
	(0.032)	(0.032)	(0.032)	(0.032)	(0.030)	(0.046)	(0.046)	(0.046)
Conscientiousness	0.001	-0.009	0.011	-0.015	0.007	0.023	0.011	0.029
	(0.032)	(0.032)	(0.029)	(0.031)	(0.031)	(0.044)	(0.045)	(0.043)
Emotional Stability	0.031	0.059**	0.002	0.050	-0.001	0.001	-0.010	0.045
	(0.033)	(0.034)	(0.033)	(0.032)	(0.032)	(0.046)	(0.047)	(0.048)
Openness to Experience	0.002	0.023	-0.018	0.021	-0.012	-0.020	-0.016	-0.017
	(0.031)	(0.032)	(0.032)	(0.031)	(0.032)	(0.047)	(0.046)	(0.047)
N	23,144	23,144	23,144	23,144	23,144	10,402	10,402	10,402

Dependent variable is life satisfaction standardised to mean 0 and standard deviation 1. All models are estimated with a Mundlak-adjusted random coefficient specification; standard errors in parentheses. a: Differences in marginal utility of income are the difference in marginal utility of income for individuals at lowest decile of respective trait and the marginal utility of income for individuals at highest decile of respective personality trait (setting all remaining personality traits at sample average). A positive (negative) difference implies that the interaction effect between income and respective personality trait is negative (positive). * significant at 5 %, ** significant at 10 %.

Table 7: Robustness II: Alternative constructs of personality measures for women

	Personality variable constructed based on:							
	Original Avg 2005 & 2009	(1) 2005	(2) 2009	(3) 2005 age-adj.	(4) 2009 age-adj.	(5) 2005	(6) 2005 age-adj.	(7) 2009
	Sample for analysis from year onwards:							
	2001	2001	2001	2001	2001	2006	2006	2006
DV: Life satisfaction (Mean 0, standard deviation 1)								
Effect of personality trait evaluated at mean income								
Extraversion	0.042*	0.036*	0.047*	0.038*	0.048*	0.042*	0.044*	0.063
	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.011)	(0.011)	(0.010)
Agreeableness	0.112*	0.098*	0.098*	0.092*	0.092*	0.111*	0.104*	0.114
	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)	(0.013)	(0.012)	(0.013)
Conscientiousness	0.018	0.023*	0.012	0.023*	0.012	0.016	0.016	0.001
	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
Emotional Stability	0.119*	0.107*	0.100*	0.102*	0.096*	0.081*	0.077*	0.085
	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
Openness to Experience	-0.026*	-0.027*	-0.019**	-0.027*	-0.019	-0.027*	-0.027*	-0.026*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
Marginal utility of income at mean personality traits								
Log income	0.030*	0.030*	0.031*	0.029*	0.030*	0.034+	0.034+	0.034+
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.021)	(0.021)	(0.022)
Differences in marginal utility of income[a] (between 10th and 90th percentile of personality trait)								
Extraversion	0.014	0.004	0.019	0.009	0.024	-0.027	-0.025	0.011
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.037)	(0.039)	(0.039)
Agreeableness	-0.026	-0.013	-0.039	-0.015	-0.042	0.050	0.050	-0.016
	(0.028)	(0.029)	(0.029)	(0.029)	(0.029)	(0.038)	(0.039)	(0.040)
Conscientiousness	-0.047**	-0.052*	-0.028	-0.055*	-0.030	-0.074*	-0.076*	-0.053
	(0.028)	(0.027)	(0.028)	(0.027)	(0.028)	(0.037)	(0.037)	0.038
Emotional Stability	0.028	0.052	-0.014	0.042	-0.024	-0.001	-0.003	-0.022
	(0.029)	(0.029)	(0.030)	(0.029)	(0.029)	(0.040)	(0.040)	(0.039)
Openness to Experience	-0.083*	-0.093*	-0.064*	-0.090*	-0.066*	-0.062+	-0.060+	-0.069**
	(0.028)	(0.028)	(0.027)	(0.028)	(0.028)	(0.039)	(0.038)	(0.039)
N	27,725	27,725	27,725	27,725	27,725	12,487	12,487	12,487

Dependent variable is life satisfaction standardised to mean 0 and standard deviation 1. All models are estimated with a Mundlak-adjusted random coefficient specification; standard errors in parentheses. a: Differences in marginal utility of income are the difference in marginal utility of income for individuals at lowest decile of respective trait and the marginal utility of income for individuals at highest decile of respective personality trait (setting all remaining personality traits at sample average). A positive (negative) difference implies that the interaction effect between income and respective personality trait is negative (positive). * significant at 5 %, ** significant at 10 %, + almost at 10 percent significance level.

APPENDIX

Table A.1: Marginal effect formulas

(1) Marginal effect of personality trait Z_{ji}
$\frac{\partial U_{it}}{\partial Z_{ji}} = \hat{\gamma}_{j1} + \hat{\gamma}_2 \times \bar{y}_i$
(2) Marginal utility of income
$\frac{\partial U_{it}}{\partial y_{it}} = \hat{\alpha}_2 + Z_i'\hat{\gamma}_2 + \bar{v}_{2i} = \hat{\alpha}_2 + Z_i'\hat{\gamma}_2$
(3) Difference in marginal utility of income by personality
$\frac{\partial U_{it}}{\partial y_{it}}|_{Z_{ji}=low} - \frac{\partial U_{it}}{\partial y_{it}}|_{Z_{ji}=high} = \hat{\alpha}_2 + \hat{\gamma}_{j2}\bar{Z}_{ji}^{low} + \bar{Z}_{ki}'\hat{\gamma}_{k2} + \bar{v}_{2i} - (\hat{\alpha}_2 + \hat{\gamma}_{j2}\bar{Z}_{ji}^{high} + \bar{Z}_{ki}'\hat{\gamma}_{k2} + \bar{v}_{2i})$

Marginal effects refer to first derivatives of estimation equation (6) in Section 2. Per definition, $\bar{v}_{2i} = 0$ in the random coefficient model.

Table A.2: Summary statistics of estimation sample

Variable	Men				Women			
	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
General life satisfaction	7.75	1.4	0	10	7.87	1.44	0	10
Age before 30 June	41.36	10.97	20	60	40.92	11	20	60
Net disposable household income	72298	45222	25	572997	69026	46441	25	572997
Married or de facto relationship	0.73	0.44	0	1	0.71	0.45	0	1
Divorced, separated, widowed	0.08	0.27	0	1	0.13	0.34	0	1
Single	0.19	0.39	0	1	0.16	0.36	0	1
Number of children in household	0.75	1.07	0	9	0.81	1.10	0	9
Number of household members	3	1.44	1	14	3.03	1.40	1	14
Non Australian origin	0.2	0.4	0	1	0.20	0.40	0	1
Excellent health	0.12	0.33	0	1	0.13	0.33	0	1
Very good health	0.38	0.49	0	1	0.40	0.49	0	1
Good health	0.36	0.48	0	1	0.34	0.47	0	1
Fair health	0.11	0.31	0	1	0.11	0.31	0	1
Poor health	0.02	0.16	0	1	0.03	0.16	0	1
Postgrad - masters or doctorate	0.05	0.22	0	1	0.04	0.19	0	1
Grad diploma, grad certificate	0.06	0.23	0	1	0.08	0.27	0	1
Bachelor or honours	0.15	0.36	0	1	0.17	0.38	0	1
Adv diploma, diploma	0.1	0.3	0	1	0.10	0.30	0	1
Any certificate	0.29	0.46	0	1	0.16	0.37	0	1
Year 12	0.14	0.35	0	1	0.16	0.37	0	1
Year 11 and below	0.21	0.4	0	1	0.29	0.45	0	1
Unemployed, but seeking work	0.03	0.16	0	1	0.02	0.15	0	1
Not in the labour force	0.09	0.28	0	1	0.24	0.43	0	1
Full-time study	0.03	0.17	0	1	0.04	0.19	0	1
Total work hours	38.03	19.27	0	130	22.75	19.00	0	119
VIC	0.25	0.43	0	1	0.24	0.42	0	1
QLD	0.21	0.41	0	1	0.22	0.41	0	1
SA	0.1	0.29	0	1	0.09	0.29	0	1
WA	0.1	0.3	0	1	0.10	0.29	0	1
TAS	0.03	0.18	0	1	0.04	0.19	0	1
NT	0.01	0.09	0	1	0.01	0.09	0	1
ACT	0.02	0.15	0	1	0.02	0.15	0	1
N	23,144				27,725			

Sample average are taken from HILDA 2001-2009. Year dummy variables are omitted.

Table A.3: Model selection test statistics

	Men		Women	
	χ^2	(p-value)	χ^2	(p-value)
Significance of personality:				
RC-M	364	(0.000)	416	(0.000)
Interaction of personality with income:				
RC-M	1.94	(0.858)	17.86	(0.003)
Significance of random components:				
RC-M	7,336	(0.000)	7,135	(0.000)
Added-variable test:				
RC-M vs RC	155	(0.000)	224	(0.000)
Hausman test				
RC-M vs FE	40	(0.180)	-24	(-)
RC vs FE	111	(0.000)	96	(0.000)

RC-M refers to the Mundlak-adjusted random coefficient model which includes the mean values of all time-varying variables as additional regressors. RC refers to random coefficient model. FE refers to fixed effects model.

Table A.4: Full estimation results

	Men			Women		
	OLS (1)	RC-M (2)	FE (3)	OLS (4)	RC-M (5)	FE (6)
Age	-0.0555***	-0.0450**	-0.0417	-0.0349***	-0.0377**	-0.0166
	(0.00833)	(0.0198)	(0.0261)	(0.00718)	(0.0189)	(0.0260)
Age squared	0.0007***	0.0005***	0.0005***	0.0005***	0.0004***	0.0004***
	(0.0001)	(0.00009)	(0.00010)	(0.00009)	(0.00009)	(0.00009)
Extraversion (Std)	0.191	0.0614	.	0.00921	0.0970	.
	(0.201)	(0.142)	.	(0.150)	(0.114)	.
Agreeableness (Std)	0.193	0.199	.	0.0377	-0.0224	.
	(0.221)	(0.157)	.	(0.215)	(0.142)	.
Conscientiousness (Std)	0.309	0.0405	.	-0.184	-0.181	.
	(0.229)	(0.148)	.	(0.174)	(0.120)	.
Emotional stability (Std)	0.207	0.237	.	0.409**	0.245*	.
	(0.223)	(0.153)	.	(0.195)	(0.130)	.
Openness to experience (Std)	-0.371*	-0.0523	.	-0.251	-0.383***	.
	(0.211)	(0.148)	.	(0.166)	(0.120)	.
Disposable household income (log)	0.0591***	0.0472***	0.0337**	0.0744***	0.0241*	0.0310**
	(0.0200)	(0.0158)	(0.0136)	(0.0163)	(0.0143)	(0.0129)
Income × Extraversion	-0.0106	0.000732	0.00622	0.00313	-0.00504	-0.0171*
	(0.0179)	(0.0126)	(0.0118)	(0.0135)	(0.0102)	(0.0102)
Income × Agreeableness	-0.00794	-0.00841	-0.00769	0.00684	0.0122	0.00943
	(0.0197)	(0.0140)	(0.0134)	(0.0193)	(0.0128)	(0.0126)
Income × Conscientiousness	-0.0239	-0.000523	0.00732	0.0188	0.0182*	0.0167
	(0.0203)	(0.0132)	(0.0119)	(0.0156)	(0.0108)	(0.0106)
Income × Emotional Stability	-0.00937	-0.0131	-0.0234*	-0.0261	-0.0115	0.000959
	(0.0199)	(0.0136)	(0.0126)	(0.0175)	(0.0118)	(0.0120)
Income × Openness to Experience	0.0285	-0.000820	-0.0106	0.0206	0.0326***	0.0403***
	(0.0188)	(0.0131)	(0.0119)	(0.0150)	(0.0108)	(0.0108)
Divorced, separated, widowed	-0.446***	-0.388***	-0.390***	-0.438***	-0.351***	-0.371***
	(0.0521)	(0.0332)	(0.0330)	(0.0347)	(0.0292)	(0.0289)
Single	-0.228***	-0.180***	-0.185***	-0.195***	-0.244***	-0.251***
	(0.0333)	(0.0279)	(0.0277)	(0.0307)	(0.0289)	(0.0288)
Number of children in household	0.0228	0.0277**	0.0238**	-0.0207	-0.000184	-0.000422
	(0.0151)	(0.0110)	(0.0110)	(0.0139)	(0.0106)	(0.0106)
Number of household members	-0.0143	-0.0270***	-0.0219**	-0.0212**	-0.0408***	-0.0421***
	(0.0112)	(0.00915)	(0.00904)	(0.0107)	(0.00913)	(0.00908)
Very good health (base: Excellent)	-0.249***	-0.113***	-0.111***	-0.232***	-0.129***	-0.131***
	(0.0248)	(0.0186)	(0.0187)	(0.0188)	(0.0173)	(0.0174)
Good health	-0.493***	-0.266***	-0.263***	-0.504***	-0.296***	-0.299***
	(0.0294)	(0.0215)	(0.0217)	(0.0234)	(0.0200)	(0.0202)
Fair health	-0.833***	-0.517***	-0.516***	-0.904***	-0.574***	-0.578***
	(0.0415)	(0.0273)	(0.0275)	(0.0363)	(0.0258)	(0.0260)
Poor health	-1.501***	-0.978***	-1.006***	-1.516***	-1.012***	-1.017***
	(0.0989)	(0.0466)	(0.0469)	(0.0789)	(0.0412)	(0.0414)
Postgrad - masters or doctorate (Base: Year 11)	-0.155***	-0.0985	-0.0674	-0.176***	0.0102	-0.0182
	(0.0551)	(0.106)	(0.107)	(0.0554)	(0.0996)	(0.0999)
Grad diploma, grad certificate	-0.158***	-0.101	-0.0645	-0.171***	0.126	0.0988
	(0.0485)	(0.0961)	(0.0977)	(0.0395)	(0.0827)	(0.0836)
Bachelor or honours	-0.158***	-0.0818	-0.0414	-0.163***	-0.0605	-0.0920
	(0.0410)	(0.0830)	(0.0853)	(0.0311)	(0.0685)	(0.0698)
Adv diploma, diploma	-0.0759*	-0.109	-0.0762	-0.0967***	-0.0596	-0.0717
	(0.0446)	(0.0820)	(0.0842)	(0.0344)	(0.0761)	(0.0776)
Any certificate	-0.0243	-0.0181	0.00851	-0.0761**	-0.0542	-0.0785*
	(0.0356)	(0.0570)	(0.0592)	(0.0318)	(0.0418)	(0.0426)
Year 12	-0.0846**	-0.00633	0.0396	-0.106***	-0.0667	-0.102
	(0.0420)	(0.0716)	(0.0773)	(0.0323)	(0.0605)	(0.0636)
Unemployed, but seeking work (Base: Employed)	-0.370***	-0.290***	-0.278***	-0.315***	-0.202***	-0.210***
	(0.0688)	(0.0395)	(0.0399)	(0.0669)	(0.0348)	(0.0351)
Not in the labour force	-0.141**	-0.258***	-0.252***	0.00559	-0.0488**	-0.0489**
	(0.0550)	(0.0337)	(0.0341)	(0.0285)	(0.0210)	(0.0211)
Full-time study	-0.108**	-0.139***	-0.152***	-0.126***	-0.0507	-0.0354
	(0.0503)	(0.0424)	(0.0434)	(0.0412)	(0.0359)	(0.0367)
Total work hours	-0.004***	-0.003***	-0.003***	-0.005***	-0.002***	-0.002***
	(0.0008)	(0.0006)	(0.0006)	(0.0007)	(0.0006)	(0.0006)
Non Australian origin	-0.0503*	-0.0475*		-0.0357	-0.0393*	
	(0.0284)	(0.0263)		(0.0257)	(0.0238)	
Individual mean of time-varying variables	No	Yes	No	No	Yes	No
Year indicators	Yes	Yes	Yes	Yes	Yes	Yes
Regional indicators	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.081***	0.326	0.831	0.520**	-0.0792	0.178
	(0.253)	(0.360)	(0.945)	(0.214)	(0.320)	(0.934)
Observations	23,144	23,144	23,144	27,725	27,725	27,725
Adjusted R^2	0.201			0.210		

Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Coefficients on mean values of all time-variant variables, year and region dummy variables are omitted..