The Returns to Cognitive Abilities and Personality in Germany

Guido Heineck[a] Silke Anger[b]

[a] *University of Erlangen-Nuremberg, Germany*

[b] *German Institute for Economic Research, Berlin, Germany*

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Abstract

We provide the first joint evidence on the relationship between individuals' cognitive abilities, their personality and earnings for Germany. Using data from the German Socio-Economic Panel Study, we employ scores from an ultra-short IQ-test and a set of measures of personality traits, namely locus of control, reciprocity and all basic items from the Five Factor Personality Inventory. Our estimates suggest a positive effect of so-called fluid intelligence or speed of cognition on males' wages only. Findings for personality traits are more heterogeneous. There however is a robust wage penalty for an external locus of control for both men and women.

Keywords: Cognitive abilities, personality traits, Five Factor Model, Locus of control, reciprocity, wages

JEL classification: J24, J31, I21

Corresponding author:

Guido Heineck, University of Erlangen-Nuremberg, Department of Economics, Lange Gasse 20, 90403 Nuremberg, Germany, guido.heineck@wiso.uni-erlangen.de

1. Introduction

It is common knowledge that cognition and personality are related to individuals' behavior and socio-economic outcomes such as educational attainment or labor market participation. The main part of the existing literature on the determination of wages and other labor market outcomes however concentrated for long mainly on traditional human capital variables such as education, experience or job-specific training. Yet, a growing literature additionally incorporates cognitive abilities arguing that ability differentials may result in job performance or productivity differences which then may lead to better promotion prospects or higher earnings potential. While this strand of literature is restricted by data availability there is a range of mostly UK or US surveys providing indicators that are based on standardized general aptitudes tests. The National Longitudinal Survey of Youth (NLSY) for instance includes the Armed Forces Qualification Test (AFQT) which is derived from the Armed Services Vocational Aptitude Battery (ASVAB) test in the US. The General Ability Test (GAT) which exists in the UK and in other Commonwealth nations is included in the National Child Development Study (NCDS). Scores from these achievement tests and sometimes school grades are typically used to approximate individuals' cognitive abilities (for a summary of evidence see Cawley et al., 2001).

On top of that, there is an even smaller literature on the link between individuals' personality and labor market outcomes. While this type of research is well-established in industrial and organizational psychology,[1] economists have examined the importance of personality for labor market success much less than the impact of cognitive abilities. Personality traits were for a long time not considered particularly relevant for labor market success compared to the intelligence of a person, which was supposed to be directly related to individual productivity. It moreover was difficult to analyze the issue of personality due to the lack of appropriate data. In contrast to cognitive skills, of which measures were included

in some datasets as outlined above, labor economists had barely any information on individuals' personality traits. The great variety of psychometric measures on personality furthermore needs some familiarity with the relevant psychological literature which usually is not the case for the mainstream trained economist.

Yet, similar to cognitive skills, individuals' personality may likewise result in job performance differentials. Behavioral characteristics such as perseverance or trustworthiness are traits that may be helpful in both employer-employee and customer relationships while other traits such as aggression or passivity might be undesirable and hence not be rewarded or even be punished. Bowles et al. (2001) argue in what they call an incentive-enhancing framework that employers may reward employee characteristics that enable them to elicit effort at low costs. Mueller und Plug (2006) as well as Heckman et al. (2006) and Borghans et al. (2008) argue that differences in skills and differences in preferences may exert direct and indirect effects on productivity: Directly, personality – and thereby implicitly assuming its effects on behavior – might be thought of as part of an individual's set of productive traits just as general or specific education or job-related training. Individuals' personality may furthermore affect labor market success indirectly through the type of schooling and occupation chosen. It consequently is unsurprising that the existing evidence suggests a non-trivial relationship between individuals' personality traits and labor market success as measured by earnings. Depending on the particular personality trait measure, the magnitude of this association is comparable to or even greater than the effects of cognitive abilities (Bowles et al., 2001; Heckman et al., 2006; Mueller and Plug, 2006).

While the effect of either intelligence or personality on earnings have so far mainly been examined for the US and the UK our study adds to the literature providing evidence for Germany. There are to the best of our knowledge only three prior studies that similarly address the impact of either cognitive skills (Anger and Heineck, 2008) or personality

(Isengard, 2006, Flossmann, et al., 2007) using German data. In addition to these studies, our paper provides the first joint evidence on the relationship between cognitive abilities, personality and earnings in Germany. Until now, the impact of both cognitive and non-cognitive skills on labor market outcomes has been addressed only by a few studies on the UK and mainly the US (Osborne Groves, 2005; Heckman, et al., 2006; Mueller and Plug, 2006, Cebi 2007). Our study examines whether the link between cognition, personality and labor market success can be found also in Germany, which has more regulations in the labor market and a less meritocratic society. It might moreover be the case that the mainly free access to schooling (at no or very low cost) in Germany has other implications for the returns to cognitive and non-cognitive skills relative to the returns to education than in anglo-saxon countries.

2. Background, previous findings and expectations

Conceptual considerations

A gradient between individuals' cognitive abilities and their behavior for example on the job may be expected since it is plausible to assume that individuals with higher cognitive abilities are abler to process new information more quickly. They may likewise be expected to perform better if challenged with more complex tasks than individuals with fewer cognitive skills. The existing evidence on the impact of cognitive skills on labor market success however is far from unanimous (see below) and partially depends on the particular measure of intelligence or cognitive abilities.

Even more complex is the impact of personality on labor market success. In contrast to cognitive abilities for which there is the uni-dimensional concept of "g" (Jensen, 1998) individuals' personality is a multi-faceted construct for which there is a large and somewhat heterogeneous battery of psychometric measures which are to capture different aspects.

What is included in empirical analyses therefore is to some extent data-driven. There is research that employs personality dimensions such as achievement-related traits (O'Connell and Sheikh, 2007), self-esteem (Goldsmith et al., 1997), aggression-withdrawal (Osborne, 2005), or challenge-affiliation (Semykina and Linz, 2007). Other studies and the analysis below employ indicators related to the so-called Five Factor Model (FFM) (McCrae and Costa, 1996, 1999) which aims to be a unifying framework to describe an individual's personality. According to the FFM, personality traits can be linked to one of the following five basic characteristics: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (emotional instability). While there is a large number of theoretical conjectures regarding the relationship between each personality trait and labor market success, Judge et al. (1999) point to a consensus in the organizational psychology literature that out of these five traits conscientiousness, extraversion, and neuroticism are most relevant to career success.

To start with, neuroticism describes the attribute of for example being tense, anxious, or moody, and is related to activation theory (Gardner and Cummings, 1988) which suggests that neurotic individuals may experience either too much or too little external stimulation which may then lead to poor task performance. As a consequence, neurotic individuals may be less suited to higher level jobs that are more complex and supply more stress (Spector et al., 1995).

Extraversion is a broad construct that includes a range of factors but is typically thought to consist of sociability. As Judge et al. (1999, p. 624) point out, "extraverts tend to be socially oriented (outgoing and gregarious), but also are urging (dominant and ambitious) and active (adventuresome and assertive)". Furthermore, extraverts are more likely to take on leadership roles and to have a greater number of close friends which are qualities that are of advantage in business environments.

Conscientiousness is related to an individual's degree of self-control, the need for achievement, order, and persistence. Put differently, conscientiousness refers to one's willingness to work hard, to be responsible and careful, and planful and organized (Costa et al., 1991). It is thus unsurprising that conscientiousness has previously been shown to be a valid predictor of job performance.[2]

While the above mentioned personality traits more or less allow distinct hypotheses regarding labor market success, the remaining facets, openness to experience and agreeableness, may be related either way to job performance and other labor market outcomes. For example, individuals who are open to new experiences typically are flexible, creative, and intellectually orientated. This may on the one hand be advantageous to career success. On the other hand, openness is also related to autonomy and non-conformity which may be a hindrance to labor market success. Similarly, agreeable individuals who are more likely cooperative and likeable may benefit from these characteristics in teamwork settings or in occupations with a higher frequency of customer contacts. There however is also a flip side of agreeableness since, as Judge et al. (1999, p. 625) put it, "extremely agreeable individuals may sacrifice their success in pleasing others".

Another indicator of individuals' personality is based on the concept of locus of control (LOC) which goes back to the work of Rotter (1966). It refers to the individual's perception of the relation between her own behavior and its consequences. Conceptually, an internal LOC relates to individuals who believe that the outcomes they experience are determined by their own skills and behavior. In contrast, individuals with an external LOC are prone to believing that chance or other factors beyond their control is the main determinant of the outcome they experience. Since an internal LOC is related to personal initiative which then may result in a higher willingness to work hard it is unsurprising that

this personality dimension has been found to be positively related to labor market success compared to the outcomes of individuals with an external LOC.

A further measure on individual's personality is reciprocity which means that "… in response to friendly actions, people are frequently much nicer and much more cooperative than predicted by the self-interest model. Conversely, in response to hostile actions they are frequently much more nasty and even brutal" (Fehr and Gächter, 2000, p. 159). Fehr and Gächter (2000) provide mainly experimentally based evidence on the importance of reciprocity in individuals' economic behavior. Clear-cut hypotheses with regard to individuals' labor market success are however difficult to establish since similar to openness and agreeableness, reciprocal behavior may work in either direction. Furthermore, there is evidence that reciprocity and the FFM traits – in particular agreeableness and neuroticism – are associated with each other (Ashton et al., 1998).

Previous findings

As for the existing evidence on the relation between cognitive and non-cognitive abilities we restrict ourselves to a short and selective review of more recent research. First, findings for the relation between cognitive skills and labor market outcomes are - as mentioned above - somewhat ambiguous:

There on the one hand is a large number of studies that reveal substantial returns to cognitive abilities in the US and Great Britain. For example, Cameron and Heckman (1993), Blackburn and Neumark (1993), and more recently, Green and Riddell (2003) as well as Bronars and Oettinger (2006) provide evidence for a positive relationship between cognitive skills and earnings. There on the other hand are as many studies suggesting that cognitive ability has barely any effect on earnings (Bound et al., 1986, or Murnane et al., 1995). Cawley et al. (2001), and Zax and Rees (2002) conclude that cognitive ability is a poor

predictor of earnings compared to a direct measure of education, family background, and environment.

Using scores from two ultra-short tests of cognitive ability that are included in the German Socio-Economic Panel Study (SOEP), the results of Anger and Heineck (2008) suggest that speed of cognition is positively related to wages of West German workers even when educational attainment is controlled for. Verbal fluency on the other hand is not related to earnings. They furthermore find that ability and education are inseparable determinants of earnings which is in line with previous studies for other countries (e.g. Cawley, Heckman, and Vytlacil 2001).

As for individuals' personality, there is evidence that some personality traits are rewarded on the labor market while others are punished. Based on Russian data, Semykina and Linz (2007) find a positive association between an internal LOC and females' earnings.

Heineck (2007) examines data from the BHPS for the UK and finds a negative relation between wages and agreeableness whereas openness to experience is rewarded. There further is a nonlinear gradient for wages and individuals' conscientiousness. Other studies that also employ the FFM taxonomy of personality are by Nyhus and Pons (2005) and by Mueller and Plug (2006), the latter being of further relevance since it is one of the few analyses that examine both cognitive and non-cognitive abilities. First, Nyhus and Pons use data from the Dutch DNB Household Survey (DHS). Their findings suggest that emotional stability, i.e. inverse neuroticism, is positively associated with wages of both males and females but that agreeableness is negatively related to females' wages. Furthermore, men benefit from conscientiousness at the beginning of an employment relationship but from autonomy as tenure increases.

As for Germany, there is only one prior unpublished study[3] that addresses the relationship between individuals' personality and earnings. Using the SOEP, Flossmann et

al. (2007) examine the role of personality traits for labor market success by focusing on the LOC measures. They find that personality matters even when controlling for different aspects such as education and professional experience and they conclude that labor market success is influenced by early childhood since the formation of personality occurs during the first years of life under the influence of the parents and the educational system.

Evidence on the joint relationship between cognitive abilities, personality and labor market outcomes at the same time is only provided by a few studies on the US and the UK. Using the LOC scale, Osborne Groves (2005) show that the earnings of US females is negatively related to externality and that aggression and withdrawal negatively affects the wages of British women while cognitive abilities are positively associated to the earnings of women in the US but not for women in the UK once the personality traits are included in the model.

The results of Mueller and Plug (2006) who use data from the Wisconsin Longitudinal Study (WLS) indicate that non-agreeableness, openness, and to a somewhat lesser extent emotional stability are positively related to men's earnings. Furthermore, women receive a wage premium for being more conscientious and open. Their findings also suggest that returns to non-agreeableness or as they put it antagonism are quite different for males and females. They further account for cognitive skills including test scores from the Henmon-Nelson Test of Mental Ability which is a measure of general intelligence. Across all specifications they employ, their estimates indicate a positive linear relationship between intelligence and earnings.

Cebi (2007) uses the Rotter-scale and achievement test scores from the AFQT provided by the NLSY to analyze the determinants of education as well as of labor market outcomes for men and women in the US. While she finds that educational outcomes are not significantly determined by LOC once cognitive ability scores are included, her results show

that internal LOC is rewarded in the labor market. She concludes that "… locus of control is in fact capturing a distinct aspect of ability not related to cognitive ability as measured by the AFQT." (Cebi, 2007, p. 930).

The NLSY is also used by Heckman et al. (2006) whose study relies on measures of LOC and self-esteem for individuals' personality traits, and on achievement test scores from the AFQT in order to analyze the determinants of educational and labor market outcomes, and to explain risky behavior of young adults. They find evidence that both cognitive and non-cognitive skills are important for social and economic success. In their analysis, achievement test scores explain much more of the earnings variance but have similar effects as the measures of personality traits. They point out that "a change in noncognitive skills from the lowest to the highest level has an effect on behavior comparable to or greater than a corresponding change in cognitive skills." (Heckman et al., 2006, p. 412).

Expectations

The outline of the above noted conceptual considerations and findings from previous empirical research on cognitive abilities and personality traits as determinants of labor market outcomes enable us to set up expectations for the analyses of the present study.

In line with prior research we expect that cognitive abilities either do not matter or are positively associated to earnings. External LOC is expected to be negatively associated with earnings, and regarding the FFM traits we expect that

- openness and conscientiousness are rewarded, though there might be differences by gender,
- extraversion is not related to earnings, and
- agreeableness and neuroticism are negatively associated with earnings, again with possible gender differences.

As mentioned above, there is no clear expectation with respect to (positive or negative) reciprocity so that is open to the empirical analysis.

3. Data and methods

The data used in this study are drawn from the German Socio-Economic Panel Study (SOEP). The SOEP is a representative longitudinal micro-database that provides a wide range of socio-economic information on private households and their individuals in Germany. The yearly data were first collected from about 12,200 randomly selected adult respondents in West Germany in 1984. After German reunification in 1990, the SOEP was extended by about 4,500 persons from East Germany, and supplemented by expansion samples later on. We use two recent waves that provide information on either personality traits (2005)[4] or cognitive abilities (2006). Using appropriate panel estimators, see below, we are nevertheless able to explore the longitudinal structure of the data in order to account for individual heterogeneity.

In order to include both East and West German individuals, we restrict our sample to the years 1991 to 2006. The final longitudinal sample comprises 13,048 person-year observations from 1,580 employed individuals in working age (20-60 years) for which there is information on both personality traits and cognitive abilities.[5]

Measures of cognitive ability

Since fully-fletched IQ tests could not be implemented in the SOEP, two ultra-short tests of cognitive ability were developed (Lang, 2005, Lang et al., 2007): a *symbol correspondence test* and a *word fluency test*. Both tests correspond to different modules of the Wechsler Adult Intelligence Scale (WAIS) which altogether comprises 14 modules, seven on verbal IQ and seven on performance IQ (Groth-Marnat, 1997, Kline, 1999).

The *word fluency test* as implemented in the SOEP is similar to a sub-module in the verbal section of the WAIS and has been developed after the animal-naming-task (Lindenberger and Baltes, 1995): Respondents name as many different animals as possible within 90 seconds. The *symbol correspondence test* (SCT) was developed after the symbol-digit-modalities-test (Smith, 1995) and corresponds to a sub-module in the non-verbal section of the WAIS. Using the distinction of fluid and crystallized intelligence (Cattell, 1987) the SCT is conceptually related to the mechanics of cognition or fluid intelligence comprising general and largely innate abilities and refers to the performance and speed of solving tasks that are related to new material. The test was implemented asking respondents to match as many numbers and symbols as possible within 90 seconds according to a given correspondence which is visible to the respondents on a screen.

Both tests were previously shown to produce outcomes which are sufficiently correlated with test scores of more comprehensive and well-established intelligence tests (Lang, 2005; Lang et al., 2007). We however decided to employ the SCT scores only since the time restriction levied on both tests interferes with the word fluency test inasmuch aspects as for example working memory come into play which is related to executive function and thus fluid intelligence rather than crystallized intelligence only.

Measures of personality

The 2005 wave of the SOEP provides several measures of individuals' personality. First, there are items that relate to the Five Factor Model (McCrae and Costa, 1996; 1999) comprising the five basic psychological dimensions as outlined above: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Since extensive psychological questioning was not feasible in the SOEP,[6] the data rather provides a set of fifteen items (listed in the Appendix) of which three each are to capture the respective

personality dimensions.[7] LOC is surveyed with ten items (cf. Appendix) of which four measure internal LOC and six relate to external LOC. Positive and negative reciprocity are asked for by three items respectively. The FFM indicators as well as the LOC and reciprocity items are to be answered on 7-point Likert type scales (1 – "disagree completely" (LOC) / "does not apply to me at all" (FFM, reciprocity) to 7 – "agree completely" (LOC) / "applies to me perfectly" (FFM, reciprocity)). The personality measures employed in this analysis then are generated by standardizing the average score from the dimension-specific questions on FFM, LOC and reciprocity.[8]

Summarizing both personality trait scores and cognitive ability test scores, Table 1 shows that there are few differences by gender. Regarding personality traits, women score higher in openness, in extraversion, and in neuroticism. They however score lower in negative reciprocity. There however are no statistical differences for the remaining personality trait scores and for the scores from the symbol correspondence test.

[Table 1 about here]

Estimation methods

In the following, we examine the returns to individuals' cognitive abilities and personality using augmented Mincer-type earnings regressions. Let y_i be individual i's gross hourly wage, x_i worker characteristics, and c_i a vector of indicators on cognition and personality. The earnings functions we estimate are based on the typical form:

$$\ln y_i = x_i'\beta + c_i'\gamma + u_i ,$$

where x is a vector of individual characteristics known to be related to earnings, c is the vector that includes the respondent's personality trait and intelligence test scores, β and γ are the corresponding parameter vectors to be estimated, and u_i denotes the idiosyncratic error

term. Since wages are observable only for employed individuals, we account for sample selection bias using Heckman's correction procedure (Heckman, 1979).[9]

There are a range of potentially problematic aspects that are taken into account as follows: first, the relationship between particularly personality and earnings might be endogenous. While previous research on the one hand suggests that an individual's personality is partially inherited (Jang et al., 1996) and fairly stable for adults (Costa and McCrae, 1988, 1994) treating personality traits as exogenous may on the other hand be misleading. Heckman et al. (2006) show for a sample of young individuals that parental background and the schooling level at the date of the test may affect test scores of both cognitive and non-cognitive abilities. Furthermore, while Costa and McCrae (1988, 1994) suggest that personality traits stop changing at age 30, recent research by Srivastava et al. (2003) show that an individual's (social and job) environment affects personality traits also in early and middle adulthood which is also pointed out by Borghans et al. (2008). In the context of earnings it may well be that there is a feedback of either low or high earnings on personality which then again may affect earnings through productivity differences by personality dimension.

Consequently, empirical research that attempts to examine causal effects of personality on labor market outcomes has to deal with the issue of reverse causality. In the present paper and similar to Semykina and Linz (2007), the possible endogeneity of personality and schooling should not matter much since the respondents' mean age is 38 years so that the interdependency between concurrent schooling level and test scores is not given.

The possible interdependency between earnings and personality however is taken into account. Following the approach of Nyhus and Pons (2005) and Osborne Groves (2005), each personality trait is regressed on age and age, squared. The residuals from these

regressions then are free from age effects. While far from perfect, this will to some extent also pick up possible feedback-effects of an individual's job (and other social) environment on her personality.

The standardized scores from the two IQ-tests are processed similarly a) to keep the results and interpretation consistent and b) to capture the negative age effects on fluid intelligence (Baltes et al., 1999). Since the resulting indicators on personality and cognition can be taken as age-free, i.e. are constant over time, this approach further allows matching this information to preceding waves of the SOEP and applying appropriate panel estimators, see below.

A further issue in the personality measures is that the variability in the resulting personality dimensions might arise from measurement error. To quantify this, and to be able to correct for it, Cronbach's alpha reliabilities (Cronbach, 1951) are calculated. For the FFM dimensions, these are: openness 0.64, conscientiousness 0.65, extraversion 0.73, agreeableness 0.54, and neuroticism 0.63. For LOC we get: internal LOC 0.22, and external LOC 0.61 and the reliability ratios for positive and negative reciprocity are 0.66 and 0.83 respectively. These reliability coefficients mainly are low compared to what is typically found in the literature (John and Srivastava, 1999), where they range between 0.70 and 0.90. However, given that only three items per personality trait are available in the SOEP, the ratios found are satisfactory: Employing the Spearman-Brown formula, Mueller and Plug (2006) show that the reliability ratios increase with an increasing number of items.[10] We however exclude internal LOC from the analyses since the alpha of 0.22 clearly indicates a too large measurement error meaning that the surveyed items are not at all appropriate for measuring the underlying scale. With the alphas at hand, we estimate an additional set of regressions to correct for the measurement error problem by imposing the reliability ratios in order to adjust both parameter estimates and standard errors (Kmenta, 1997, pp. 352-357).

Although the indicators on personality and cognition are given only in the 2005 and 2006 waves of the SOEP, it is still possible to exploit the longitudinal structure of the survey to further account for individual specific heterogeneity. Since we assume that the 'residualized' indicators on cognition and personality are constant over time, we match the cross-sectional indicators to all preceding waves to be able to exploit the longitudinal structure of the SOEP. While this excludes the use of fixed effects estimation, we estimate random effects regressions in addition to the pooled OLS estimator to account for unobservable heterogeneity. This comes at the price of assuming that individual specific heterogeneity is uncorrelated with cognition and personality which might not be appropriate. One possible alternative would therefore be to use the Hausman-Taylor IV estimator (Hausman and Taylor, 1981) which would allow including time-invariant covariates that might be assumed to be either exogenous or endogenous. Experiments with this estimator did not result in findings that are substantially different to our random effects results below so that they need not be provided in detail. Furthermore, Plümper and Troeger (2007) recently introduced the fixed effects vector decomposition approach (FEVD), and provide evidence that their method is superior to pooled OLS, fixed effects, random effects, and Hausman-Taylor IV estimation for the estimation of time-invariant or rarely changing variables in panel data models.

The FEVD approach is a three-stage procedure in which estimated unit effects from a fixed effects regression are decomposed in an explained and unexplained part. The latter is then included in a final pooled OLS regression. The underlying model is as follows:

$$\ln y_{it} = \beta_0 + \sum_{k=1}^{K} x'_{kit}\beta_k + \sum_{m=1}^{M} z'_{mi}\gamma_m + u_i + \varepsilon_{it},$$

where the x are time varying and z are time-invariant variables. u_i are N-1 unit specific effects and ε_{it} is the remaining stochastic error term. The first stage of the FEVD

procedure is the standard fixed effects approach which by within transformatoin eliminates the unit effects u_i but also time-invariant covariates.

$$\ln y_{it} - \ln \overline{y}_{i\cdot} = \beta_k \left(\sum_{k=1}^{K} x_{kit} - \overline{x}_{ki\cdot} \right) + \gamma_m \left(\sum_{m=1}^{M} z_{mi} - z_{mi} \right) + \left(u_i - u_i \right) + \left(e_{it} - \overline{e}_{i\cdot} \right)$$

This fixed effects estimation is necessary to obtain estimates of the unit effects $\hat{u}_i$ which "… do not equal the unit effects u_i" in the data generating process but rather "…includes the unobserved unit-specific effects as well as the observed unit-specific effects z, the unit means of the residuals $\overline{e}_{i\cdot}$, and the time-varying variables $\overline{x}_{ki\cdot}$, whereas u_i only accounts for unobservable unit-specific effects." (Plümper and Troeger, 2007, p. 5)

In stage 2, the estimated unit effects $\hat{u}_i$ then are decomposed into a part explained by the observed time-invariant variables *z* and an unexplained part h_i by regressing $\hat{u}_i$ on *z*

$$\widehat{u}_i = \sum_{m=1}^{M} z'_{mi} \gamma_m + h_i$$

where h_i denotes the unexplained part which then can be obtained by computing the residuals

$$h_i = \widehat{u}_i - \sum_{m=1}^{M} z'_{mi} \gamma_m \ .$$

The third and final stage is to estimate the full model without unit effects but including h_i using pooled OLS

$$\ln y_{it} = \beta_0 + \sum_{k=1}^{K} x'_{kit} \beta_k + \sum_{m=1}^{M} z'_{mi} \gamma_m + \delta h_i + \varepsilon_{it} \ .$$

The resulting estimator is consistent if the unobserved unit effects are orthogonal to the time-invariant variables. Using Monte Carlo simulations, Plümper and Troeger (2007) further provide evidence that this estimator outperforms the above mentioned techniques for the case of either time-invariant or rarely changing variables.

As robustness checks, we estimate further specifications. First, adapting the approach of Mueller and Plug (2006), we estimate two sets of regression specifications each: one set of models including only the following socio-demographic variables: a dummy on whether the individual is living in East Germany, a dummy for being married, a dummy for not having German citizenship, the individual's years of education, age and age squared. The second set of regressions then additionally includes the following job-related regressors: tenure and tenure, squared, a dummy on whether the respondent has a public employer, whether she works in a firm with 2000 employees or more, whether she has a temporary job, a part-time job, and another dummy on whether the respondent is a white-collar worker. In this full specification we further control for occupational and industry dummies.[11] This will to some extent capture that workers who differ in cognitive skills and/or personality might self-select into specific jobs that either reward certain traits or off-set the lack of traits (cf., e.g., Filer, 1986 or Jackson, 2006).[12]

To test for non-linearities in the relationship between cognitive and non-cognitive skills and earnings we again follow Mueller and Plug (2006) and estimate regressions including dummies that indicate whether the individual's scores are in the top or bottom 25% of the distribution. This is because using linear scores may push the estimated average returns to zero if for example only moderate openness is rewarded on the labor market but both being too open or not being open at all is punished.

It might further be argued that an employee's cognition and personality are not observable to the employer at the beginning of an employment relationship but over time only so that returns to these traits might vary with tenure (Nyhus and Pons, 2005). We therefore estimate additional regressions including variables interacting cognition and personality indicators with worker's tenure. Accounting for the differences by gender found

in previous research, we run our regressions separately for males and females. Finally, as outlined above, all estimations include the IMR to account for selection into employment.[13]

4. Results

Cross-section

Estimates from the OLS regressions as well as from the regressions that correct for measurement error are provided in Table 2.[14] These findings do not account for individual heterogeneity but are given as benchmark to compare with prior findings in the literature. The first issue worth noting is that there are only few changes comparing the results from the base OLS specifications that include only a small set of socio-demographic controls with the results from the regressions that include the full set of job characteristics as well as occupational and industry dummies (Table 2, column 1 and 2 for females and columns 5 and 6 for males).[15] In general, the coefficients decrease in value and statistical significance. However, similar to the findings of Mueller and Plug (2006), the results in the error-in-variables regressions that impose the reliability ratios in the estimation then mostly indicate increases in the absolute values of the estimated coefficients and, if significant, also in the significance level.

Substantially, the results indicate that some of our a priori expectations are met while others are not in line with hypotheses or previous findings. We in particular suggested that both openness and conscientiousness would positively relate to earnings. While there are wage premiums of about 2% in the OLS regressions to about 6% in the EIV models for a one standard deviation increase in openness for women, the coefficients indicate a wage penalty of 2 to 5% for males. This is contrary to the results of Mueller and Plug (2006) but note again that the theoretical conjectures also allow for a negative effect on labor market success since openness is linked to autonomy and non-conformity (Judge et al., 1999).

Another difference by gender is found for conscientiousness. The coefficients indicate a wage penalty for female workers in the base specifications but turn statistically insignificant in the full model including all job characteristics. Men in contrast seem to gain from conscientiousness which is in line with expectations. There is a wage premium of about 1.5% for a one standard deviation increase in conscientiousness. The coefficient however loses statistical significance in the full specification model once measurement error is accounted for. It might be argued that selection into conscientiousness rewarding jobs or industries offsets the differential found first.

There again is mixed evidence by gender with regard to extraversion. We find a wage differential of about 3% for women but a 2% wage premium for males for a one standard deviation increase in extraversion (Table 2, columns 4 and 8). Based on prior evidence from economic research our expectation was that extraversion would not be related to wages but note again that theoretical reasoning from the psychology literature allows for both positive and negative effects on job performance (Judge et al., 1999).

Agreeableness is mainly not associated to males' wages but negatively related to females' wages. The point estimates in the full specifications suggest for a wage penalty of some 3% for 'being nice', i.e. a one standard deviation increase in agreeableness, which even increases to more than 6% in the error-corrected model (Table 2, columns 2 and 4). While this may seem implausible at first glance it is consistent with theoretical arguments above and the existing evidence (cf. Nyhus and Pons, 2005, or Mueller and Plug, 2006). Agreeable individuals may be extremely cooperative and may hence sacrifice their career by being nice to others for example in order to avoid conflicts.

[Table 2 about here]

Again in contrast to prior expectations we find no statistical relationship between neuroticism and wages. We however control for individual's attitude towards reciprocal

behavior. Since neuroticism and reciprocity are linked (Ashton et al., 1998) it may well be that the results for neuroticism as found in previous research are reflected in the indicators on reciprocity here. These in fact are more robust inasmuch as there is statistical significance across all first specifications with the exception of negative reciprocity which is not related to females' wages.

However, female workers who score high in positive reciprocity earn some 3% more, increasing to about 5% adjusting for measurement error. Somewhat lower premiums of about 2 to 3% are found for males respectively. Interestingly though, there are also wage premiums of about the same size for males for negative reciprocity. This result may not appear plausible but, as outlined, note that negative reciprocity and agreeableness or rather inverse agreeableness likely are measures of the same underlying personality trait. It hence may well be the case that the effect of this trait works through negative reciprocity rather than agreeableness.

The remaining personality trait in our analysis, external locus of control, is the most robust and strongest predictor of wage differentials: individuals who believe that the outcomes they experience are beyond their control have wages that depending on the respective specification are between 4 and more than 9% lower for a one standard deviation increase in the LOC scale.

Turning to the estimates for cognitive abilities, we find further differences by gender: The measure for fluid intelligence is not statistically different from zero in all baseline regressions, for female workers. Yet, cognitive abilities are relevant for males' wages. The coefficients for the *symbol correspondence test* first imply wage benefits of some 4% for a one standard deviation increase in the test score (Table 2, columns 5 and 7) which decreases to about 2% once job related characteristics are included in the models (Table 2, columns 6 and 8). This decrease may be the consequence of self-selection into jobs on the basis of

personality traits and cognition so that including job controls mediates the effect of individuals' cognitive abilities.

Panel results

It might be argued that cognitive abilities or personality trait are good proxies for unobservable heterogeneity but this depends on the measures used. Employing panel estimators might thus account for remaining individual specific heterogeneity. Our results in fact show that the FFM indicators are sensitive to the method applied. With the exception of a wage differential of about 2.5% for agreeableness for females none of the other FFM covariates is statistically different from zero in the random effects regressions (Table 3). Most of the results from the FEVD approach however reinforce the first findings on the FFM variables from the pooled OLS estimations though there are some changes by gender.

Again, and despite the decrease of the coefficients in size, openness is rewarded for females but penalized for males (Table 3, columns 4 for females and 8 for males). There are also wage penalties for females for extraversion in the full model specification and for agreeableness throughout. Furthermore, while the negative coefficients for conscientiousness were statistically significant only in the base OLS specifications above, there are wage penalties of about 1.5% for conscientiousness for females in the FEVD model (Table 3, column 3 and 4).

The results change even more for males. In particular, the weakly positive effect of extraversion is not statistically significant anymore. The results from the FEVD approach now imply a wage benefit of roughly 1% for a one standard deviation increase in agreeableness. While this was first expected to be negatively related to males' wages it is in line with prior reasoning which could result in both positive and negative effects. We furthermore find a wage penalty for males with an increase in neuroticism. This however is in line with a priori expectations.

[Table 3 about here]

The most robust results across both RE and FEVD estimations are again found for the remaining personality traits, i.e. reciprocity and locus of control. Positive reciprocity is positively related to the wages of both males and females implying wage premiums ranging between 2 and almost 5%. Similar to the findings above, negative reciprocity is associated to males' wages indicating wages that are some 2% higher for a one standard deviation increase in this personality dimension. The strongest predictor once more is external locus of control i.e. for individuals who believe that the outcomes they experience are consequences from actions beyond their control. Increasing a worker's external locus of control by one standard deviation results in wages which depending on method and specification are some 5% to 8% lower (Table 3).

Referring to cognitive abilities the findings from the panel regressions corroborate the above provided OLS results. There again is no statistical relation between the scores from the symbol correspondence test and the wages of female workers. The wages of males however increase with fluid intelligence and the SCT coefficients are even slightly larger compared to the baseline OLS estimations. The wage premiums now are at about 3% in the full model, i.e. including all job related variables (Table 3, columns 6 and 8).

To further account for possible non-linearities in the relationship between cognitive abilities, personality and wages we ran additional regressions that include dummies on whether the respondent scores either in the bottom or top 25% of the particular trait. Table 4 and 5 provide the results from the full specification models of OLS, RE, and FEVD estimations for females and males respectively.

Focusing the discussion on the results from the FEVD estimations, the coefficients suggest that modeling a linear relationship is not appropriate for all personality traits. For females, there in particular is a u-shaped relation between wages and extraversion and,

though somewhat weaker, wages and neuroticism and an inverse u-shaped relation between females' wages and conscientiousness. The latter would for example imply that scoring in the bottom 25% of this dimension would come along with a wage penalty of 7% while scoring in the top 25% would result in a wage differential of about 9% (Table 4, column 3). Put in simple words, being either sloppy or perfectionist is not of advantage for females. Roughly linear relationships are found for openness and positive reciprocity and, inversely, for agreeableness, negative reciprocity and external locus of control. For the latter, we find a wage differential of about 11% for women who score in the top 25% of this personality dimension. Furthermore, and in contrast to the above findings which indicate that cognitive abilities would not be relevant for females' wages, scoring in the top 25% of the symbol correspondence test is associated with a wage benefit of almost 3% (Table 4, column 3).

[Table 4 about here]

There is even more evidence for non-linear relationship between certain personality traits and the wages of male workers. U-shaped gradients are found for conscientiousness and agreeableness while inverse u-shaped relationships exist for openness, neuroticism and, albeit weaker, for extraversion meaning that scoring in the top 25% is associated to a wage penalty of about 5%. This contrasts the weakly positive linear relationship between extraversion and males' wages found in the OLS regressions above and thus highlights the necessity to account for both individual specific heterogeneity and non-linearity.

[Table 5 about here]

Corroborating the results above, we find linear relationships between males' wages and positive reciprocity and cognitive abilities. Increases from the bottom 25% to the top 25% would be associated with wage increases of more than 15% for positive reciprocity and some 10% for fluid intelligence. And inverse relationship is again found for an external locus of control, with wage penalties of about 19% for a similar bottom to top increase.

We further account for the possibility that both a worker's cognitive abilities and her personality may become observable to the employer over time only by estimating additional regressions that include variables that interact cognition or personality with tenure (Table 6). It has to be noted that there are differences between the findings from the OLS equations and the FEVD regressions. Since the latter are more appropriate we rely on these panel findings for interpretation.

[Table 6 about here]

In the regressions above, being open to experience is positively associated to females' wages. The results here now suggest that while the main effect is not different from zero the joint effect evolves with tenure (Table 6, column 2). There is a similar finding for males which however indicates that the negative main effects turns smaller with increases in tenure (Table 6, column 4). A reverse result is found for the effect of conscientiousness on males' wages, meaning that the positive main effect decreases with increasing tenure. There furthermore is no relation between conscientiousness and tenure for females.

For extraversion, there are no main effects for both females' and males' wages but a negative interaction with tenure for females (Table 6, column 2) and a positive interaction for males (column 4). In line with the findings above, there is a negative main effect for agreeableness for females' wages and a positive effect for males' wages. The latter however decreases with tenure. There further are no effects for neuroticism by tenure for females' wages and also only a negative main effect in the wage regression for males.

There further are more convincing findings for positive reciprocity inasmuch as there are positive main and interaction effects on the wages of females and positive main but decreasing effects for males' wages (Table 6, columns 3 and 4). While there are no effects of negative reciprocity along with tenure on females' wages there also is only a positive main effect on males' wages of about the same size as found above (Table 6, column 4). For

external locus of control, the findings again differ by gender. While the negative main effect is counteracted by tenure for females, it even increases for males. Finally, there are neither main nor interaction effects for cognitive abilities on females' wages. The positive main effects for males' wage however decrease with tenure.

Robustness checks

We ran additional regressions as robustness checks but do not provide them in detail since the results from these exercises are not substantially different from those given above. First, we estimated our models based on workers from West Germany only. The intention is to take into account that East Germans tend to have a higher external locus of control (average of 3.8 in comparison to 3.5, t-value of -3.335) which might have to do with their historic experience of having been forced to live in an authoritarian regime. As pointed out, the results do not change. We further estimated models that included either IQ or personality indicators to control of possible interdependencies between cognition and personality traits. Again, by and large in line with the findings of Mueller and Plug (2006), there were no substantial changes in the results.[16] Finally, since we are well aware of the risk of reverse causality we estimated earnings equations using data from the 2007 sweep of the SOEP, i.e. regressing wage on socio-demographics and job characteristics from 2007 but including the indicators on cognition from 2006 and personality from 2005. The idea here is to eliminate any concurrent relationship between wages and cognition or personality. The sample size we got was rather small, roughly 1,300 observations altogether, so it is not surprising that only a few coefficients were statistically different from zero. In particular, we find no statistically significant coefficients in these cross-sectional wage regressions for females. The results for males are reinforced inasmuch as there are wage penalties for the external locus of control in all model specifications. There further is a wage premium for negative reciprocity in the full

model, but the wage benefit for fluid intelligence that appears in the parsimonious baseline model vanishes once job characteristics are included.

5. Conclusions

There is a consensus among labor economists that traditional human capital variables such as education or experience are not sufficient to predict wages and other labor market outcomes. At the same time, there is an increasing awareness of the importance of both cognitive abilities and personality traits as determinants for labor market success. Cognitive skills may result in better job performance and productivity differences which directly translate into earnings differentials. Likewise, individuals' personality may result in job performance differentials. It is intuitively obvious that behavioral characteristics such as perseverance or trustworthiness are traits that may be advantageous in both employer-employee and customer relationships while other personal traits might be unfavorable and hence not be rewarded or even punished in the labor market. There is still a great need for empirical analyses to specify the relationship between intelligence and personal traits on the one hand, and labor market success on the other, i.e. to identify which skills are important and to quantify the effects.

We provide the first joint analysis of the relationship between cognitive skills, personality traits and earnings in Germany, and add to the scarce and merely US-based literature which deals with intelligence and personality at the same time. Using data from the SOEP, we employ one measure of cognitive abilities, the *symbol correspondence test*, and a range of indicators that measure individuals' personality. In particular, we use measures for locus of control, reciprocity, and all basic items of the Five Factor Model: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. We examine the returns to cognitive abilities and personality using augmented Mincer-type earnings

regressions and account for sample selection bias using Heckman's correction procedure. Since the variability in the personality dimensions might arise from measurement error, we correct for this by quantifying Cronbach's alpha reliability coefficients, and imposing the calculated reliability ratios in order to adjust both parameter estimates and standard errors. We explicitly take into account that an individual's ability and personality might change with age by employing predicted residuals from estimations of intelligence test scores and personality trait items that are regressed on age and age squared. This approach further allows matching this information to prior panel waves that do not provide information on cognition and personality so that we are able to apply appropriate panel estimators, random effects regression and a more novel approach, the fixed effects vector decomposition.

Our results suggest for wage effects of personality and cognitive abilities with differences by gender and by specification. The results show that the FFM traits, externality and reciprocity are either linearly or non-linearly related to workers' wages and to some extent change with a worker's tenure. Cognitive abilities mainly affect the wages of male workers only.

While the findings for the FFM indicators are sensitive to model specification and the respective estimator, there is one robust result across gender, all specifications and estimators applied: Individuals who score high in the external locus of control scale on average earn less than their counterparts who have low scores. These differentials are substantial: Compared to workers who score in the bottom 25% of the LOC scale, there is a wage penalty of about 19% for workers who score in the top 25% of the scale.

To sum up, the results of our analysis reveal that also in Germany, personality is an important predictor of earnings even if a large set of socio-demographic and job-related characteristics and, even more relevant, cognitive ability scores are included. Despite the more regulated labor market and the less meritocratic society in Germany, the effect of locus

of control is of comparable size if not larger than revealed by similar studies for the US. In contrast, cognitive abilities affect only the earnings of males. Quantitatively, these findings further suggest a relatively greater importance of certain personality traits compared to cognitive abilities. While there a no simple straightforward policy implications, we conclude with Borghans et al. (2008) who claim that "…personality traits are more malleable than cognitive ability over the life cycle and are more sensitive to investment by parents and to other sources of environmental influences at later ages than are cognitive traits" (Borghans et al., 2008, p. 4). Put differently, both prior research and our findings here may point to the necessity for social policy to put greater emphasis on abilities other than or in addition to cognitive skills, and to effectively attain greater achievement by investing in personality traits.

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Table 1: Personality traits and cognitive abilities by gender

	Females	Males	Difference
Personality traits			
FFM: Openness	4.79	4.56	0.22***
FFM: Conscientiousness	4.80	4.85	-0.05
FFM: Extraversion	5.06	4.87	0.19***
FFM: Agreeableness	4.78	4.83	-0.05
FFM: Neuroticism	4.37	4.12	0.25**
Positive reciprocity	5.93	5.97	-0.04
Negative reciprocity	2.86	3.23	-0.37***
External locus of control	3.57	3.54	0.03
Cognitive abilities			
Symbol correspondence test	29.85	29.60	0.25
N	786	794	

Notes: N=1580, *** p<0.01, ** p<0.05, * p<0.1

Source: SOEP, 2005-06

Table 2: Log hourly wages regressed on cognitive abilities and personality traits, pooled cross-sections

	Females: OLS		Females: EIV		Males: OLS		Males: EIV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Personality traits								
FFM: Openness	0.017**	0.021***	0.053***	0.063***	-0.020***	-0.021***	-0.046**	-0.053***
	(0.007)	(0.006)	(0.017)	(0.016)	(0.006)	(0.006)	(0.018)	(0.019)
FFM: Conscientiousness	-0.013*	-0.003	-0.035***	-0.015	0.016***	0.013**	0.018*	0.014
	(0.007)	(0.007)	(0.013)	(0.012)	(0.006)	(0.005)	(0.011)	(0.010)
FFM: Extraversion	0.004	-0.006	-0.008	-0.032*	0.010*	0.010*	0.023	0.024*
	(0.008)	(0.007)	(0.018)	(0.017)	(0.006)	(0.005)	(0.015)	(0.014)
FFM: Agreeableness	-0.047***	-0.030***	-0.099***	-0.062***	-0.010*	-0.002	-0.018	-0.001
	(0.007)	(0.006)	(0.016)	(0.016)	(0.005)	(0.005)	(0.013)	(0.012)
FFM: Neuroticism	-0.002	0.001	0.016	0.013	0.001	-0.002	0.009	0.004
	(0.006)	(0.006)	(0.012)	(0.011)	(0.005)	(0.005)	(0.009)	(0.009)
Positive reciprocity	0.034***	0.025***	0.076***	0.054***	0.014**	0.017***	0.028***	0.032***
	(0.007)	(0.006)	(0.012)	(0.011)	(0.005)	(0.005)	(0.010)	(0.010)
Negative reciprocity	-0.001	0.001	0.008	0.011	0.022***	0.020***	0.034***	0.031***
	(0.006)	(0.006)	(0.009)	(0.008)	(0.005)	(0.005)	(0.007)	(0.007)
External locus of control	-0.061***	-0.043***	-0.116***	-0.091***	-0.054***	-0.040***	-0.092***	-0.070***
	(0.007)	(0.006)	(0.015)	(0.014)	(0.005)	(0.005)	(0.010)	(0.010)
Cognitive abilities								
SCT	0.008	-0.001	0.007	-0.001	0.041***	0.021***	0.041***	0.022***
	(0.007)	(0.006)	(0.007)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Individ. controls	+	+	+	+	+	+	+	+
Occ. / industry controls	–	+	–	+	–	+	–	+
F-Test FFM vars.	12.80***	6.88***	13.55***	8.23***	4.11***	3.59***	2.46**	2.19*
F-Test personality vars.	22.15***	11.69***	22.76***	11.90***	18.81***	14.04***	19.11***	14.22***
R^2	0.25	0.37	0.27	0.38	0.37	0.47	0.39	0.47

Notes: N = 6222 (females) / 6826 (males); Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: SOEP, 1991-2006.

Table 3: Log hourly wages regressed on cognitive abilities and personality traits, panel estimates

	F: RE		F: FEVD		M: RE		M: FEVD	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Personality traits								
FFM: Openness	0.016	0.017	0.027***	0.030***	-0.008	-0.012	-0.008*	-0.007*
	(0.016)	(0.014)	(0.005)	(0.005)	(0.016)	(0.014)	(0.004)	(0.004)
FFM: Conscientiousness	0.001	0.001	-0.015***	-0.013***	0.012	0.011	0.000	-0.000
	(0.016)	(0.014)	(0.005)	(0.005)	(0.015)	(0.013)	(0.004)	(0.004)
FFM: Extraversion	-0.010	-0.010	-0.007	-0.012**	0.008	0.009	0.001	0.004
	(0.017)	(0.015)	(0.005)	(0.005)	(0.015)	(0.013)	(0.004)	(0.004)
FFM: Agreeableness	-0.026*	-0.022*	-0.045***	-0.039***	-0.008	-0.007	0.011***	0.014***
	(0.015)	(0.013)	(0.004)	(0.004)	(0.013)	(0.012)	(0.004)	(0.004)
FFM: Neuroticism	-0.001	-0.002	0.001	0.002	-0.005	-0.006	-0.016***	-0.017***
	(0.014)	(0.013)	(0.004)	(0.004)	(0.013)	(0.011)	(0.003)	(0.003)
Positive reciprocity	0.032**	0.023*	0.051***	0.045***	0.029**	0.028**	0.040***	0.038***
	(0.015)	(0.013)	(0.004)	(0.004)	(0.014)	(0.012)	(0.004)	(0.004)
Negative reciprocity	0.000	0.001	-0.000	0.001	0.020	0.022*	0.016***	0.018***
	(0.015)	(0.013)	(0.004)	(0.004)	(0.013)	(0.012)	(0.004)	(0.004)
External locus of control	-0.069***	-0.054***	-0.084***	-0.080***	-0.070***	-0.055***	-0.074***	-0.067***
	(0.015)	(0.014)	(0.005)	(0.005)	(0.013)	(0.012)	(0.004)	(0.004)
Cognitive abilities								
SCT	0.012	0.005	0.005	0.002	0.046***	0.033***	0.041***	0.034***
	(0.015)	(0.014)	(0.005)	(0.005)	(0.013)	(0.012)	(0.004)	(0.004)
Individ. controls	+	+	+	+	+	+	+	+
Occ. / industry controls	–	+	–	+	–	+	–	+
F-Test FFM vars.	4.31	4.35	30.16***	26.30***	1.58	2.41	6.47***	8.25***
F-Test personality vars.	30.04***	23.20***	76.49	63.87***	37.05***	33.89***	73.52***	63.96***
R^2	0.23	0.33	0.66	0.67	0.34	0.42	0.70	0.71

Notes: N = 6222 (females) / 6826 (males); Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: SOEP, 1991-2006.

Table 4: Females' wages and non-linearities in cognitive abilities and personality traits

	OLS (1)	RE (2)	FEVD (3)
Personality traits			
FFM Openness: Bottom 25%	-0.006	-0.020	-0.028**
	(0.016)	(0.034)	(0.011)
FFM Openness: Top 25%	0.022	-0.007	0.047***
	(0.014)	(0.030)	(0.010)
FFM Conscientiousness: Bottom 25%	0.004	-0.043	-0.068***
	(0.016)	(0.033)	(0.011)
FFM Conscientiousness: Top 25%	0.001	-0.008	-0.090***
	(0.014)	(0.031)	(0.010)
FFM Extraversion: Bottom 25%	0.030*	0.043	0.094***
	(0.017)	(0.037)	(0.013)
FFM Extraversion: Top 25%	0.016	0.007	0.017*
	(0.014)	(0.030)	(0.010)
FFM Agreeableness: Bottom 25%	0.060***	0.079**	0.143***
	(0.015)	(0.032)	(0.011)
FFM Agreeableness: Top 25%	-0.024*	0.008	-0.006
	(0.014)	(0.031)	(0.010)
FFM Neuroticism: Bottom 25%	0.033**	0.016	0.010
	(0.014)	(0.031)	(0.010)
FFM Neuroticism: Top 25%	0.030**	0.020	0.019*
	(0.014)	(0.031)	(0.010)
Positive Reciprocity: Bottom 25%	-0.047***	-0.003	-0.096***
	(0.014)	(0.029)	(0.010)
Positive Reciprocity: Top 25%	0.023*	0.006	0.058***
	(0.014)	(0.034)	(0.010)
Negative Reciprocity: Bottom 25%	-0.001	-0.030	0.029***
	(0.014)	(0.031)	(0.010)
Negative Reciprocity: Top 25%	0.018	0.046	-0.001
	(0.015)	(0.031)	(0.011)
External locus of control: Bottom 25%	0.044***	0.040	0.067***
	(0.014)	(0.031)	(0.010)
External locus of control: Top 25%	-0.063***	-0.089***	-0.106***
	(0.015)	(0.032)	(0.011)
Cognitive abilities			
SCT: Bottom 25%	-0.028*	-0.026	0.003
	(0.015)	(0.032)	(0.011)
SCT: Top 25%	-0.020	-0.006	0.027***
	(0.014)	(0.030)	(0.010)
Individ. controls	+	+	+
Occ. / industry controls	+	+	+
F-Test FFM variables	3.58***	10.13	36.35***
F-Test personality variables	5.95***	28.84**	45.87***
F-Test cognitive ability variables	2.22*	0.67	3.65**
R^2	0.38	0.33	0.67

Notes: N = 6222 (females) / 6826 (males);
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: SOEP, 1991-2006.

Table 5: Males' wages and non-linearities in cognitive abilities and personality traits

	OLS (1)	RE (2)	FEVD (3)
Personality traits			
FFM Openness: Bottom 25%	0.002	-0.018	-0.041***
	(0.012)	(0.029)	(0.009)
FFM Openness: Top 25%	-0.044***	-0.031	-0.051***
	(0.012)	(0.030)	(0.009)
FFM Conscientiousness: Bottom 25%	-0.005	-0.002	0.019**
	(0.012)	(0.029)	(0.009)
FFM Conscientiousness: Top 25%	0.042***	0.048*	0.039***
	(0.012)	(0.029)	(0.009)
FFM Extraversion: Bottom 25%	-0.054***	-0.028	-0.002
	(0.012)	(0.029)	(0.009)
FFM Extraversion: Top 25%	-0.051***	-0.037	-0.052***
	(0.012)	(0.029)	(0.009)
FFM Agreeableness: Bottom 25%	0.011	0.036	0.038***
	(0.012)	(0.029)	(0.009)
FFM Agreeableness: Top 25%	0.006	0.003	0.041***
	(0.011)	(0.027)	(0.008)
FFM Neuroticism: Bottom 25%	-0.025**	-0.037	-0.048***
	(0.011)	(0.027)	(0.008)
FFM Neuroticism: Top 25%	-0.031***	-0.029	-0.051***
	(0.012)	(0.030)	(0.009)
Positive Reciprocity: Bottom 25%	-0.057***	-0.070**	-0.132***
	(0.012)	(0.029)	(0.009)
Positive Reciprocity: Top 25%	0.008	0.017	0.020**
	(0.012)	(0.028)	(0.009)
Negative Reciprocity: Bottom 25%	-0.062***	-0.083***	-0.046***
	(0.012)	(0.030)	(0.009)
Negative Reciprocity: Top 25%	0.015	0.024	-0.007
	(0.011)	(0.028)	(0.008)
External locus of control: Bottom 25%	0.057***	0.090***	0.084***
	(0.012)	(0.028)	(0.008)
External locus of control: Top 25%	-0.056***	-0.066**	-0.090***
	(0.012)	(0.029)	(0.009)
Cognitive abilities			
SCT: Bottom 25%	-0.041***	-0.033	-0.023***
	(0.012)	(0.028)	(0.009)
SCT: Top 25%	0.013	0.053*	0.071***
	(0.012)	(0.027)	(0.008)
Individ. controls	+	+	+
Occ. / industry controls	+	+	+
F-Test FFM variables	6.33***	9.74	17.28***
F-Test personality variables	11.52***	49.41***	45.43***
F-Test cognitive ability variables	8.78***	7.68**	50.15***
R^2	0.47	0.42	0.72

Notes: N = 6222 (females) / 6826 (males);
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: SOEP, 1991-2006.

Table 6: Wages effects of cognitive abilities and personality traits by tenure

	F: OLS	F: FEVD	M: OLS	M: FEVD
	(1)	(2)	(3)	(4)
Tenure	0.015***	0.005***	0.015***	0.009***
	(0.002)	(0.002)	(0.002)	(0.001)
Tenure^2/100	-0.011	-0.006	-0.017***	-0.008**
	(0.008)	(0.006)	(0.005)	(0.004)
Personality traits				
FFM: Openness	0.007	-0.006	-0.035***	-0.035***
	(0.009)	(0.007)	(0.009)	(0.006)
IA: Openness*tenure	0.001*	0.004***	0.002**	0.003***
	(0.000)	(0.001)	(0.001)	(0.000)
FFM: Conscientiousness	0.008	-0.010	0.006	0.011*
	(0.009)	(0.007)	(0.008)	(0.006)
IA: Conscientiousness *tenure	-0.001	-0.000	0.001	-0.001**
	(0.001)	(0.001)	(0.001)	(0.000)
FFM: Extraversion	-0.017*	-0.002	0.015*	-0.007
	(0.009)	(0.007)	(0.008)	(0.006)
IA: Extraversion *tenure	0.001	-0.001**	-0.001	0.001*
	(0.001)	(0.000)	(0.001)	(0.000)
FFM: Agreeableness	-0.015*	-0.042***	-0.008	0.025***
	(0.008)	(0.006)	(0.007)	(0.005)
IA: Agreeableness *tenure	-0.002**	0.000	0.001	-0.001***
	(0.000)	(0.001)	(0.001)	(0.000)
FFM: Neuroticism	0.002	0.002	0.007	-0.013**
	(0.008)	(0.006)	(0.007)	(0.005)
IA: Neuroticism *tenure	0.000	0.001	-0.001*	-0.000
	(0.001)	(0.001)	(0.000)	(0.000)
Positive reciprocity	0.010	0.032***	0.029***	0.028***
	(0.009)	(0.006)	(0.008)	(0.006)
IA: pos. reciprocity*tenure	0.002**	0.002***	-0.001*	-0.001**
	(0.001)	(0.001)	(0.000)	(0.000)
Negative reciprocity	0.010	0.006	0.011	0.013**
	(0.008)	(0.006)	(0.007)	(0.005)
IA: neg. reciprocity*tenure	-0.001*	-0.001	0.001*	0.001
	(0.000)	(0.001)	(0.000)	(0.000)
External locus of control	-0.045***	-0.090***	-0.035***	-0.048***
	(0.009)	(0.006)	(0.007)	(0.005)
IA: ext. LOC*tenure	0.001	0.001**	-0.001	-0.002***
	(0.001)	(0.000)	(0.001)	(0.000)
Cognitive abilities				
SCT	0.002	0.002	0.009	0.052***
	(0.009)	(0.006)	(0.007)	(0.005)
IA: SCT*tenure	-0.000	0.000	0.001**	-0.002***
	(0.001)	(0.001)	(0.000)	(0.000)
R^2	**0.37**	**0.67**	**0.46**	**0.71**

Notes: N = 6222 (females) / 6826 (males);
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: SOEP, 1991-2006.

Appendix Table A1: SOEP questions and personality traits (FFM, LOC, Reciprocity) used in the analysis (except where indicated)

Variable label	Personality trait
FFM: I see myself as someone who ...	
is original, comes up with new ideas	Openness to Experience
values artistic experiences	Openness to Experience
has an active imagination	Openness to Experience
does a thorough job	Conscientiousness
does things effectively and efficiently	Conscientiousness
is communicative, talkative	Extraversion
is outgoing, sociable	Extraversion
is sometimes somewhat rude to others (*reversed*)	Agreeableness
has a forgiving nature	Agreeableness
is considerate and kind to others	Agreeableness
worries a lot	Neuroticism
gets nervous easily	Neuroticism
is relaxed, handles stress well (*reversed*)	Neuroticism
LOC: I see myself as someone who ...	
How my life goes depends on me	Internal LOC (not used)
If a person is socially or politically active, he/she can have an effect on social conditions	Internal LOC (not used)
One has to work hard in order to succeed	Internal LOC (not used)
If I run up against difficulties in life, I often doubt my own abilities (*reversed*)	Internal LOC (not used)
Compared to other people, I have not achieved what I deserve	External LOC
What a person achieves in life is above all a question of fate or luck	External LOC
I frequently have the experience that other people have a controlling influence over my life	External LOC
The opportunities that I have in life are determined by the social conditions	External LOC
Inborn abilities are more important than any efforts one can make	External LOC
Reciprocity: I see myself as someone who ...	
If someone does me a favor, I am prepared to return it	Positive Reciprocity
I go out of my way to help somebody who has been kind to me before	Positive Reciprocity
I am ready to undergo personal costs to help somebody who helped me before	Positive Reciprocity
If I suffer a serious wrong, I will take revenge as soon as possible, no matter what the cost	Negative Reciprocity
If somebody puts me in a difficult position, I will do the same to him/her	Negative Reciprocity
If somebody offends me, I will offend him/her back	Negative Reciprocity

Appendix Table A2: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
FFM: Openness*	4.678	(1.121)	1	7
FFM: Conscientiousness*	4.825	(0.583)	2.33	7
FFM: Extraversion*	4.964	(0.774)	2	7
FFM: Agreeableness*	4.809	(0.723)	2	7
FFM: Neuroticism*	4.251	(0.863)	1.67	7
Positive reciprocity*	5.958	(0.855)	2	7
Negative reciprocity*	3.047	(1.433)	1	7
External locus of control*	3.563	(0.929)	1	7
Symbol correspondence test*	29.724	(9.175)	3	54
Male	0.524	(0.499)	0	1
Age	38.820	(9.503)	20	60
From East-Germany	0.136	(0.343)	0	1
Is married	0.646	(0.478)	0	1
Is Non-German	0.101	(0.302)	0	1
Years of education	11.952	(2.430)	7	18
Has public employer	0.249	(0.432)	0	1
Firm size: >= 2,000	0.234	(0.423)	0	1
Is white-collar worker	0.507	(0.499)	0	1
Has part-time employment	0.183	(0.386)	0	1
Has temporary job	0.174	(0.379)	0	1
Tenure	9.220	(8.794)	0	47.5
ISCO: Professionals	0.043	(0.204)	0	1
ISCO: Technicians	0.115	(0.319)	0	1
ISCO: Clerks	0.113	(0.317)	0	1
ISCO: Service	0.118	(0.323)	0	1
ISCO: Agricultural	0.012	(0.112)	0	1
ISCO: Crafts	0.166	(0.372)	0	1
ISCO: Plant operators	0.081	(0.273)	0	1
ISCO: Elementary	0.081	(0.272)	0	1
ISCO: Others	0.033	(0.179)	0	1
Industry: Agric., Mining, Textiles	0.028	(0.166)	0	1
Industry: Manufacturing metallics	0.140	(0.347)	0	1
Industry: Manufacturing non-metallics	0.065	(0.246)	0	1
Industry: Power, Construction	0.079	(0.270)	0	1
Industry: Wholesale, Hotels,	0.162	(0.369)	0	1
Industry: Financial intermediation	0.098	(0.298)	0	1
Industry: Administration, Health	0.157	(0.364)	0	1
Industry: Social services, others	0.062	(0.241)	0	1

Notes: N = 13,048; * = 1,580
Source: SOEP 1991-2006, * 2005-06.

[1] See e.g. Tett et al. (1991), Barrick and Mount (1991), Salgado (1997), or Tokar et al. (1998).

[2] For references, cf. Judge et al. (1999).

[3] There further is a conference presentation by Isengard (2006) who suggests a wage premium for low risk aversion and high openness to experience and a wage penalty for an external locus of control and neuroticism.

[4] Note that there is a small set of personality traits surveyed from 1994 to 1996. We did not use these indicators because the wording changes from the 1994/95 indicators to the 1996 items and, more severe, since it would result in further sample size reduction.

[5] The sample size is rather low since we have to restrict our sample to individuals who are SOEP respondents in both 2005 and 2006 and, which is more limiting, were CAPI surveyed in 2006 since only those were potential respondents of the ultra-short IQ-tests. That is, instead of the 22,358 observations available in the full sample we could work with only 5,545 observations of persons who took part in both tests and who could be matched to individuals who participated in the 2005 wave. This results in a drop of observations to 3,453 for which we then matched the preceding waves. The age restriction and further data cleaning result in an additional drop in sample size.

[6] Note that the full inventory, the NEO PI-R, comprises 240 questions (Costa and McCrae, 1985).

[7] See Dehne and Schupp (2007) for an overview of the implementation of the short version of the Big Five inventories in the SOEP. They show amongst other things the validity and reliability of the short version of the Big Five used in the SOEP.

[8] Not all items are used to generate the indicators since exploratory analyses showed that a few of the items resulted in low construct validity.

[9] We calculate the Inverse Mills Ratio (IMR) by estimating a Probit model for the employment participation equations separately for males and females with the following regressors: a dummy on whether the individual is living in East Germany, a dummy for being married, a dummy for not having German citizenship, the individual's years of education, age and age squared. The exclusion restrictions are based on the individual's number of children, and whether she has bad self-reported health.

[10] In particular, they show that changes in reliabilities can be computed as $R1=R0\cdot((k0 + \Delta k) / (k0 + R0\cdot \Delta k))$, where R0 is the given reliability and k are the number of items measuring the respective scale. For example, presume a fixed reliability of 0.54. If this ratio were obtained with 6 instead of 3 items, like the original agreeableness measure, the ratio would rise to 0.7 and thus reach the critical threshold.

[11] We ran additional regressions including socio-demographic and job-related covariates but without occupation and industry. Since the results from these models do not differ substantially from the full models, they are not provided.

[12] Additional regressions by occupation are estimated to further examine this. There are only a few non-trivial findings quite likely because of sample size restrictions. However, where statistically significant, the results correspond to the findings presented.

[13] All equations have in addition been estimated without the IMR and yield almost identical results.

[14] Note that the control variables yield expected findings. Full estimation results are therefore not discussed but are available upon request.

[15] As mentioned above, we further estimated specifications that include job characteristics but without occupational or industry dummies. The results do not differ substantially from the full specification.

[16] This is a nice finding since it indicates that analyses that are based on either personality dimensions (Heineck, 2007) or cognitive abilities only (Anger and Heineck, 2008) do not suffer from a severe omitted variable bias.