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DISCUSSION PAPER SERIES 16/24

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Ramin Izadi & Joonas Tuhkuri

AUGUST 2024

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Evolving Returns to Personality*

Ramin Izadi
VATT

Joonas Tuhkuri
Stockholm University

July 2024

Abstract

We analyze trends in labor-market returns to psychological traits using data from half a million Finnish men from 2001 to 2015. Cognitive skills' value declined, while noncognitive skills' value increased. Our novel findings show that extraversion drives this rise, while conscientiousness remains stable. Extraversion's rising returns are most pronounced for lower earners and those on the employment margin. These traits predict different labor market paths: extraversion predicts lower education and more work experience, while cognitive ability and conscientiousness lead to higher education and high-paying jobs.

Keywords: noncognitive skills, personality, labor market, cognitive skills, education.
JEL Codes: I26, J24, J31

*Izadi: VATT Institute for Economic Research and Helsinki GSE, ramin.izadi@vatt.fi. Tuhkuri: Stockholm University and Etla, joonas.tuhkuri@su.se. We thank Daron Acemoglu, Joshua Angrist, David Atkin, David Autor, Manuel Bagues, Christian Dustmann, Bengt Holmström, Markus Jokela, Simon Jäger, Martti Kaila, Erik Lindqvist, Drazen Prelec, Matti Sarvimäki, Frank Schilbach, Mikko Silliman, Alexandra Spitz-Oener, Roope Uusitalo, Marko Terviö, Michael Wong, and workshop participants at MIT, Helsinki GSE, Stockholm University, SOLE, EALE, and UCL-CReAM/RFBerlin for discussions and comments, and the ROCKWOOL Foundation, Harvard Center for European Studies, Shultz Fund, OP Group Research Foundation, Emil Aaltonen Foundation, and Kone Foundation for financial support. All errors are our own.

1 Introduction

New research documents that noncognitive skills[1] have become increasingly important in the labor market over the recent decades (Deming, 2017; Edin et al., 2022), while the returns to cognitive skills have declined (Acemoglu & Autor, 2011; Beaudry et al., 2016; Castex & Kogan Dechter, 2014). Noncognitive skills are multiple in nature (Cunha & Heckman, 2007), and what dimensions have contributed to this pattern remains unclear.

We investigate which noncognitive skills drive the rising returns. So far, lack of data with direct measures of different noncognitive skills has limited the scope of this research. We overcome this limitation by using consistent cognitive and personality test records from half a million Finnish men, collected during mandatory military service across 19 birth cohorts born from 1962 to 1979. We combine these data with administrative tax and education records to study the economic returns to cognitive and noncognitive skills. The available data measure eight different personality traits. Using insights from psychology, we group these multidimensional data into two components: extraversion and conscientiousness, common constructs in personality psychology.[2]

In line with earlier studies, we observe a decline in the value of cognitive skills and an increase in the value of noncognitive skills between 2001 and 2015 for men aged 36–39. However, analyzing noncognitive skills without accounting for their multidimensional nature hides significant trends. We find that traits related to extraversion entirely drive the increase in the value of noncognitive skills, whereas the earnings premium to conscientiousness-related traits have remained stable. This result is robust to various reasonable groupings of the traits.

A more detailed analysis reveals that the increasing returns to extraversion are explained mainly by the extensive margin: the employment rate for extraverts has steadily improved. The intensive margin returns for those with stronger labor force attachment have increased only modestly. We also find that the trends are stronger at the bottom of the wage distribution. Collectively, our results document that the increased importance of extraversion mainly relates to the employment prospects of low-earning men.

Including educational attainment in the analysis does not substantially change the trends but has a dramatic effect on the coefficients' levels. Conditional on years of education, we find that the partial returns to conscientiousness are not only flat over time but precisely zero in absolute terms. Conversely, controlling for education increases the returns to extraversion, even above the premia for cognitive skills and years of education.

[1] 'Noncognitive skills' refer here to all potentially economically valuable skills that are not cognitive; in line with the literature. This broad category includes personality traits and social-emotional skills.

[2] 'Extraversion' refers to "an orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experience; characterized by positive affect and sociability." 'Conscientiousness' is "the tendency to be organized, responsible, and hard working" (American Psychological Association, 2007).

The second part of the paper contextualizes the traits we study—extraversion, conscientiousness, and cognitive skills—in the labor market more broadly. Extensive evidence shows that noncognitive skills improve labor market success (Almlund et al., 2011), but the channels are incompletely understood. One view is that noncognitive skills directly improve productivity at work. For example, Deming (2017) argues that social skills facilitate teamwork. Another view is that noncognitive skills affect labor-market performance indirectly, for example, through education (Cunha & Heckman, 2007).

Turning our analysis to the cross-section, we establish a robust pattern: extraversion and conscientiousness influence labor market success through largely separate domains. Conscientiousness is a strong predictor of educational attainment across cohorts, both in test scores and in years of education, and also predicts higher earnings. In contrast, extraversion predicts *worse* educational performance but still positive labor market outcomes.

These cross-sectional patterns provide some empirical grounds for the common stereotypes of socially awkward 'nerds' and outgoing 'jocks,' which suggest an inverse relationship between academic achievement and particular dimensions of noncognitive skills.[3] High achievers in school may lack at least some dimensions of economically valuable personality traits. Conversely, low-achieving students may have some redeeming qualities that compensate in the labor market for their lack of academic success. A path to success can be achieved through either route.

These results should be discussed in the context of two earlier key papers. The observation that some noncognitive skills can be harmful in some domains and useful in others has been raised earlier by Levine & Rubinstein (2017) and Papageorge et al. (2022). Levine & Rubinstein (2017) show that 'illicit' tendencies in the youth combined with high cognitive skills is associated with a successful career in entrepreneurship. Papageorge et al. (2022) find that boys' externalizing behavior is associated with low school performance but positive wage returns. They argue that externalizing behavior (e.g., hyperactivity, aggression, rule-breaking) is a productive skill, not merely a proxy for valuable unobservables.[4]

Our study contributes to this discussion by documenting an increasing value over time for extraversion, a trait exhibiting this inverse pattern. Although pinpointing a unifying concept behind these measures—harmful in one context but beneficial in another—is challenging, their common denominator appears to be an orientation toward *action*.[5]

We also explore the mechanisms of how personality influences earnings in the labor market. Conscientiousness predicts higher education, later career starts, and in the end, higher-paying professions. Extraversion predicts lower education, earlier career starts, and

[3] Stereotype accuracy is one of the most replicable findings in social psychology (Jussim et al., 2016).

[4] Almlund et al. (2011) review the evidence on personality, education, and labor market outcomes.

[5] DeYoung et al. (2008) also document a correlation between extraversion, externalizing behavior, and delinquency. They note: "[externalizing behavior] typically emphasize not only instability and lack of restraint but also exploratory, approach-oriented behavior. Individuals high in both Extraversion and Openness appear to be strongly motivated to explore and approach."

fewer unemployment spells, but does not predict ending up in particularly high-paying occupations. However, extraverted men more often advance to managerial roles. That is, conscientiousness predicts formal skills and formal occupations, extraversion informal skills and jobs where education is less important. The evidence is also consistent with the idea that conscientiousness works primarily through sorting, while extraversion is valuable in a broader set of contexts.

Finally, we estimate potential complementarities between different skill dimensions. Perhaps surprisingly, we observe a clear downward trend in the interaction term between cognitive and noncognitive skills. Having *both* high cognitive and noncognitive skills appears less important than before (contrasting with Deming 2017 and Levine & Rubinstein 2017). The group that experienced the highest earnings growth between 2001 and 2015 are those in the lowest tercile of cognitive skills and highest tercile of extraversion. The main trends are robust to including interaction terms: the only trait that trends upward is the main effect for extraversion. Our novel results show also that more men have either high cognitive skills *or* high extraversion, and are less likely to have both. Specialization into these 'separating' skill bundles is consistent with a supply-side response, where increasing returns to social skills encourage skill specialization (echoing the observations of Hermo et al. 2022).[6]

Discussion on the relative importance of different traits is not meaningful without addressing the problem of potential measurement error. Grönqvist et al. (2017) show that noncognitive skills are likely measured with more error relative to cognitive skills, which would attenuate their point estimates toward zero and make them appear smaller relative to cognitive skill estimates. We employ several strategies to address this concern: an instrumental variable approach that exploits the similarity of traits between brothers, a simulation exercise which adds noise, and validity scales embedded in the military test directly aimed at gauging measurement error. Our results are robust to these tests.

This paper adds to the expanding literature on the rising importance of noncognitive skills in the labor market. We are aware of few other papers that study the returns to noncognitive skills, social skills, or other 'higher-order skills' over time. The closest papers to ours are Deming (2017) and Edin et al. (2022). Our main results are consistent with both. Deming (2017) shows that the economic returns to social skills increased between 1980s and 2000s in the US. Edin et al. (2022) document that the returns to noncognitive skills have risen between 1990s and 2010s in Sweden. Our novel finding is that increasing returns to extraversion, and not conscientiousness, is a critical driver of this trend.

Our research relates to the large literature on skill-biased technological change (Katz & Murphy, 1992; Goldin & Katz, 2008; Acemoglu & Autor, 2011). Which skills have become more valuable and which less valuable over time? One view is that cognitive and technical

[6] In the model we develop in Appendix C, this could be interpreted as a reaction to the increased returns to social skills, where individuals face trade-offs in skill investments and develop school or people skills along comparative advantage.

skills have become more important for workers to operate new machines effectively. Another view is that social and outward-oriented skills have become more relevant, as that is where machines are weaker. Our evidence is consistent with the latter view. We are uncertain what exactly has been driving the increasing returns to extraversion. Deming (2017) provides convincing evidence for the role of teamwork. Other simultaneous drivers are possible. For example, Izadi & Tuhkuri (2023), building on the foundational contributions of Nelson & Phelps (1966), Welch (1970), and Schultz (1975), document the adaptive value of extraversion in the labor market.[7] As a whole, our evidence points toward explanations focusing on labor force participation of worse-performing men.

An active literature shows that noncognitive skills matter in the labor market. Besides the papers mentioned earlier, important contributions include Heckman et al. (2006), Lindqvist & Vestman (2011) and Borghans et al. (2016).[8] We show in one setting with large-scale data that extraversion predicts low school performance but good labor market performance, while conscientiousness predicts success in both. The idea that some skills can be valuable in one economic context and disadvantageous in another is also put forward by Lleras-Muney et al. (2023), who analyze the dual decision of investment in education and social capital, and Bursztyn et al. (2019) who highlight the trade-off between social-image concerns and school effort.[9]

2 Data on Psychological Traits, Education, and Work

In this paper, we estimate earnings regressions by combining military test score data with administrative tax and education records using unique person identifiers.[10]

2.1 Psychological Traits

We obtain personality and cognitive skill data from the Finnish Defence Forces (FDF). FDF has tested all conscripts since 1955 in a two-hour paper-and-pencil format in standardized group-administered conditions during military service. The conscripts take two tests: one test measures cognitive skills and the other test measures personality. Conscription is universal and mandatory, and the available data cover 79% of Finnish men born between 1962 and 1979 (N = 489,252). The test is administered in the second week of military service,

[7] Potential complementary explanations may include broader societal changes, such as a decline in the value of obedience (Bowles & Gintis, 1976) that increases the value of rule-breaking traits.

[8] See also Kuhn & Weinberger (2005), Heckman & Kautz (2012), Borghans et al. (2014), Weinberger (2014), Gensowski (2018), and more recently, Deming (2021), Weidmann & Deming (2021), Caplin et al. (2023), Navarini (2023), and Hyytinen & Soini (2024).

[9] An emerging line of research focuses on the multidimensional match between skills and tasks (Guvenen et al., 2020; Lise & Postel-Vinay, 2020; Fredriksson et al., 2018; Lindenlaub, 2017; Gathmann & Schönberg, 2010; Groes et al., 2015). These studies emphasize the potential for skill mismatch: a situation where a worker's skills are not well-matched with the skill requirements for the set of tasks.

[10] Appendix B describes the data in more detail.

at the average age of 20.[11] It is used to assess conscripts' suitability for non-commissioned officer training and to collect information for the military. Importantly, performing badly does not exempt one from service.

The data provide detailed test scores for cognitive skills (3 dimensions) and personality (8 dimensions). The cognitive test contains 120 multiple-choice questions, 40 for each dimension. The personality test contains 218 statements with a response scale of yes/no, 18–33 items for each trait. The test questionnaires have been unchanged for the timeline of the study, and the scores are designed to be comparable across cohorts.

2.1.1 Cognitive Skills

The three measured cognitive skills are visuospatial, arithmetic, and verbal reasoning. The visuospatial test is equivalent to Raven's Progressive Matrices (Raven et al., 2000). The arithmetic and verbal reasoning tests correspond to the arithmetic reasoning (AR), mathematics knowledge (MK), and word knowledge (WK) parts in Armed Forces Qualifying Test (AFQT).[12] The arithmetic test assesses various numerical skills: executing arithmetic operations, identifying patterns in number sequences, interpreting and solving brief word problems, and recognizing relationships among numbers. The verbal subtest assesses language skills, including understanding of synonyms and antonyms, categorical grouping, outlier identification in word groups, and recognition of analogous word pairs. In short, these are standard tests of cognitive performance. Nyman (2007) reports test-retest reliabilities of 0.76–0.88 for each cognitive test.

We construct one measure for cognitive skills by taking an average of the three tests. We first normalize the raw scores to have mean 0 and standard deviation 1 within each birth cohort, take the mean, and re-standardize the composite measure in the same way. Figure A1 shows the distributions of raw scores across cohorts and Figure A2 shows the cross-correlations between the standardized variables. Jokela et al. (2017) and Appendix B include a more detailed description of these data.

2.1.2 Personality Traits

The eight measured personality traits are: sociability, activity-energy, dutifulness, deliberation, achievement striving, leadership motivation, masculinity, and self-confidence.[13] The military test was developed based on the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley 1951). MMPI is one of the most widely used tests

[11] The cohorts born 1977–1979 took the personality test during enlistment.

[12] The AFQT is implemented as part the National Longitudinal Survey of Youth (NLSY) waves, and widely used in research (Neal & Johnson, 1996; Altonji et al., 2012; Deming, 2017). It is part of the Armed Services Vocational Aptitude Battery (ASVAB), not a separate test.

[13] The test and materials are in Finnish; the terms describing the traits are translations. In English, these terms vary slightly; for example, 'achievement striving' also appears as 'achievement motivation' or 'need for achievement.' We use one-word shorthands for these terms.

in psychology: At the beginning of our timeline in 2000, MMPI ranked second in the US among clinical psychologists, only behind the Wechsler Adult Intelligence Scale, and first among neuropsychologists (Camara et al., 2000; Butcher & Williams, 2009). While the testing approach is similar to MMPI, FDF did not exactly follow MMPI, which contains over 120 scales.[14]

Columns 4–6 labeled "FDF" in Table 1 summarize the personality data, describe each variable, and provide example questions that FDF uses to measure the traits. For example, sociability aims to measure "the person's level of gregariousness and preference for socializing with others" with 33 items. Answering yes to statements like "I like to be with people" and "I easily make new friends," or no to statements like "I consider myself to be reserved" counts toward higher sociability. As another example, dutifulness aims to measure "how closely the person follows social norms." Agreeing with "I set high standards for myself and expect others to do the same," and disagreeing with "You can bend the law as long as you don't break it" leads to higher dutifulness.[15]

To make our analysis tractable, we reduce the test-score data into a manageable set of personality dimensions, shown in columns 1–3 in Table 1. Extraversion is the average of sociability and activity. Conscientiousness is the average of dutifulness, deliberation, and achievement. Noncognitive skills, our summary measure, combines the first seven FDF traits, sociability, activity, dutifulness, deliberation, achievement, leadership and confidence by taking an average over the standardized personality traits. In this way, extraversion and conscientiousness are subgroups of the broader measure of noncognitive skills.

This grouping closely follows the five-factor model of personality (FFM, McCrae & John 1992; John & Srivastava 1999). The five-factor model, also known as the Big Five, is the most widely used model of personality (McCrae & John, 1992). Table 1 shows the commonly accepted facets for extraversion and conscientiousness specified in the Revised NEO Personality Inventory (NEO PI-R, Costa & McCrae 1992). Our selected FDF traits map to these facets. Sociability and activity are facets of extraversion. Dutifulness, deliberation, and achievement striving are all facets of conscientiousness.[16]

Earlier empirical evidence supports this grouping. Jokela et al. (2017) performed both FDF and FFM tests for a sample of 231 participants. They found that extraversion predicts

[14] Although the exact terms may vary, the foundational aspects of these traits are examined extensively in personality psychology (see, for example, Almlund et al. 2011; Costa & McCrae 1992; McCrae & John 1992; American Psychological Association 2007). For example, the US army introduced in 2009 a personality test, Tailored Adaptive Personality Assessment System (TAPAS; Nye et al. 2014), that measures up to 26 personality traits with 120 questions (compared to FDF test measuring 8 traits with 218 questions). TAPAS includes elements or adjectives of all our personality traits, sociability, activity, dutifulness, deliberation, achievement, leadership, and confidence, except masculinity.

[15] Nyman (2007) reports test-retest reliabilities of 0.60-0.90 for each FDF trait.

[16] The example questions from the FDF also cover topics related to warmth, positive emotions, and excitement seeking for sociability, competence and self-discipline for achievement, and order for dutifulness—essentially covering all facets of these broader traits. A possibly more precise translation of the FDF variable sociability would be gregariousness.

strongly and positively sociability and activity but negatively dutifulness and deliberation. Conscientiousness most clearly predicts positive dutifulness, deliberation, achievement, and negatively sociability. Their results support the view that extraversion and conscientiousness are different traits when defined in this way.

The remaining three traits, confidence, leadership, and masculinity, do not map unambiguously to extraversion or conscientiousness or the other factors: agreeableness, neuroticism/emotional stability, and openness to experience. Confidence appears in the NEO PI-R as an adjective for neuroticism (not self-confident, as in vulnerability to stress) and extraversion (self-confident, as in assertiveness). Leadership motivation potentially maps to extraversion (as in assertiveness). However, looking at the questions in more detail, we find that leadership motivation captures a preference to lead more than an assertive personality. It is also potentially a problematic measure because FDF uses the test to choose conscripts for leadership positions, and the testing environment may influence responses to this question more than for others.[17] Masculinity does not map to the five-factor model, and we leave it out of the analysis.

We acknowledge that our composite measures of extraversion and conscientiousness are not the only reasonable ways to group the traits.[18] In Section 3.3 we show that our main results are robust to the alternative groupings discussed above. Our measures also do not capture all potential dimensions of personality or noncognitive skills. For example, we are silent on creativity (Csikszentmihalyi, 1996) and self-efficacy (Bandura, 1997). New research in personality psychology emphasizes the value of measuring narrow traits (Paunonen & Ashton, 2001; Mõttus, 2016; Asendorpf, 2016; Vainik et al., 2019; Elleman et al., 2020). Our psychological measures are also likely measured with error, which we explore in Section 3.9. A serious limitation of our data is its exclusion of women.

Comparing our measures to the closest papers, we think our composite noncognitive skill measure maps conceptually close to Edin et al. (2022). They use a measure based on an interview conducted by a psychologist that evaluates the person's overall fitness for service on a scale between 1 to 9.[19] Our extraversion measure is conceptually similar to the social skills measure in Deming (2017). That paper measures social skills by self-reported sociability in adulthood and childhood, participation in clubs and sports in high school, and two questions that capture extraversion. The author also constructs a measure for noncognitive skills by combining the Rotter Locus of Control and the Rosenberg Self-Esteem

[17] The analysis of Jokela et al. (2017) shows that extraversion predicts leadership motivation, but leadership motivation is also negatively associated with agreeableness. Their evidence also shows that the FDF data mostly do not appear to capture the three other factors.

[18] In Izadi & Tuhkuri (2023) we conduct a factor analysis on the same data and find that dutifulness and deliberation load onto one factor and sociability, activity, achievement, leadership, and confidence load onto another.

[19] As part of the evaluation, the psychologist also evaluated four more narrow scores apparently aimed at capturing social maturity, psychological energy, intensity, and emotional stability. Fredriksson et al. (2018) and Lindqvist & Vestman (2011) use also these narrow measures.

Scale, which relate to our measures of dutifulness and confidence. Our distinct advantage is using over-time-consistent, observer-independent measures that map onto well-established personality constructs.

2.2 Labor-Market Outcomes and Background Characteristics

The project uses detailed longitudinal register data on the full Finnish population compiled by Statistics Finland from multiple sources. The register data provide yearly information on earnings, employment, labor market activity, occupation, industry, firm identifiers, demographics, and the identity of parents and siblings, for all Finnish residents.

Income data are obtained from the Finnish Tax Authority. For analysis, we focus on 'labor earnings', which is constructed by summing up wage earnings and entrepreneurial earnings. Both variables are top coded by Statistics Finland so that the top percentile in each year is assigned its median value. We deflate all values to 2015 Euros using the Statistics Finland Consumer Price Index. The distribution of labor earnings in our sample is shown in Figure A3.

2.3 Educational Records

Data on education come from three sources. The Register of Completed Education and Degrees contains exact information on the educational degrees the individual has obtained, including both the level and field, and the date at which the degree was granted. All degrees completed in Finland are generally recorded in these data. When we use 'Education Years' as a linear predictor, we map degrees onto years according to their target duration. In some regressions we control for education fixed-effects. In those cases we construct degree-field cells at the two digit level.

To relate personality traits to educational attainment in the cross-sectional analysis, we use two measures of school performance. For 9th grade GPA, we use the The Secondary Education Application Register, which contains information on the 9th-grade transcript. These data are only available for cohorts born 1975–1979. The Finnish Matriculation Examination Board Register contains test-score data by academic subject in the standardized national-level high-school exit examination, The Matriculation Examination. These data are available for all birth cohorts but only for the 40% of men who participated in the academic track. Mathematics tests have basic and advanced-level versions. We map the mathematics test scores into a single dimension by weighting the advanced and basic test scores using their predictive power on the military arithmetic test.[20]

[20] Appendix B describes this procedure in more detail.

2.4 Main Estimation Sample

Our main estimation sample consists of men aged 36–39 with valid military test scores. Our focus on this age group is natural given the available data. The final year in our tax record data is 2018, when the last military test cohort (born 1979) is 39 years old. The first military test cohort (born 1962) are 39 years old in 2001. This is the widest possible window to study. However, by including four age groups per year, we gain considerable precision at the expense of shortening the window by three years. Our final estimation window is 2001–2015. This includes approximately 479,000 individuals with a total of 1,592,000 person-year observations containing about 79% of the corresponding full population.

For most analysis, we use logarithmic labor earnings and restrict the sample to positive values. This removes 7.4% of person-year observations. Figure A3 shows the distribution of log earnings in our main sample. Selection into labor force and heterogeneous effects across the earnings distribution are an important part of our findings and discussed in the main results starting from Section 3.5. We explore these by estimating our main specification with various outcomes: earnings rank, relative earnings, and labor force participation, and by estimating quantile regressions.

3 Trends in the Returns to Psychological Traits

The primary objective of our analysis is to estimate the labor market returns to different psychological traits over time. We estimate the following types of descriptive regressions:

$$Y_{itc} = \mathbf{P}_i'\beta_t + \delta_c + \epsilon_{itc}, \tag{1}$$

where $\mathbf{P}_i$ denotes a vector of psychological traits for individual i born in year c, and Y_{itc} is an outcome of interest; primarily log income or employment. We estimate the regressions separately for each year t between 2001–2015 for our sample of males, who are aged 36–39 in that year. Each estimation includes an individual only once. The birth-year fixed effects, δ_c, are included to control for the increasing stock of traits across age groups.[21] We include all men for whom we have valid military test scores ($N \approx 479,000$).

3.1 Rising Returns to Noncognitive Skills

Our empirical analysis starts by contrasting cognitive and noncognitive skills. Figure 1 visualizes the estimates from Equation 1 using our composite measures of cognitive and noncognitive skills and log earnings as the outcome. The figure shows a secular fall in the value of cognitive skills and clear rise in the value of noncognitive skills between 2001–2015. The premium to cognitive skills begins from 18 log points per standard deviation in 2001

[21] Jokela et al. (2017) report rising trends in cognitive and noncognitive skills in our sample.

and falls by five log points to 13. In contrast, the premium to noncognitive skills begins at 7.5 log points per standard deviation in 2001 and increases to 11 by 2015. An increase of 3.5 log points.

These results align with previous research in different settings. The declining value of cognitive skills since 2001 in consistent with Beaudry et al. (2016) who observe a reduction in the employment share of cognitive tasks in the US, and with Castex & Kogan Dechter (2014) who report a decline in the returns to cognitive skills in the US using NLSY data. The study most closely related to ours, both in terms of data and institutional context, is Edin et al. (2022). Using Swedish military data they document a similar decline in the premium for cognitive skills starting in 2001, alongside an increase in wage returns to noncognitive skills during the 1990s and 2000s. Relative to our analysis, Edin et al. (2022) investigate a longer time frame starting from 1992. The largest changes in returns to skills in Sweden happen during the 1990's, but the trends for our overlapping period align closely. Our results are also consistent with Deming (2017) who finds an increase in the returns to social skills between the NLSY79 and NLSY97 cohorts.

3.2 Extraversion Is Driving the Rising Returns

Our novel psychological data allows us to investigate the trends in two components of noncognitive skills: extraversion and conscientiousness. Panel A in Figure 2 shows our main result: the return to extraversion has increased, but the return to conscientiousness has remained flat. This result suggests that the increasing return on noncognitive skills can be primarily attributed to extraversion rather than conscientiousness in our dataset. Both are valuable in themselves but their trends differ: conscientiousness's return hovers around 5 log points per standard deviation and extraversion starts from 2.5 in 2001 and increases to 7.5 in 2015. Without controlling for cognitive skills, extraversion retains a similar increase, but conscientiousness now shows a negative trend. These results strikingly illustrate that noncognitive skills are inadequately described by a single dimension.

3.3 Trends Are Robust to Different Personality Measures

As explained in Section 2, our main measures for extraversion and conscientiousness combine different traits into these broader domains. Extraversion is a combination of sociability and activity-energy; conscientiousness is a combination of dutifulness, deliberation, and achievement striving. These groupings reflect the standard association between facets and higher-level personality domains (Almlund et al., 2011), and we use them because they have an unambiguous mapping between them.

How robust are our results to different personality composites? Our detailed personality data also include measures for leadership motivation and confidence. Both could be seen as reflecting assertiveness, which in the literature is typically associated with the broader

trait extraversion (Almlund et al. 2011, p. 44). On the other hand, not being self-confident is often seen as a facet of the broader concept of neuroticism. Different conceptual and empirical divisions of personality traits are possible: for example, confidence or self-esteem could be seen as a single core attribute (Rosenberg, 1989) or as part of construct termed core self-evaluations (Judge et al., 2002).

Figure A5 shows that our main results are robust to different personality composites. In the first panel, extraversion is measured by combining four facets: sociability, activity-energy, leadership, and confidence. The increasing trend for extraversion slightly decreases, but the results are essentially unchanged. In the second panel, we redefine extraversion and conscientiousness using common factor analysis performed in Izadi & Tuhkuri (2023), grouping sociability, activity, leadership, confidence, and achievement into a single extraversion factor, and dutifulness and deliberation into a conscientiousness factor. This redefinition results in a level shift up for extraversion and down for conscientiousness, but the trends remain unchanged. In the third panel, we keep our original measures, but include a third variable that combines leadership motivation and confidence. The inclusion of this new variable slightly increases the slope of extraversion and shifts the level down, but otherwise the results are similar.

3.4 The Role of Education

Next, we examine education's contribution to these skill returns. Panel A in Figure 3 adds years of education to Equation 1. Controlling for education shifts the estimate levels dramatically, but has no influence on the trends. The return to extraversion now rises from 5 to 9 log points per standard deviation between 2001–2015. The return to conscientiousness is flat and the level is indistinguishable from zero. Both cognitive skills and education (albeit less) show declining patterns and their levels are approximately equal. In 2015, the returns to extraversion were higher than the returns to cognitive skills among men with similar levels of education.

How are education and these psychological characteristics related? Panel B in Figure 3 shows that the two dimensions of noncognitive skills—extraversion and conscientiousness—show opposite patterns when it comes to education: conscientiousness predicts higher education and extraversion predicts lower education. Cognitive skills also predict higher education: one standard deviation of cognitive skills is associated with a one more year of education.

The reason for the dramatic level shifts but unchanged trends in Panel A become apparent with the patterns in Panel B. In Panel A, education absorbs much of the positive association between cognitive skills, conscientiousness and income. Conversely, the low return to extraversion in the main specification in Figure 2 Panel A reflect partly the fact that extraverted men have lower educational attainment. Comparing men with similar levels of

education, as in Panel A, creates a much stronger correlation between income and extraversion. The stable trends in Panel A reflect the fact that in Panel B there is little change over time in the relationship between education and psychological characteristics.

These results suggest that extraversion and conscientiousness play a very different role in relation to educational attainment, a point that is further explored in Section 4.1.

3.5 Employment Is Driving the Rising Returns to Extraversion

Figure 4 investigates the predictive impact of cognitive and noncognitive skills separately on employment and income. In Panel A we estimate the linear probability model in Equation 1, where the outcome is an indicator for strong labor force attachment: positive end-of-year employment status and log earnings over 9 (about 8100 euros). In Panel B we estimate Equation 1 conditional on having strong labor force attachment. The main observation is that the difference between the trends in extraversion and conscientiousness is more pronounced at the extensive margin.

Cognitive skills' predictive effect on both employment and income has declined and noncognitive skills' has increased over the time horizon. Breaking down noncognitive skills into extraversion and conscientiousness, we find that the employment trends are driven by extraversion. In our preferred specification, controlling for cognitive skills, the effect of employment increases from 0.5 to 2.5 percentage points per standard deviation of extraversion. The employment return to conscientiousness has hovered below 2 percentage points. As is clear from Figure 4, extraversion and conscientiousness have on average similar predictive power on employment (1.3 and 1.5 percentage points per standard deviation, respectively), but the trends are different.

As an additional observation, the employment graphs show a temporary increase, a bump, in 2009. A potential explanation is the rapid increase in unemployment during the Great Recession that temporarily increased the value of cognitive and noncognitive skills at the extensive margin. The same bump is visible in Edin et al. (2022) in the same year in Sweden.

We also explore two alternative income measures: income rank and income relative to the mean ($y_{ict}/\bar{y}_{ct}$). Both can handle zero values in income. For income rank, zero refers to the lowest percentile, and for relative earnings zero mean no labor earnings. Figure A6 shows that our results are robust to using these income measures: the returns to cognitive skills slope up, noncognitive skills slope down, and the increase appears to be driven by extraversion.

3.6 Trends Are Strongest at the Bottom of the Income Distribution

Which part of the income distribution has seen the most change in returns to different psychological traits? Figure 5 shows the quantile regression estimates for cognitive skills,

extraversion, and conscientiousness (see, e.g., Angrist et al. 2006). The quantile regressions correspond to Equation 1 and include all three traits. For clarity, we present the estimates in three separate panels divided by trait. The trends are most pronounced at the lowest quintiles.

Looking at cognitive skills, the returns have declined in all three quantiles, but the drop is clearest at the 20th percentile. The return at the lowest quintile was 19 log points per standard deviation in 2001 declining to 13 log points by 2015. Concurrently, the returns at the median declined from 14 to 11 log points. For extraversion, the trends are a mirror image. The return at the lowest quintile increased sharply from 1 to 6 in 2001–2015. During the same period, the returns at the median increased considerably less, from 3 to 5. For conscientiousness, the returns have increased steadily from 4 to 5 at the median and at the 80th percentile. However, at the 20th percentile, the returns to conscientiousness have sloped downward from around 7 to 5. In all three traits, the returns across quantiles have converged almost to equality by 2015.

These results are consistent with our observations about the employment margin: most action is in the lower part of the income distribution, potentially at the employment margin or those close to the participation margin. These quantile results for noncognitive skills are consistent with Edin et al. (2022) from 2001 onward. While their rapid rise in returns to noncognitive skills is driven by the upper quantiles before 2001, their increase is driven by the lower quantiles after 2001. At the same time, their estimates indicate higher returns in the upper quantiles compared to the lower ones. In contrast, our findings, along with those of Lindqvist & Vestman (2011), suggest greater returns to noncognitive skills at the lower end of the earnings spectrum.

3.7 Interactions Between Traits Decrease

Figure 6 reports the estimates when we include interactions between traits in Equation 1. The main effects for cognitive vs. noncognitive skills are largely unchanged when including their interaction term: cognitive skill premium slopes down, noncognitive skill premium slopes up. The interaction term, however, declines from 5 to 2.5 log points.

When investigating the two different components of noncognitive skills that we can measure—extraversion and conscientiousness—we find that their interaction terms with cognitive skills and with each other have remained stable or drifted slightly downward. The only trait that slopes upward is extraversion. Compared to our main result without interactions, the yearly coefficients for extraversion are similar in magnitude. The premium for conscientiousness also remains positive at 5 log points per standard deviation when including the interaction terms, while not increasing or declining over time. The interaction term between cognitive skills and extraversion stays close to zero.

Figure A7 estimates the interactions between the psychological traits and education.

Education is scaled to standard deviations to estimate the interactions (not in years as in other figures). The results broadly echo the observations from Figure 6. None of the interactions terms show increases over time time. The only trait that clearly increases in value is extraversion. Notably, when controlling for and including the interactions with education, the returns to extraversion are far below the returns to cognitive skills in 2001 but exceed them in 2015.

3.8 Illustrating Magnitudes with Discrete Groups

To convey the scale of these effects, we categorize individuals by their levels of extraversion and cognitive skills and calculate earnings growth for different discrete skill levels. The analysis, depicted in Figure 7, covers earnings growth from 2001 to 2015. Our main observation is that the difference between the income growth for people with high vs. low extraversion is considerably larger when they have low cognitive skills. The group with high extraversion but low cognitive skills—occupying the extreme thirds—saw the most significant income rise, at 33%. In contrast, those ranking low in both traits experienced less growth at 19%. The earnings growth was 22% for individuals with high cognitive skills and extraversion and comparable for those with high cognitive skills but low extraversion, at 23%. Figure A8 reports similar results when, instead of cognitive skills, we divide the data into college vs. non-college educated workers. These data include individuals with zero earnings. The results echo conclusions from the quantile regressions.

We further examine shifts in group composition in Figure A9. The landscape of men's traits has gradually shifted: more men now score high in either cognitive skills or extraversion, but fewer rank high in both. The share of men ranking low in both traits has also declined. The groups that were either high or low in both covered 29% of the sample in 2001, but that fell to 26% in 2015. Conversely, the groups where one trait was in the upper third and the other in the lower third expanded from 15% to 18%.

3.9 Addressing Measurement Error

Potential measurement error is an important consideration in our study. The explanatory variables—cognitive skills, extraversion, and conscientiousness—may not accurately reflect their underlying concepts, such as overall cognitive performance or average performance over multiple tests. Differential attenuation caused by measurement error that varies between traits can affect the interpretation of relative magnitudes. However, we are primarily interested how earnings premiums for these traits has changed over time. Therefore, we are also primarily concerned about measurement error that changes over time. For example, if extraversion is measured more accurately (with less attenuation) in later years, this would show up as an increasing trend. We also introduce controls, which may exacerbate the role of measurement error. Dealing with measurement error is not easy in this context.

One way to get a sense of the extent of measurement error is analyzing brother correlations. If we assume that the correlation between brothers' actual skills is consistent across traits (a big if), then the difference in correlations across traits could be attributed to measurement error. Figure A10 plots the brother correlations over time. The correlations in each trait are stable and do not show trends. This observation provides suggestive evidence that measurement error in traits has not changed over time. For example, increasing brother correlation in extraversion could indicate decreasing measurement error, but we do not observe that.

The correlation in cognitive skills between brothers is approximately 0.45, and in extraversion and conscientiousness approximately 0.25. These correlations are in the same ballpark as reported by Grönqvist et al. (2017) with Swedish data (0.46 for cognitive skills and 0.31 for noncognitive skills). These differences suggest that noncognitive skills are measured with more error than cognitive skills.[22]

A possible solution to correct for measurement error is to use instrumental variables (Ashenfelter & Krueger 1994; Edin et al. 2022). Figure A11 shows the 2SLS estimates where we instrument each individual's test scores with their brother's test scores in the same trait. The trends revealed by the IV analysis are comparable to our main results, albeit imprecisely estimated and exhibiting less linear patterns. The substantial shifts in levels are examined in more detail in our cross-sectional analysis in Section 4.2.[23]

A simulation exercise is another way to understand how sensitive our results are to measurement error. Figure A12 adds simulated noise to the noncognitive skill measures. We show two types of simulations: one adds a reasonably large level of noise that keeps the results qualitatively similar, and the other shows the point at which the results start to disappear. In Panel A, this noise increases each year by 2% and 4% of the standard deviation in the variable. The added +2%, while accumulating up to 30%, does not make a big difference in the estimates. At the same time, adding 4% white noise yearly flattens the trend in noncognitive skills. These observations suggest that our results are robust to reasonable changes in measurement error. The results of this analysis should be applied in reverse: even a 2% yearly increase in measurement *accuracy* is not enough to explain our trends, even in the absence of trends in the underlying variables.

As a third approach, we bring in external information on the extent of measurement error embedded in the test itself. The test contains three validity scales adapted from the original MMPI test: L, F, and K-scales (Graham, 1990). These scales aim to measure the person's test-taking attitude and approach to the test. The L-scale intends to identify people who deliberately try to avoid answering the test honestly and in a frank manner. The F-scale

[22] Other interpretations are possible. For example, family background may influence cognitive skills more, leading to greater relative variance in personality traits within families.

[23] These IV estimates focus on variations that are common among brothers in each trait, as opposed to idiosyncratic variations, where brothers are different. Alternatively, controlling for family fixed effects (in the sample of brothers) does not reject our results, but is underpowered.

intends to detect unusual or atypical ways of answering the test items, and the K-scale aims to identify psychopathology in people who otherwise would have profiles within the normal range. F-scale could be interpreted as "faking bad," and L and K-scales as "faking good." Figure A13 controls for the validity scales. The controls bring down cognitive skill and extraversion coefficient levels, but the trends are robust.

3.10 Decomposing Trends

We decompose the observed trends into variations across and within industries, firms, occupations, and educational groups. This simple decomposition sets the stage for future research to understand what drives the increased returns to extraversion and the declining returns to cognitive skills by pointing out where it (approximately) occurred.

Table A1 shows the results. In each row, we separately control for industry, firm, occupation, and education fixed effects in Equation 1. We then compare changes in the coefficients from 2005 to 2014 with and without each set of fixed effects, following (Edin et al., 2022). We include three start and end years (2004–06 and 2013–15) to increase power. Availability of occupation codes limits our time frame to post 2004. The sample is the same for all estimates in the table, and it only includes individuals for which we can observe all fixed effects. Note that this means conditioning on employment.

For this sample, the overall increase for extraversion is 1.37 log points, and the decline for cognitive skills is 1.96 log points between 2005 and 2014. Conscientiousness does not experience significant changes over the timeline.

Three main results arise from this decomposition. First, the increase in the value of extraversion occurred mainly within industries, firms, occupations, and educational groups—rather than between them. That is, controlling for these fixed effects has a limited effect on the comparison between the beginning and end periods. Second, the decline in the value of cognitive skills happened mostly within industries, firms, and occupations, but between educational groups. Third, while the overall change in the value of conscientiousness is about zero, we observe increases within groups but declines in the residual, between-term. To summarize, the increasing overall premium to extraversion appears not to be driven by changes in the industry or occupation composition, such as rising employment in the service sector.

4 Contextualizing the Traits in School and Labor Market

We now contextualize our findings and explore the role of these psychological traits in the labor market more broadly, analyzing their effects at school and work, and on occupational sorting and labor-market participation.

4.1 Education Responds in Different Ways to Different Traits

We examine the empirical relationship between academic achievement and our detailed psychological measures and estimate:

$$H_{ic} = \mathbf{P}'_{ic}\beta + \delta_c + \epsilon_{ic}, \tag{2}$$

where $\mathbf{P}_i$ denotes a vector of skills for individual i born in year c, and H_i is an outcome of interest; selection into education or a test score measuring academic performance. We estimate regressions in the cross-section of all men for whom the relevant outcome is measured. Each individual is observed once.

Table 2 shows the OLS regression results, where all seven personality traits are used as linear predictors for educational outcomes. Each test score and personality trait is standardized within birth cohort. The first four columns analyze years of schooling, selection into high school, 9th grade GPA, and cognitive skills. The last four columns use different high-school test records as outcome variables. These test scores are from a nationwide academic track exit exam taken around age 18. The military tests are completed shortly after high school during basic training. Both tests are graded in a double-blind procedure.

A clear pattern emerges from these partial correlations: sociability and activity consistently negatively predict educational outcomes, while deliberation, dutifulness, achievement-striving, confidence, and leadership motivation positively predict academic outcomes. The traits associated with extraversion (sociability and activity) predict bad school performance, while the traits related to conscientiousness (dutifulness, deliberation, and achievement orientation) predict good school performance.[24]

The relative impact varies somewhat by subject. Achievement orientation and confidence are the strongest positive predictors, while activity and sociability are the most potent negative predictors of educational performance. Overall, these personality traits explain 19–21% of the variation in selection into education and 9–13% of the variation in different high-school test scores. The cross-correlations in Table A2 show similar patterns, while none of the predictors are negative alone.

4.2 Personality Matters in the Labor-Market

We estimate a cross-sectional earnings regression where logarithmic earnings (Y) are regressed on the intensity of cognitive skills, extraversion, and conscientiousness ($\mathbf{P}$), and in some specifications including controls ($\mathbf{X}$):

$$Y_{itc} = \mathbf{P}'_i\beta + \mathbf{X}'_{it}\gamma + \delta_{tc} + \epsilon_{itc}, \tag{3}$$

[24] Ivcevic & Brackett (2014) also document that conscientiousness predicts school performance. Almlund et al. (2011) provide an excellent review.

where i indexes individuals, c indicates birth cohort and t indexes the year when earnings are observed. The construction of the measures for cognitive skills, extraversion, and conscientiousness is described in Section 2. Year-cohort fixed effects δ_{tc} are always included to facilitate pooled cross-sectional analysis. We cluster standard errors by individual. Earnings are calculated from the tax register as the sum of inflation-adjusted wage and entrepreneurial income. For each individual, earnings are included at age 36–39 when available. The interval is chosen so that tax records exist for the last cohort (1979) in the last year of our main sample (2018).

Our main analysis sample includes all Finnish men born between 1962 and 1979, for whom we have military test records. In the baseline estimation, all predictors are normalized to have zero mean and unit standard deviation within birth cohorts.

Table 3 presents the estimates of the β coefficients for different specifications of P.[25] Column 1 shows that cognitive and noncognitive skills have independent predictive power on earnings. The standardized coefficients of both measures are statistically significant and large in magnitude. The cognitive skills have a higher earnings premium at 15.6 log points per standard deviation increase, while the premium for the noncognitive skills is 9.4 log points.

Columns 2 and 3 investigate the different components of noncognitive skills. The partial returns to extraversion and conscientiousness are about equal at 4.7 and 5.4 log points, respectively, per one standard deviation increase when controlling for cognitive skills. The coefficient for cognitive skills stays essentially unchanged when dividing up noncognitive skills into two components. Without controlling for cognitive skills, the coefficient for extraversion is almost unchanged (now 5.4), but the coefficient for conscientiousness increases to 10.3.

Columns 4 and 5 display the estimates with the inclusion of a measure for years of schooling. Alone, the descriptive returns to an extra year of education is 9.8 log points, which is consistent with literature (Card, 2001). When controlling for education, extraversion's coefficient increases to 6.5, but the coefficient for conscientiousness becomes zero.

Table 4 divides the analysis into the extensive vs. intensive margin— employment and income conditional on employment. We define a worker as employed if they were employed at the end of the year and their yearly log earnings were above 9 (about 8100 euros), effectively excluding workers with a weak attachment to the labor market. The income estimates are now smaller but similar. Specifically, a one standard deviation increase in cognitive traits, extraversion, and conscientiousness raises earnings by 0.123, 0.039, and 0.045, respectively. Employment probabilities improve by 4.7 percentage points for one standard deviation in cognitive traits, 1.3 for extraversion, and 1.5 for conscientiousness. Given the baseline nonemployment rate of 17%, these effects are non-trivial, and comparable in magnitude to

[25] Table A3 shows that the observed patterns are robust to using levels of earnings.

the 5% employment decline observed during the 2008–09 Great Recession (Figure A4).

While the extensive margin appears to be much more critical than the intensive margin for our trends, we do not observe such a clear difference between traits here in the pooled cross-section of prime-age men. The relative magnitudes of the coefficients for different traits are comparable for earnings and employment.

Table A2 presents the brother IV estimates discussed in the previous section concerning trends, where we instrument the individual's traits with their brother's traits. The 2SLS estimates are different from the OLS in one significant way: the value of extraversion increases from 0.047 to 0.145. In contrast, the returns to cognitive skills and conscientiousness are almost unaffected. When controlling for education, the return to extraversion increases and the return to conscientiousness even becomes negative, -0.072. One interpretation of these IV results is that they reflect the true partial returns to these traits by correcting for measurement error. In this view, extraversion is just as important predictor of labor market success as cognitive skills.

4.3 Diverging Paths to Success for Different Personalities

This section analyzes occupational sorting, workers' educational paths, work experience, career advancement, and job performance within occupations.

4.3.1 Occupational Sorting

How do cognitive skills and personality traits predict selection into occupations? We now estimate Equation 3 with indicators for different occupations as the response variables. Table 5 presents the results showing how psychological characteristics strongly predict occupational sorting.

Cognitive skills predict working in a professional job, such as an economist, medical doctor, lawyer, or engineer. A one standard deviation increase in cognitive skill increases that likelihood by 12.5 percentage points at age 35. Relative to the baseline of 21%, this number corresponds to a 60% rise in the probability of working in a professional occupation. Cognitive skills also positively predict working in a technical or clerical position (3.8 pp) or as a manager (3.1 pp).[26] In contrast, cognitive skills predict a lower likelihood of working in a production job (14.8 pp) or service and sales (1.7 pp).

Extraversion predicts working as a manager (2.4 pp) but not in a professional job (-2.9 pp). Compared to the baseline, the likelihood of working as a manager increases by 34%, and the likelihood of working as a professional declines by 14%. Extraversion also positively predicts working in service and sales or a technical or clerical role. It also predicts a slightly lower likelihood of working in production (-0.8 pp).

[26] Our definition of managers excludes small-business owners who perform employee-type work in the firm, such as owners of small trucking firms.

Conscientiousness predicts similar patterns as cognitive skills: a higher likelihood of working in a professional job, as a manager, or in a technical or clerical role, and a lower probability of working in service, sales, or production.

These results are also reflected in the average incomes of the occupations, shown in Column 7. One standard deviation higher cognitive skills predict working in a 5,796 euros higher paid occupation. In contrast, extraversion has only limited predictive power on the average occupational income and predicts only 431 euros higher income in the occupation. For conscientiousness, the coefficient is 2,761 euros. The average yearly income in our sample is 45,557 euros. In other words, despite earning more themselves, extraverted men do not work in particularly high-paying occupations (except for managers).

Similar patterns also arise when looking at how the composite traits predict educational attainment, echoing Table 2. Cognitive skills and extraversion have the opposite impacts on years of education. A one standard deviation increase in cognitive skills predicts a 1.04 increase in the years of schooling. Conversely, a one standard deviation increase in extraversion predicts a 0.22 decrease in the years of education. Unlike cognitive skills, extraversion predicts sorting toward low-skill occupations.

Table A4 shows the premia to cognitive skills and personality within broad occupational groups. We divide the data into occupational categories and estimate the relationship between the traits and log income within each group. Note that this analysis mutes any returns the skills have through selection into broad occupational categories. The returns to cognitive skills increase by occupational status: they are highest for managers (14.2), second highest for professionals and technical and clerical workers (7.9 and 8.3), and less significant in service, sales, and productions (4.8 and 3.1). Conscientiousness follows the patterns for cognitive skills. In contrast, the returns to extraversion are more similar across occupations: highest in service and sales (5.7) and lowest in production (1.6). We do not observe particularly high returns for managers' extraversion. These estimates are broadly consistent with sorting based on comparative advantage: selection into occupations and occupational returns follow approximately similar patterns.

4.3.2 Productive Activities from Early to Mid Adulthood

How do psychological traits predict how men spend their years between 18 and 39? The response variables in Table 6 are cumulative years spent in the given activity from age 18 to 38. Columns 1–4 represent an exhaustive and mutually exclusive list of principal activities, as recorded annually by Statistics Finland for each individual. By construction, each row sums to zero, and in the regression, each man is only observed once.

The results indicate that a cognitive test score one standard deviation above the mean is associated with an additional 0.74 years spent studying[27] and 0.71 years less nonemploy-

[27] 'Years spent studying' is distinct from 'years of education,' which counts the completed degrees and

ment. However, cognitive skills have limited predictive power regarding work experience: one standard deviation in cognitive skills predicts 0.1 additional years of work experience. In other words, for men with high cognitive ability, time spent studying is offset by reduced nonemployment instead of reduced work experience.

In contrast, a one standard deviation increase in extraversion is associated with 0.32 fewer years of studying, 0.43 more years of work experience, and 0.12 fewer years of nonemployment relative to the average individual. For extraverted men, the increase in work experience is offset by reductions in both nonemployment and studying time.

The patterns for conscientiousness are slightly different from those of cognitive skills. One standard deviation increase in conscientiousness predicts 0.48 more years spent studying, 0.43 years less nonemployment, and 0.05 years less work experience.

Summarizing the evidence so far, men with an extraverted personality start their careers earlier and accumulate more work experience by avoiding nonemployment and skipping education. They are more likely to end up in managerial positions relative to their peers. They enjoy an earnings premium, even without being in particularly high-paying occupations. Conversely, those with high cognitive ability educate themselves without compromising work experience. Compared to average individuals, they are more likely to be employed in high-paying, professional, and managerial occupations.

Together, we interpret this as suggestive evidence that while cognitive skills, extraversion, and conscientiousness all benefit workers, they do so by guiding them onto different paths in the labor market. Extraversion aids in gaining work experience with less schooling, whereas cognitive ability and conscientiousness help workers start higher up the career ladder.

4.3.3 Narrowing the Comparison Group with Fixed Effects

We next progressively include fixed effects for education, occupation, industry, and firm in Table 7. The table notes provide more information on their level of granularity. This exercise speaks to the question: How much is the return to a psychological trait valuable in any job vs. through sorting?

Overall, the controls quickly reduce the coefficients of conscientiousness and cognitive skills, but the coefficient of extraversion remains large. This observation suggests that the premium for conscientiousness and cognitive skills arises from sorting into profitable education paths and occupations. The premium for extraversion is less affected by educational or occupational sorting.

In more detail, the premium for cognitive skills drops by 2/3 when controlling for education or occupation. When comparing men with the same education, occupation, industry,

their expected duration. For example, a year in community college without graduation is considered study activity, not completed education.

and firm, cognitive skills' return is 1/8 of its unconditional return. This evidence suggests that most of the returns to cognitive skills are linked to selection into jobs, rather than predicting higher earnings within jobs.

The returns to extraversion react only little to the controls. Even with all fixed effects, the return to extraversion is a significant 2.9, down from 4.9. This result implies that extraverted (one standard deviation above the mean) employees earn 2.9 log points more than their colleagues with the same occupational and educational background, even within the same firm. Within jobs, the premium to extraversion remains economically significant and exceeds the premium to cognitive skills. In contrast, the returns to conscientiousness reduce to zero with controls for education and close to zero with occupation. While conscientiousness positively predicts earnings without controls, it does not predict higher earnings within a job.

These observations also matter for interpreting our decomposition in Table A1. We found there that most increases in the value of extraversion happened across educational groups, occupations, industries, and firms. These results show that it is not because these controls removed the returns to extraversion.

Three caveats merit discussion. First, outcomes such as firm, education, and occupation are fundamentally *bad controls* because our psychological measures influence them. There are likely to be unobservable reasons why different types of men end up in similar jobs. If these unobservables influence earnings, it will bias the estimate for the returns to traits *even* if personality was a randomly assigned endowment. Second, the granularity of the fixed-effect variables matters for the size of the coefficients. For this reason, we focus on the relative magnitudes. Third, the traits are likely measured with error, and including controls may exacerbate the noise compared to their signal. However, based on the brother correlations in Figure A10, we do not expect measurement error to differ between extraversion and conscientiousness.

5 Discussion

Our main findings—the decline in the cognitive skill premium and the rise in the extraversion premium—are broadly consistent with the demand-side explanations put forward by Beaudry et al. (2016), Deming (2017), and Brynjolfsson & McAfee (2014). Together, they suggest that post-2000, the demand for cognitive skills decelerated, possibly due to the conclusion of the adoption phase of cognitively intensive technologies (the end of the IT boom) or because newer technologies began to substitute for high-cognitive tasks more effectively. Concurrently, the demand for tasks necessitating teamwork and interpersonal skills fueled the increasing returns to social skill.

Shifts in the relative prices of skills could precipitate changes in their supply. In Ap-

pendix C, we flesh out this idea with a model of endogenous skill formation, building on our cross-sectional observation that skills are valued differently in educational settings compared to the labor market. In our model, individuals face a tradeoff between investing in social skills versus formal education. We think of high school as a natural setting for these choices, where students can focus on studying or social life (Lleras-Muney et al., 2023). This framework helps clarify the interplay between personality, education, and labor market outcomes.

If there is an exogenous relative increase in the premium for social skills, the model predicts that students will increasingly specialize in the skill where they have a comparative advantage. Figure A9 demonstrates this trend in our data. It shows that high or low values in *both* cognitive skills and extraversion are becoming less common. Conversely, specialization into either one is becoming more common. These changes take place mostly in the latter half of our observation period, perhaps reflecting a delayed signal of the changing demand for these skills.

Another prediction arising from the model is that we should see the largest earnings gains for those who already have the strongest comparative advantage in developing social skills, that is, those with high extraversion and low cognitive skills. Likewise, gains should be lowest for the opposite bundle. Earnings gains for those with equal trait endowments should fall somewhere in between. This result is demonstrated in Figures 7 and A8.

6 Concluding Remarks

This study used unique data on personality and cognitive skills for half a million Finnish men linked to their labor-market records to analyze how the returns to different dimensions of personality have changed over time.

We found that economic returns to extraversion have rapidly increased over the past two decades. In comparison, returns to cognitive skills have declined, and returns to conscientiousness have been stable. The increased returns to extraversion are primarily observed at the lower end of the earnings distribution and in employment rates. Extraverted men with low cognitive skills have experienced the highest earnings gains.

To contextualize our findings, we analyzed the role of cognitive skills, extraversion, and conscientiousness in the labor market more broadly. We found that these traits predict different paths in the labor market. More extraverted men perform worse in school and complete less education but still perform well in the labor market. In contrast, cognitive ability and conscientiousness predict sorting into highly educated and high-paying jobs. Despite predicting different paths, extraversion and conscientiousness lead to similar earnings.

A central limitation of our analysis is the lack of data on women. To what extent would our results extend to women? Based on earlier research, we suspect that it is not obvious that our findings would hold for women. Some evidence points to baseline gender differences

in personality traits and noncognitive abilities (Weisberg et al., 2011). During childhood, boys generally display more externalizing behavior and inferior social skills (Bertrand & Pan, 2013; Autor et al., 2019b). In adulthood, men tend to be less agreeable and exhibit greater emotional stability than women. Differences in adult extraversion and conscientiousness appear to be smaller, but women tend to score higher in both (Weisberg et al., 2011; Keiser et al., 2016).

Equally important, the relationships between personality traits and life outcomes may vary by gender. For instance, Papageorge et al. (2022) discover that while externalizing behavior boosts earnings for both genders (through different mechanisms), it only reduces educational attainment in men. Similarly, Almlund et al. (2011) demonstrate that extraversion correlates with fewer years of schooling solely in men. Levine & Rubinstein (2017) do not examine their "smart and illicit" hypothesis by gender but reveal that men predominantly drive selection into incorporated entrepreneurship, an indicator of success. The precise reasons for these gender disparities remain uncertain. However, it is conceivable that noncognitive skills have distinct impacts on men and women, influenced by social dynamics, gender norms, occupational preferences, and educational resources.

Furthermore, these trends' underlying causes may impact women and men distinctively. Our findings document that the increased importance of extraversion mainly relates to the employment prospects of low-earning men. This prompts a question: Are our observations specific to men's labor market opportunities in recent decades, or do they reflect a wider phenomenon also relevant to women? (see, Autor & Wasserman 2013; Autor et al. 2019a). Exploring this topic further presents a compelling avenue for future research.

Our results are descriptive. If they signal similar causal relationships, they could provide insights for policy. The big picture is that the economic returns to skills may have changed. As policymakers and society consider which skills are helpful for the work of the future (The New York Times, 2023), these results indicate that the value of cognitive skills may have declined, and the value of action-oriented personality, extraversion, sociability, and activity may have increased. We are hesitant to make strong policy conclusions before more research is conducted. However, the mounting evidence on the apparent disparity between what is helpful in school vs. the labor market warrants a cautious suggestion against losing hope in boys who exhibit bad school performance due to their action-oriented personalities.

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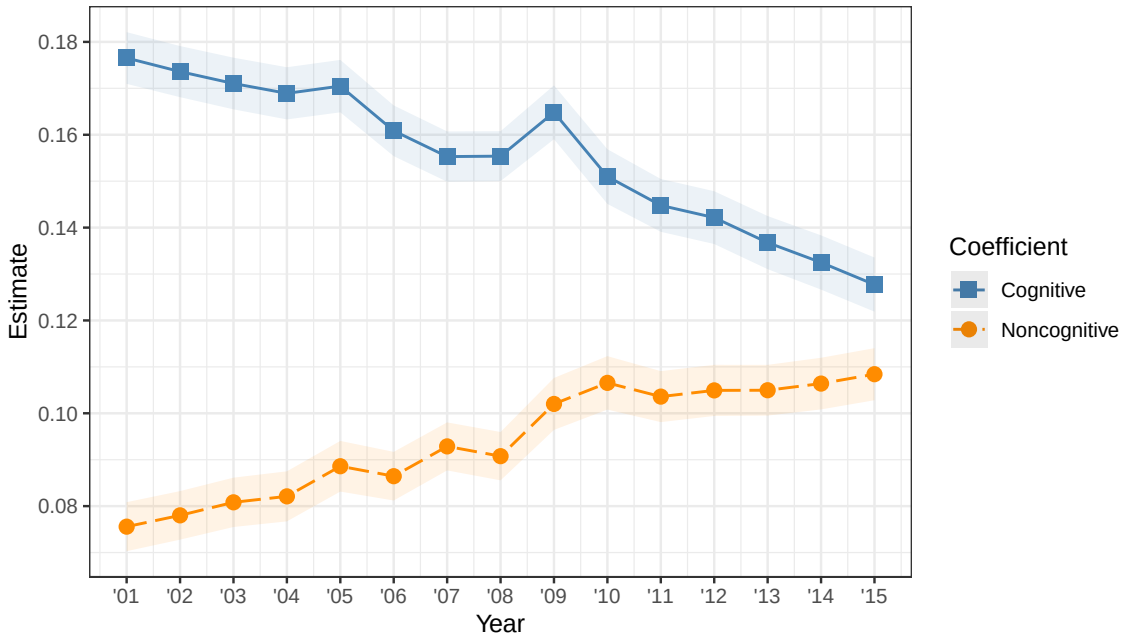
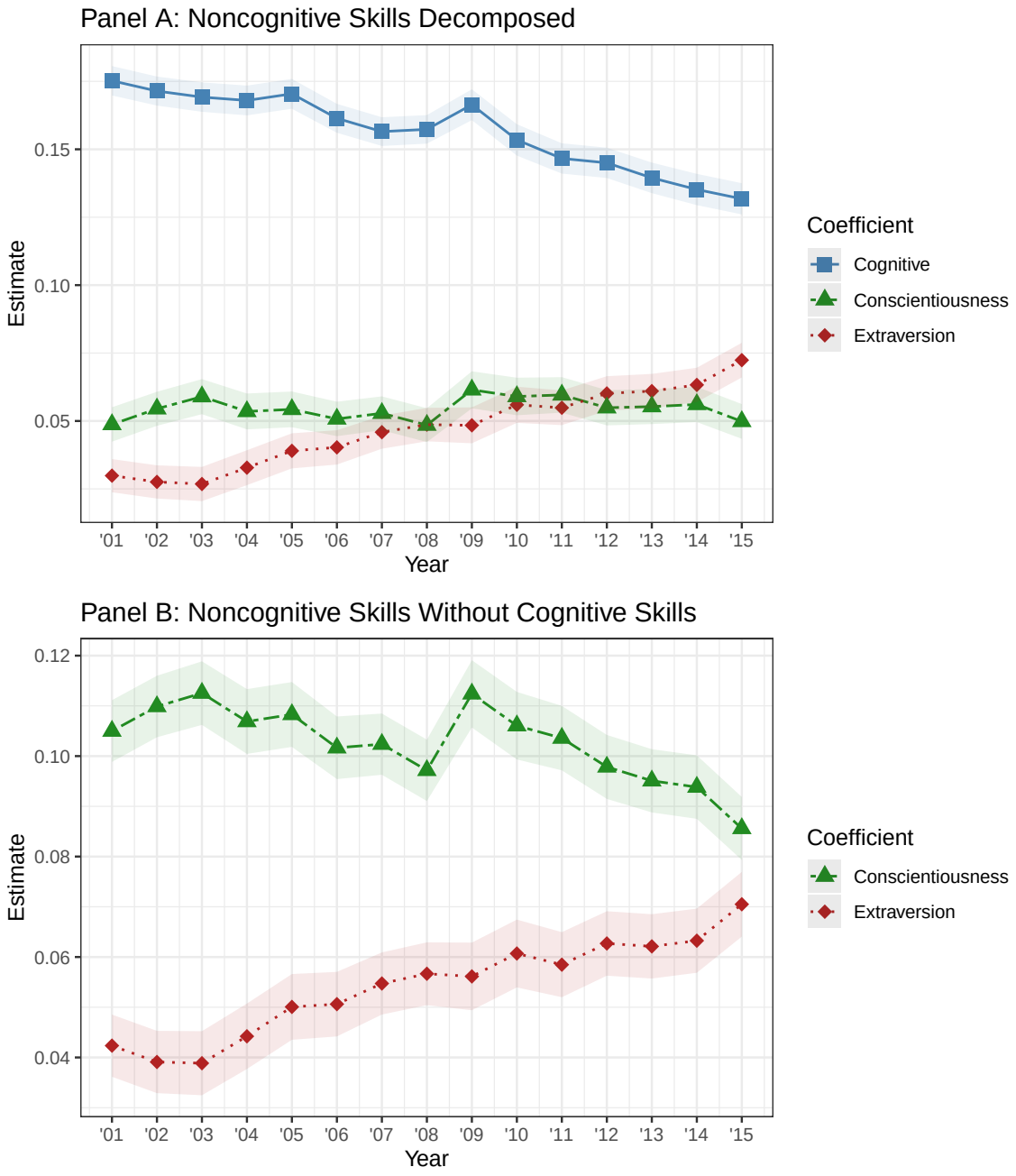
Main Figures and Tables

Figure 1: Evolution of Skill Premia for Cognitive and Noncognitive Skills



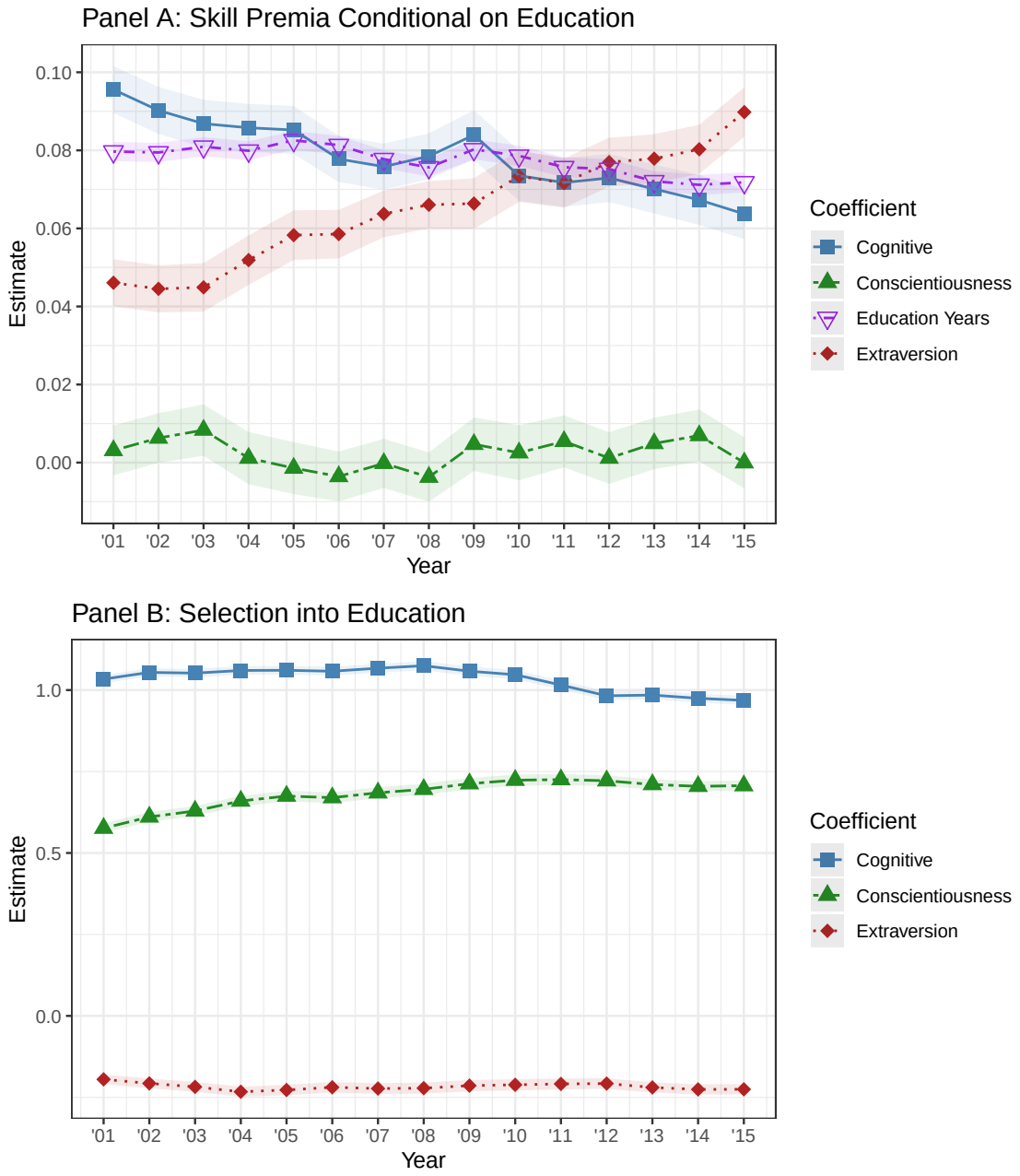
Notes: Each point in the figure corresponds to a regression coefficient from estimating Equation 1 separately for each year, with the individual as the unit of observation. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations). The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Noncognitive' is the mean of sociability, activity-energy, dutifulness, deliberation, achievement striving, leadership motivation, and self-confidence. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Construction of the composite measures is described in more detail in Section 2. Confidence bands are based on robust standard errors. Back to Section 3.1.

Figure 2: Differential Evolution of Skill Premia for Extraversion and Conscientiousness



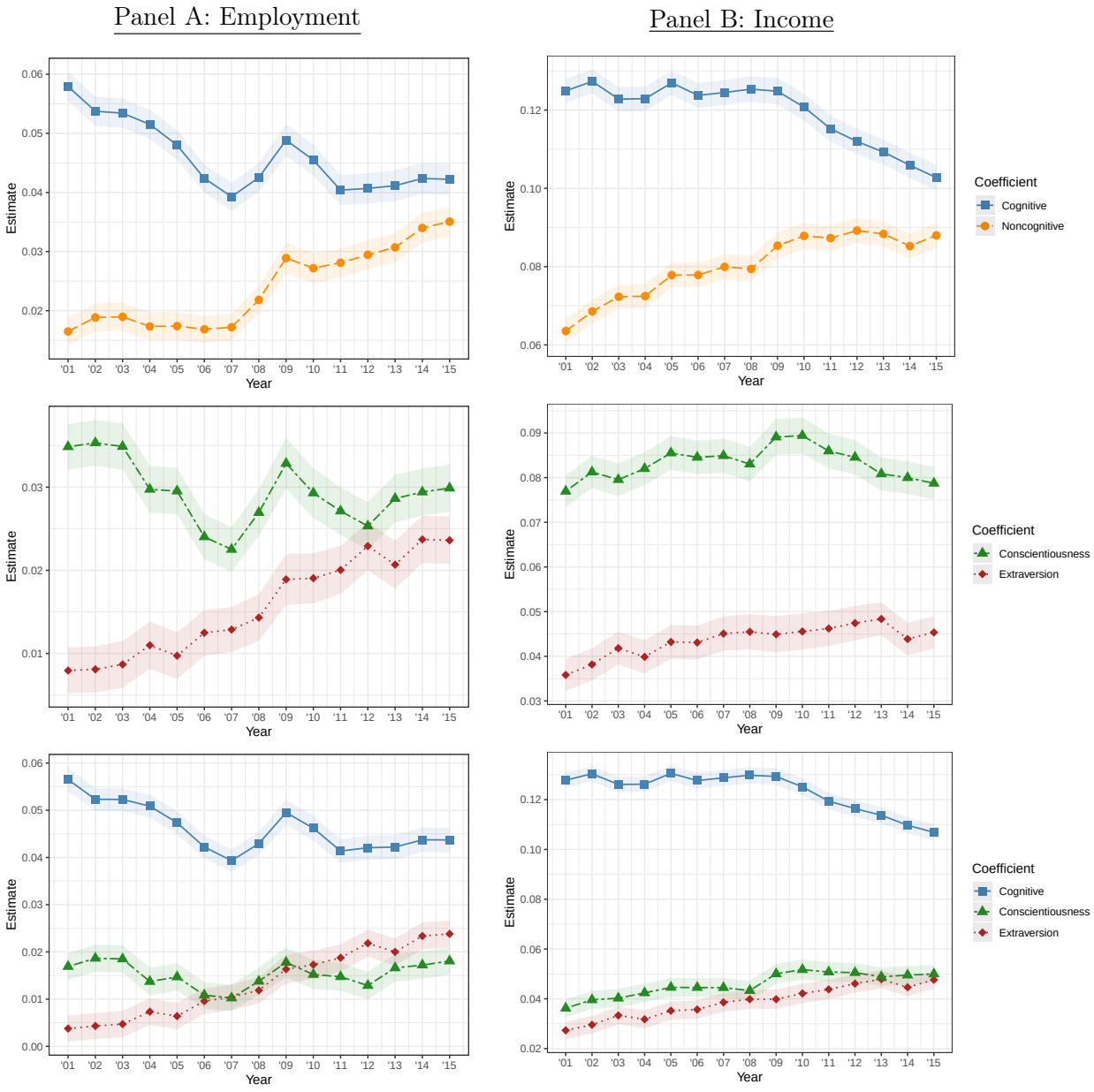
Notes: Each point in the figure corresponds to a regression coefficient from estimating Equation 1 separately for each year, with the individual as the unit of observation. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations). The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Construction of the composite measures is described in more detail in Section 2. Confidence bands are based on robust standard errors. Back to Section 3.2.

Figure 3: Changes in Returns to Education Are Not Driving the Trends



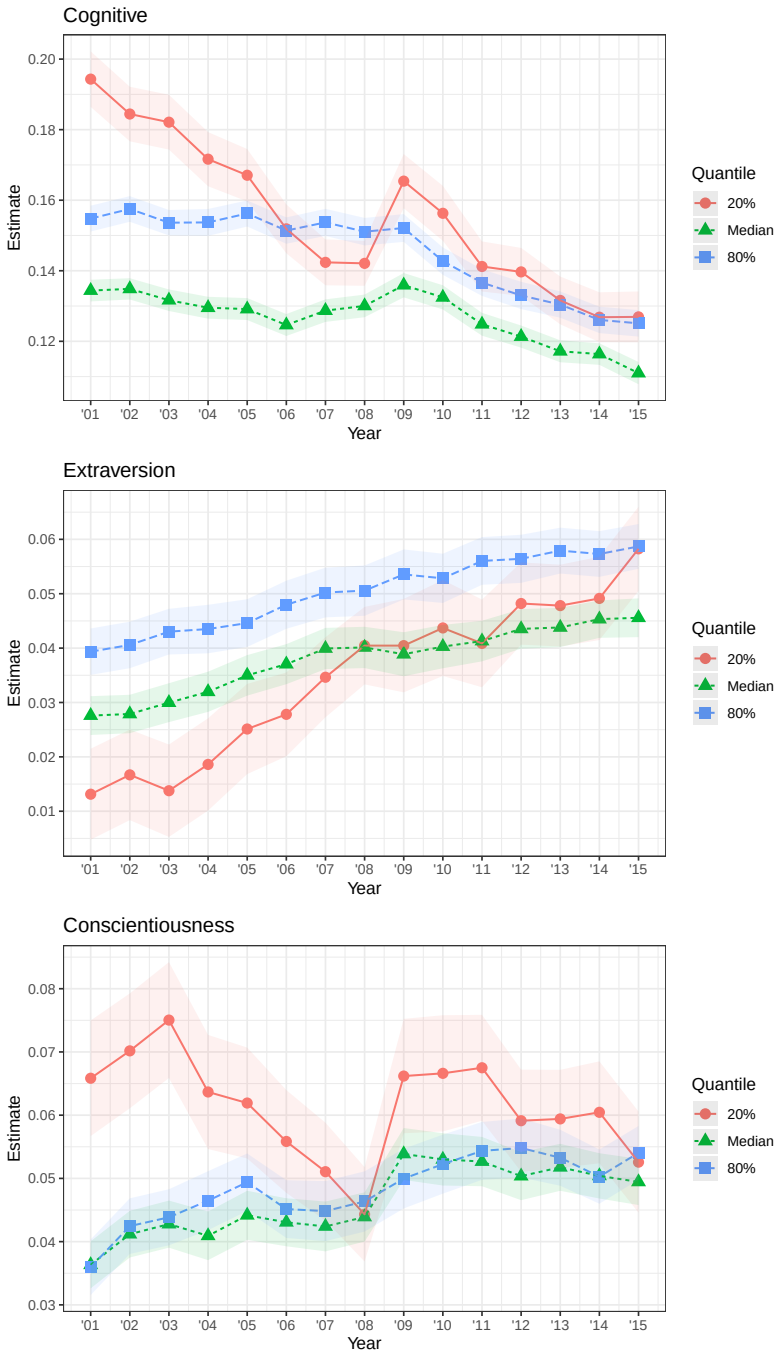
Notes: Each point in the figure corresponds to a regression coefficient from estimating Equation 1 separately for each year, with individual as the unit of observation. The outcome variable is indicated at the top of the plot. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations) in Panel A. The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. 'Noncognitive' is the mean of all seven traits available in the data and described in Section 2. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Confidence bands are based on robust standard errors. Back to Section 3.4.

Figure 4: Selection into Employment vs. Income Conditional on Employment



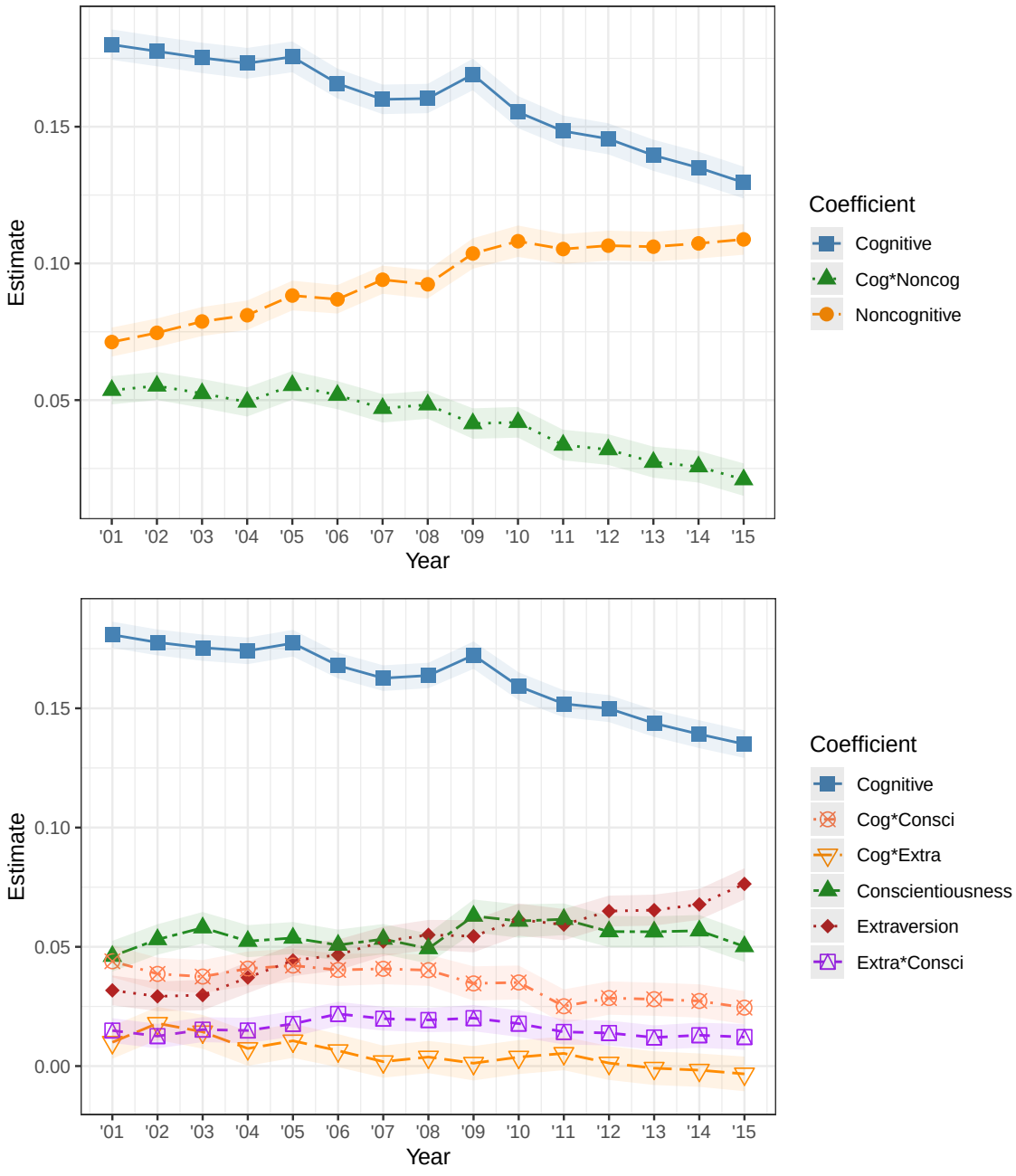
Notes: Each point in the figures correspond to a regression coefficient from estimating Equation 1 separately for each year, with individual as the unit of observation. In Panel A, the outcome is an indicator for strong labor force attachment: positive end-of-year employment status and log earnings in excess of 9 (about 8100 euros). In panel B, the outcome is log earnings conditional on having strong labor force attachment. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations). The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Construction of the composite measures is described in more detail in Section 2. Confidence bands are based on robust standard errors. Back to Section 3.5.

Figure 5: Quantile Regression Estimates



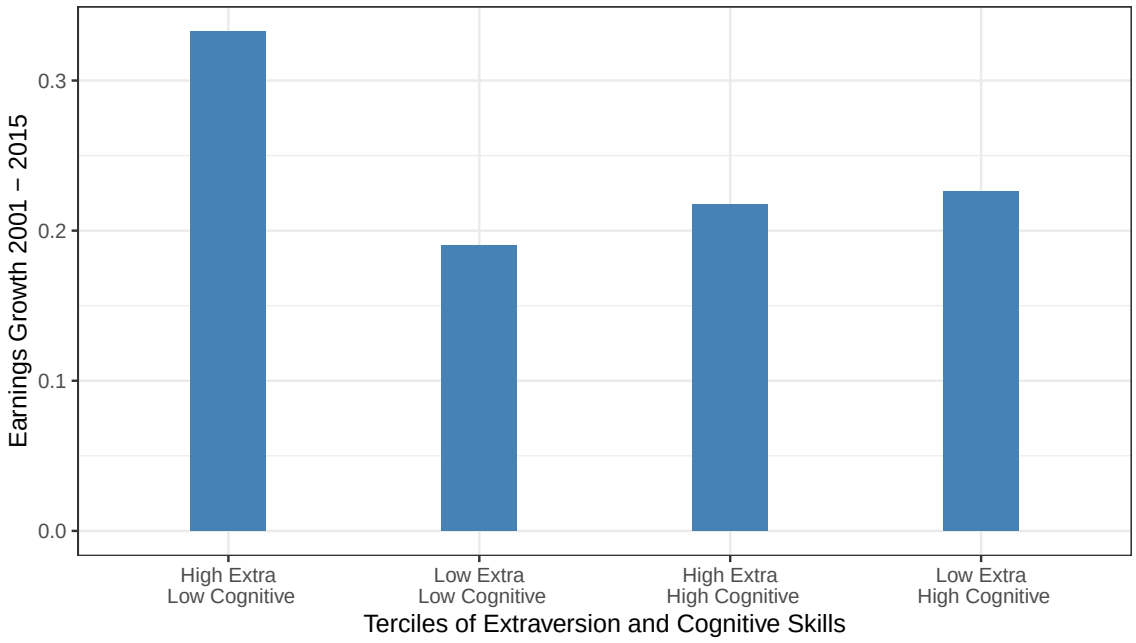
Notes: Each point in the figures correspond to a quantile regression coefficient estimated separately for each year, with individual as the unit of observation. The coefficients are split across three figures for clarity, but in each regression, all traits are included as explanatory variables. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations). The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Construction of the composite measures is described in more detail in Section 2. Confidence bands are based on robust standard errors. Back to Section 3.6.

Figure 6: Evolution of Skill Interactions



Notes: Each point in the figure corresponds to a regression coefficient from estimating Equation 1 separately for each year, with individual as the unit of observation. Interaction terms are included as indicated in the legend. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations). The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. 'Noncognitive' is the mean of sociability, activity-energy, dutifulness, deliberation, achievement striving, leadership motivation, and self-confidence. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Construction of the composite measures is described in more detail in Section 2. Confidence bands are based on robust standard errors. Back to Section 3.7.

Figure 7: Earnings Growth by Extraversion and Cognitive Skills



Notes: Each bar corresponds to the change in median earnings of that bundle in year 2015 relative to the base year 2001. The 'High Extra, Low Cognitive' bundle includes persons who belong to the top tercile in extraversion and the bottom tercile in cognitive skills within their birth cohort. Other labels follow a similar logic. Individual earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. The sample contains males aged 36–39 with approximately 100,000 observations at the start and end years. Personality traits and cognitive ability are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. Back to Section 3.8.

Table 1: Personality Measures

Measure	APA Description	NEO Facets	FDF Trait	FDF Description	FDF Example Statements
Extraversion	"an orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experience; characterized by positive affect and sociability"	Gregariousness Activity Excitement-Seeking Positive Emotions Warmth Assertiveness	**Sociability** (33 items)	The person's level of gregariousness and preference for socializing with others.	1) I consider myself to be reserved. 2) I like to be with people. 3) I easily make new friends.
			Activity (28 items)	How much the person exerts physical effort in daily activities and how quickly prefers to execute activities.	1) I usually work quickly and energetically. 2) I like to linger over lunch.
Conscientiousness	"the tendency to be organized, responsible, and hard working"	Dutifulness Deliberation Achievement striving Competence Self-Discipline Order	**Dutifulness** (18 items)	How closely the person follows social norms.	1) I set high standards for myself and expect others to do the same. 2) You can bend the law as long as you don't break it.
			Deliberation (26 items)	How much the person prefers to think and plan ahead.	1) I usually don't try my luck if success seems doubtful. 2) I prefer to plan ahead.
			Achievement (24 items)	How strongly the person wants to perform well and succeed.	1) I would like to achieve something really significant. 2) I find it important to succeed.
(Neuroticism/Extraversion)		*(Vulnerability to stress/Assertiveness)*	Confidence (32 items)	The person's self-esteem and beliefs about his own abilities.	1) I feel I am just as good and capable as other people. 2) Critique makes me uncomfortable.
(Extraversion)		*(Assertiveness)*	Leadership (30 items)	Preference for taking charge in groups and influencing people.	1) I am often the one who leads among friends. 2) I prefer to follow along.
–			Masculinity (27 items)	Interests traditionally associated with masculinity (vs. femininity).	1) I enjoy reading love stories. 2) I don't daydream much.

Notes: This table maps our main measures to the FDF Traits and includes descriptions and example statements. The descriptions for the traits are obtained from the American Psychological Association Dictionary. The facets come from the five-factor (NEO-PI-R) personality inventory (Costa & McCrae, 1992). The FDF descriptions are from Jokela et al. (2017) and examples from the FDF. The table builds on John & Srivastava (1999) and Almlund et al. (2011). Back to section 2.1.2.

Table 2: Personality and Academic Performance

					High School Test Scores			
	Educ. Years	In HS	9th gr. GPA	Cognitive	Math	Verbal	Electives	HS GPA
Sociability	−0.331	−0.052	−0.195	−0.188	−0.254	−0.147	−0.204	−0.203
	(0.006)	(0.001)	(0.004)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Activity	−0.535	−0.120	−0.234	−0.190	−0.135	−0.248	−0.197	−0.279
	(0.005)	(0.001)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)	(0.003)
Deliberation	0.180	0.002	0.047	−0.082	0.110	0.064	0.088	0.066
	(0.004)	(0.001)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Dutifulness	0.286	0.070	0.192	0.105	0.017	0.113	0.092	0.096
	(0.005)	(0.001)	(0.004)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Achievement	0.648	0.112	0.305	0.286	0.192	0.171	0.201	0.227
	(0.005)	(0.001)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)	(0.003)
Confidence	0.488	0.088	0.232	0.359	0.259	0.126	0.159	0.191
	(0.005)	(0.001)	(0.004)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Leadership	0.297	0.088	0.107	0.125	0.072	0.123	0.152	0.136
	(0.006)	(0.001)	(0.005)	(0.002)	(0.005)	(0.005)	(0.005)	(0.004)
Outcome mean	12.940	0.360	0.000	0.000	0.000	0.000	0.000	0.000
Cohort FE	yes	yes	yes	yes	yes	yes	yes	yes
Adj. R^2	0.184	0.194	0.235	0.210	0.089	0.076	0.097	0.104
Observations	480803	483303	126651	483303	164438	164790	157853	170512

Notes: Each column reports the OLS regression results from Equation 2. The column name indicates the outcome. Estimates in each column are from the same multivariate regression. The unit of observation is the person. Sample includes men born in 1962-1979 with valid personality test scores (79% of all men). Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. The standardized high school (HS) tests are administered by the Matriculation Examination Board before military service. HS test scores are available only for the academic track (see "In HS" column for selection into high school). 9th grade GPA is available only for cohorts 1975-1979. Test scores and personality traits are standardized to have mean 0 and standard deviation 1 within cohorts. All models control for the birth year (cohort) fixed effects. Robust standard errors are reported in parentheses. Back to Section 4.1.

Table 3: Personality and Earnings

	Dependent Variable: Log Earnings				
	(1)	(2)	(3)	(4)	(5)
Variables					
Cognitive	0.156		0.159		0.079
	(0.001)		(0.001)		(0.001)
Noncognitive	0.094				
	(0.001)				
Extraversion		0.054	0.047		0.065
		(0.001)	(0.001)		(0.001)
Conscientiousness		0.103	0.054		0.002
		(0.001)	(0.001)		(0.001)
Education Years				0.098	0.078
				(0.0004)	(0.0005)
Fixed-effects					
Year-Cohort (60)	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	1,463,502	1,469,611	1,469,611	1,473,806	1,469,611
R^2	0.07500	0.04171	0.07446	0.09759	0.11284
Within R^2	0.06404	0.03021	0.06335	0.08668	0.10220
Dep. Mean	10.4	10.4	10.4	10.4	10.4

Notes: Each column reports the OLS regression results from Equation 3, with person-year as the unit of observation. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations). The sample contains males aged 36–39 in years 2001-2015. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. 'Noncognitive' is the mean of sociability, activity-energy, dutifulness, deliberation, achievement striving, leadership motivation, and self-confidence. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Standard errors are clustered at the individual level and reported in parentheses. Back to Section 4.2.

Table 4: Intensive vs. Extensive Margin

Dependent Variables:	Log Earnings		Employed	
	(1)	(2)	(3)	(4)
Variables				
Cognitive	0.123	0.060	0.046	0.024
	(0.0007)	(0.0007)	(0.0005)	(0.0006)
Extraversion	0.039	0.052	0.013	0.018
	(0.0008)	(0.0008)	(0.0006)	(0.0006)
Conscientiousness	0.045	0.005	0.015	0.0006
	(0.0008)	(0.0008)	(0.0006)	(0.0006)
Education Years		0.060		0.022
		(0.0003)		(0.0002)
Fixed-effects				
Year-Cohort (60)	Yes	Yes	Yes	Yes
Fit statistics				
Observations	1,329,039	1,329,039	1,587,535	1,587,535
R^2	0.13567	0.20290	0.02694	0.04147
Within R^2	0.11452	0.18339	0.02561	0.04016
Dep. Mean	10.6	10.6	0.840	0.840

Notes: Each column reports the OLS regression results from Equation 3, with person-year as the unit of observation. The first two columns report estimates with log earnings as the outcome estimated in a subsample with strong labour force attachment (employed at the end of year and yearly log earnings above 9 or about 8100€). The last two columns report estimates from a linear probability model with strong labor force attachment as the outcome. The sample contains males aged 36–39 in years 2001-2015. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Standard errors are clustered at the individual level and reported in parentheses. Back to Section 4.2.

Table 5: Occupational Sorting

Dependent Variables:	Managers	Professional	Tech./Clerical	Serv./Sales	Production	Other	Mean Inc.	Educ. Y.
ISCO classes:	(1)	(2)	(3–4)	(4–5)	(7–8)	(0,6,9)		
Variables								
Cognitive	0.031	0.125	0.038	-0.017	-0.148	-0.029	5,796	1.04
	(0.0004)	(0.0007)	(0.0007)	(0.0005)	(0.0008)	(0.0005)	(28.2)	(0.011)
Extraversion	0.024	-0.029	0.011	0.014	-0.008	-0.013	431	-0.217
	(0.0005)	(0.0008)	(0.0008)	(0.0005)	(0.0009)	(0.0005)	(31.9)	(0.005)
Conscientiousness	0.009	0.069	0.012	-0.009	-0.082	0.0008	2,761	0.674
	(0.0005)	(0.0008)	(0.0009)	(0.0006)	(0.0010)	(0.0005)	(33.0)	(0.014)
Fixed-effects								
Year-Cohort	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Cohort								Yes
Fit statistics								
Observations	1,036,325	1,036,325	1,036,325	1,036,325	1,036,325	1,036,325	829,897	483,065
R^2	0.03611	0.13585	0.01385	0.01008	0.16260	0.01898	0.24211	0.29885
Within R^2	0.03354	0.13217	0.01349	0.00550	0.15865	0.01765	0.21368	0.28973
Dep. Mean	0.070	0.210	0.210	0.080	0.360	0.070	45,557	12.9

Notes: Each column reports the OLS regression results from Equation 3, with person-year as the unit of observation. The column name indicates the outcome. Each outcome variable is an indicator of working in the given occupation (at the end of the calendar year). Sample is limited to individuals with valid occupation codes, which become available in the data after 2003. The outcome 'Mean Inc.' measures the average earnings of all other men employed in the same occupation-education cell in the same year. Only cells with 100+ observations are included. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Standard errors are clustered at the individual level and reported in parentheses. Back to Section 4.3.1.

Table 6: Cumulative Activity, Ages 18–39

Dependent Variables:	Work Experience (1)	Study (2)	Nonemployment (3)	Other (4)
Variables				
Cognitive	0.103	0.740	-0.711	-0.145
	(0.007)	(0.003)	(0.005)	(0.003)
Extraversion	0.434	-0.317	-0.118	-0.019
	(0.008)	(0.004)	(0.005)	(0.004)
Conscientiousness	-0.048	0.483	-0.433	0.002
	(0.008)	(0.004)	(0.006)	(0.004)
Fixed-effects				
Year-Cohort (371)	Yes	Yes	Yes	Yes
Fit statistics				
Observations	483,065	483,065	483,065	483,065
R^2	0.09386	0.26737	0.10991	0.04825
Within R^2	0.00992	0.15241	0.10084	0.00644
Dep. Mean	14.7	2.16	2.13	1.10

Notes: Each column reports the OLS regression results from Equation 3, with person as the unit of observation. The column name indicates the outcome. The four outcomes represent exhaustive and mutually exclusive categories of 'principal activities' recorded by Statistic Finland yearly for each person. The outcome variable is measured in total years from age 18 to age 39. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Robust standard errors are reported in parentheses. Back to Section 4.3.2.

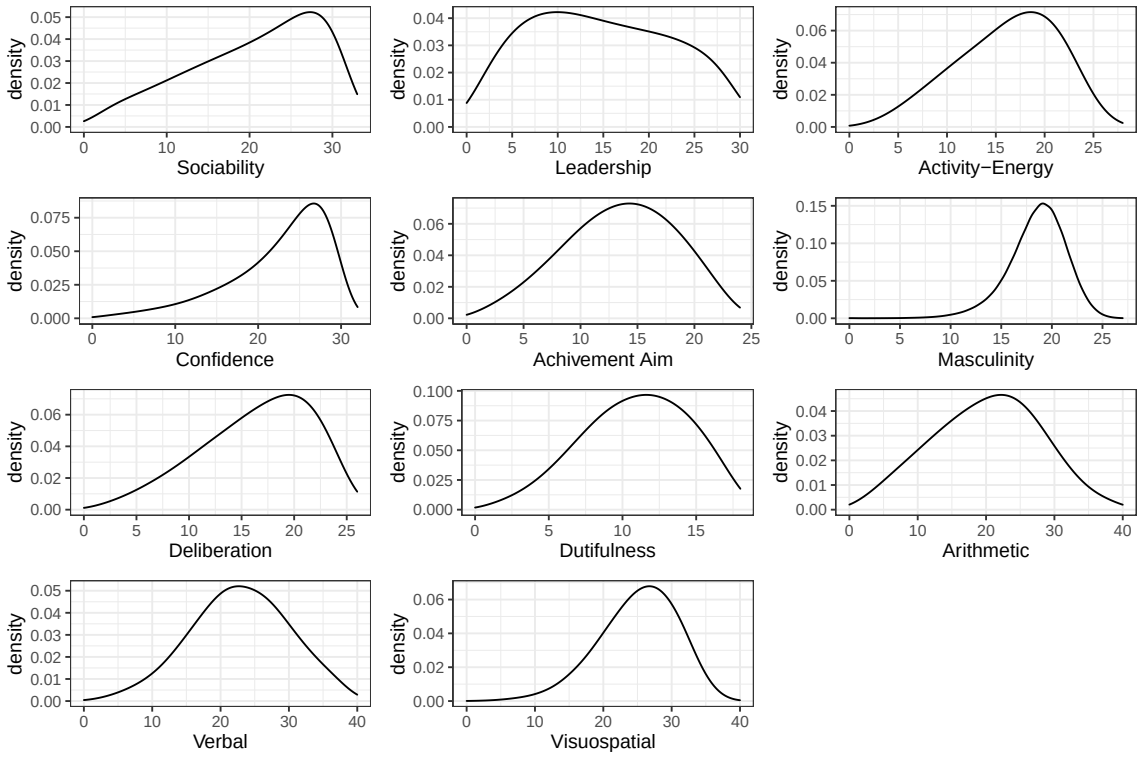
Table 7: Controlling for Fixed Effects

	Dependent variable: Log Earnings					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Cognitive	0.133	0.042	0.046	0.101	0.063	0.017
	(0.0010)	(0.001)	(0.0010)	(0.0010)	(0.0009)	(0.0008)
Extraversion	0.046	0.058	0.035	0.052	0.042	0.029
	(0.001)	(0.001)	(0.0010)	(0.001)	(0.0009)	(0.0008)
Conscientiousness	0.050	-0.003	0.011	0.036	0.020	-0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0009)	(0.0008)
Fixed-effects						
Year-Cohort (48)	Yes	Yes	Yes	Yes	Yes	Yes
Education (65)		Yes				Yes
Occupation (81)			Yes			Yes
Industry (54)				Yes		Yes
Firm (103,972)					Yes	Yes
Fit statistics						
Observations	819,035	819,035	819,035	819,035	819,035	819,035
R^2	0.10279	0.20177	0.26832	0.18314	0.62397	0.67607
Within R^2	0.09969	0.01812	0.01609	0.06526	0.04092	0.00669
Dep. Mean	10.6	10.6	10.6	10.6	10.6	10.6

Notes: Each column reports the OLS regression results from Equation 3, with person-year as the unit of observation. All models control for the year-cohort fixed effect and additional fixed effects as indicated, with number of cells in parenthesis. Industry and occupation are included at the two-digit level. Education is included at the field-of-study×degree-level. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. The sample contains males aged 36–39 in years 2004-2015. Most men appear in four consecutive years. The sample includes only person-year observations with non-missing values for all fixed-effects. This limits the sample to private sector individuals post 2003; a sample for whom occupation and firm codes are available. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Standard errors are clustered at the individual level and reported in parentheses. Back to Section 4.2.

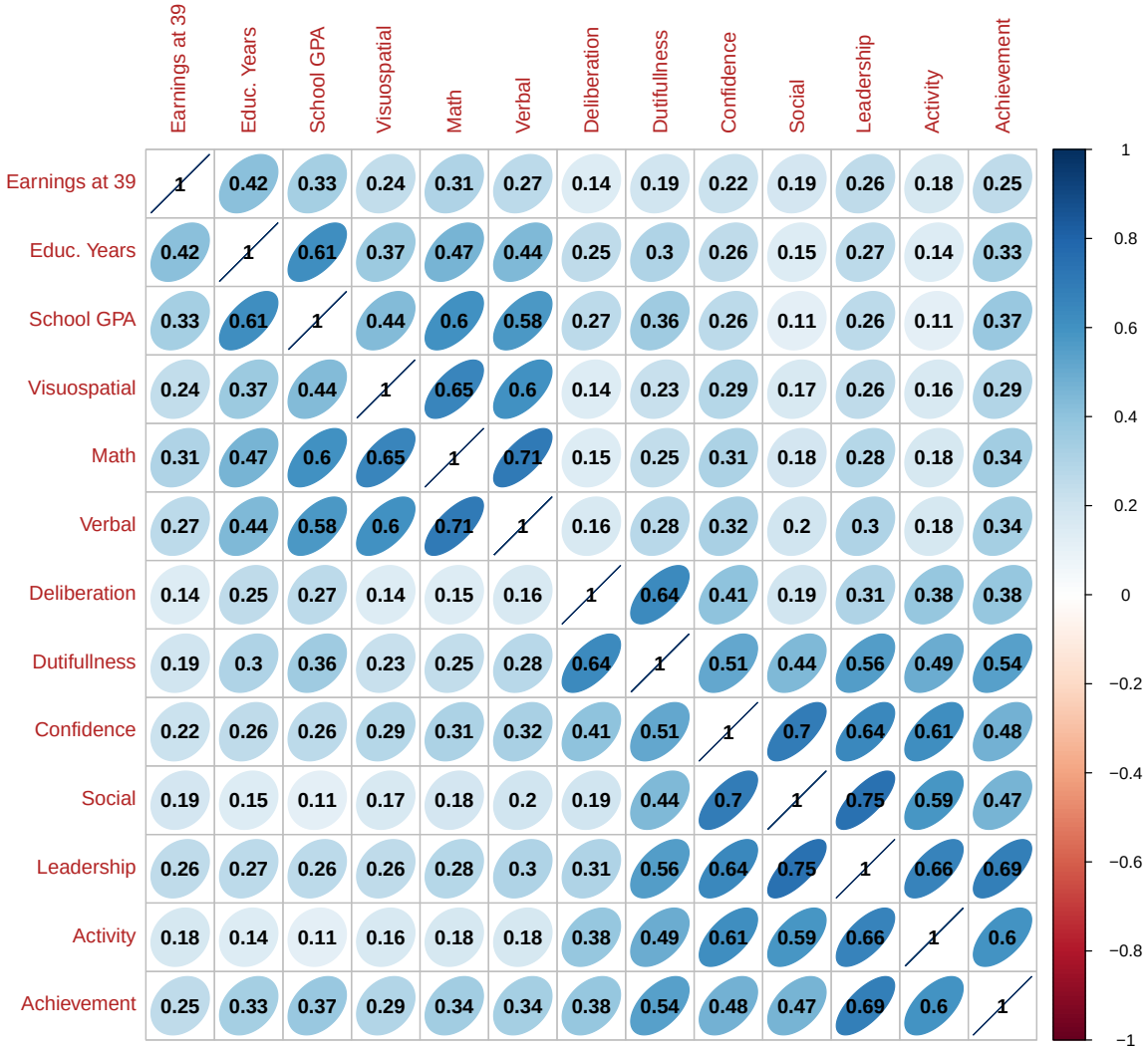
A Supplementary Figures and Tables

Figure A1: Cognitive and Personality Test Score Distributions



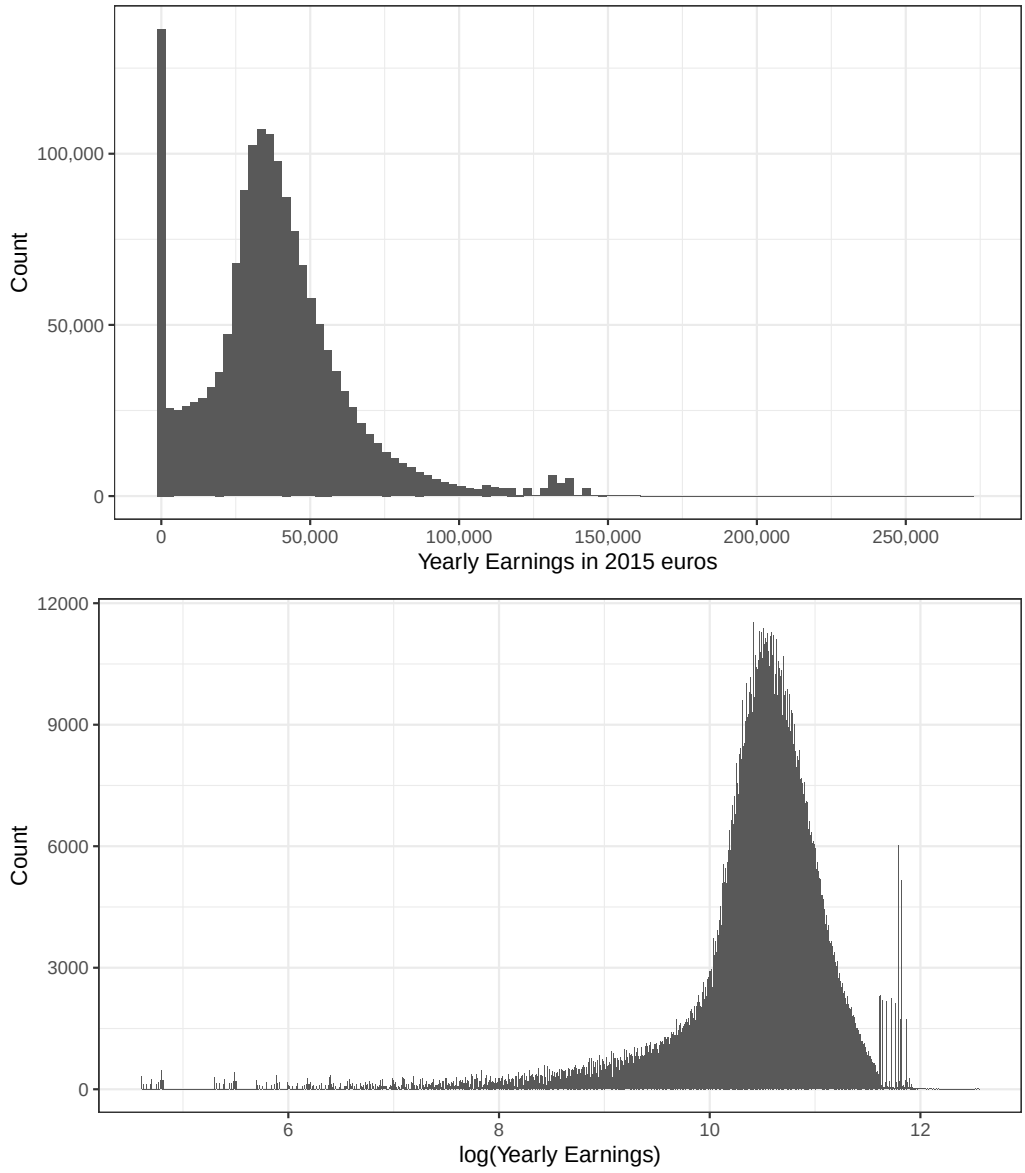
Notes: Density plots of the raw test scores. The personality test contains 218 statements with a response scale of yes/no. The raw score for a trait is the sum of affirmative answers in that subscale. The cognitive test contains 40 multiple-choice questions for each each scale. Visuospatial, arithmetic, and verbal scores are the number of correct answers. The sample includes all men with valid military test scores ($N \approx 489,000$). Back to Section 2.

Figure A2: Cross-Correlations



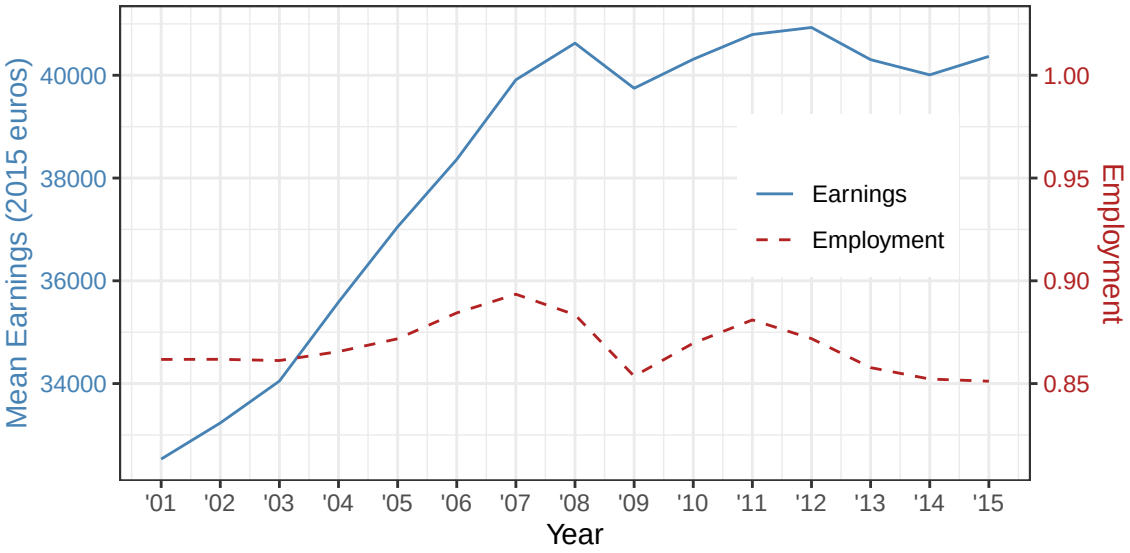
Notes: Each number is a pairwise correlation coefficient with person as the unit of observation. All variables, apart from earnings and education years, are standardized to have mean 0 and standard deviation 1 within cohorts. Earnings are measured by the sum of wage and entrepreneurial income earned at age 39 as recorded by the tax authority. The data include all men for whom we have data for the given pairwise correlation ($N \approx 489,000$). Back to Section 2.

Figure A3: Earnings Distributions



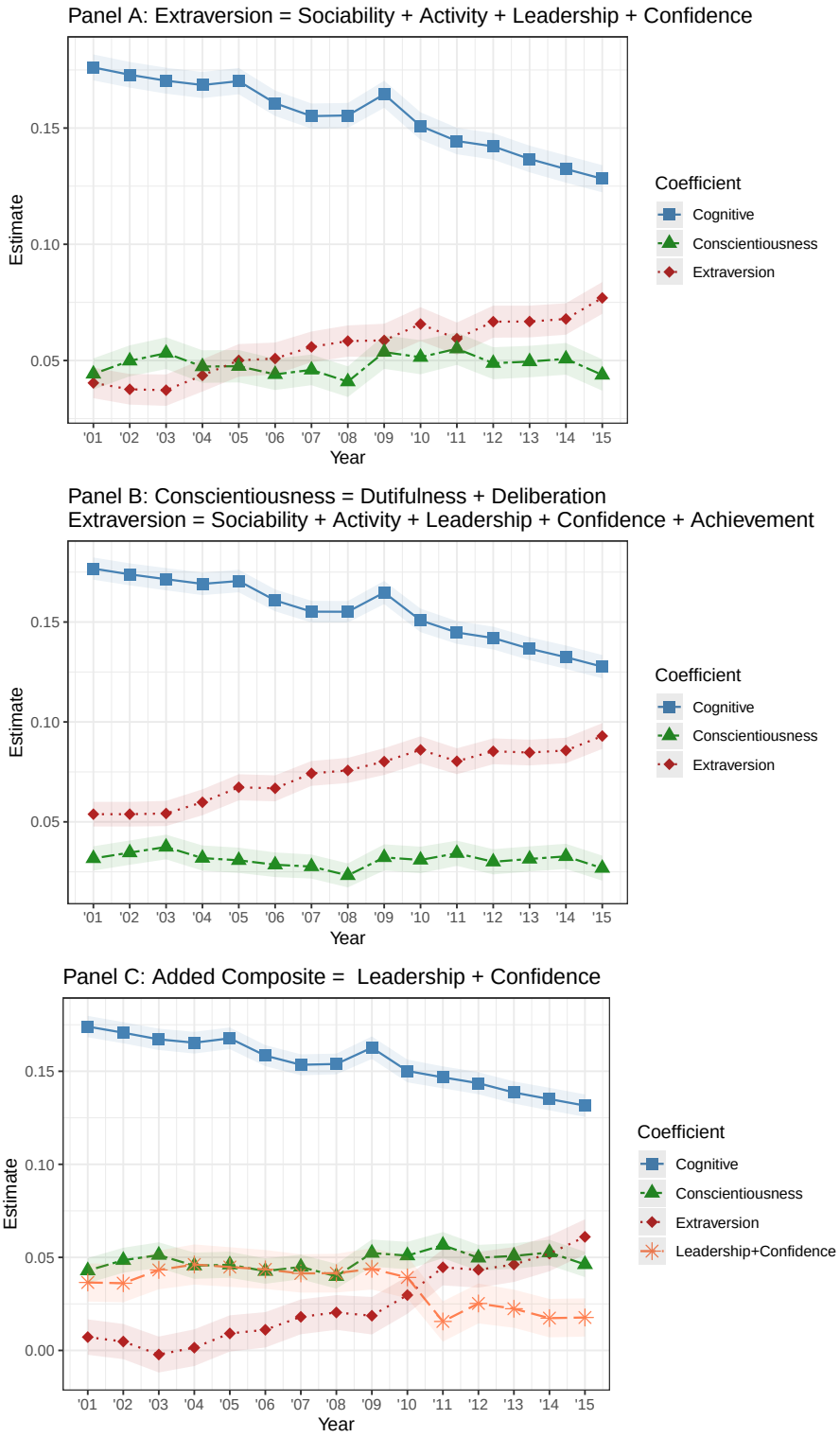
Notes: The histograms show the distribution of earnings and log earnings in the main sample of all males with military test scores. The full sample includes 1,592,000 person-year observations. For logarithmic earnings we restrict the sample to positive values. This removes 7.4% of person-year observations. Earnings are top coded to the median for the top 1% of earners. Back to Section 2.4.

Figure A4: Trends in Earnings and Employment



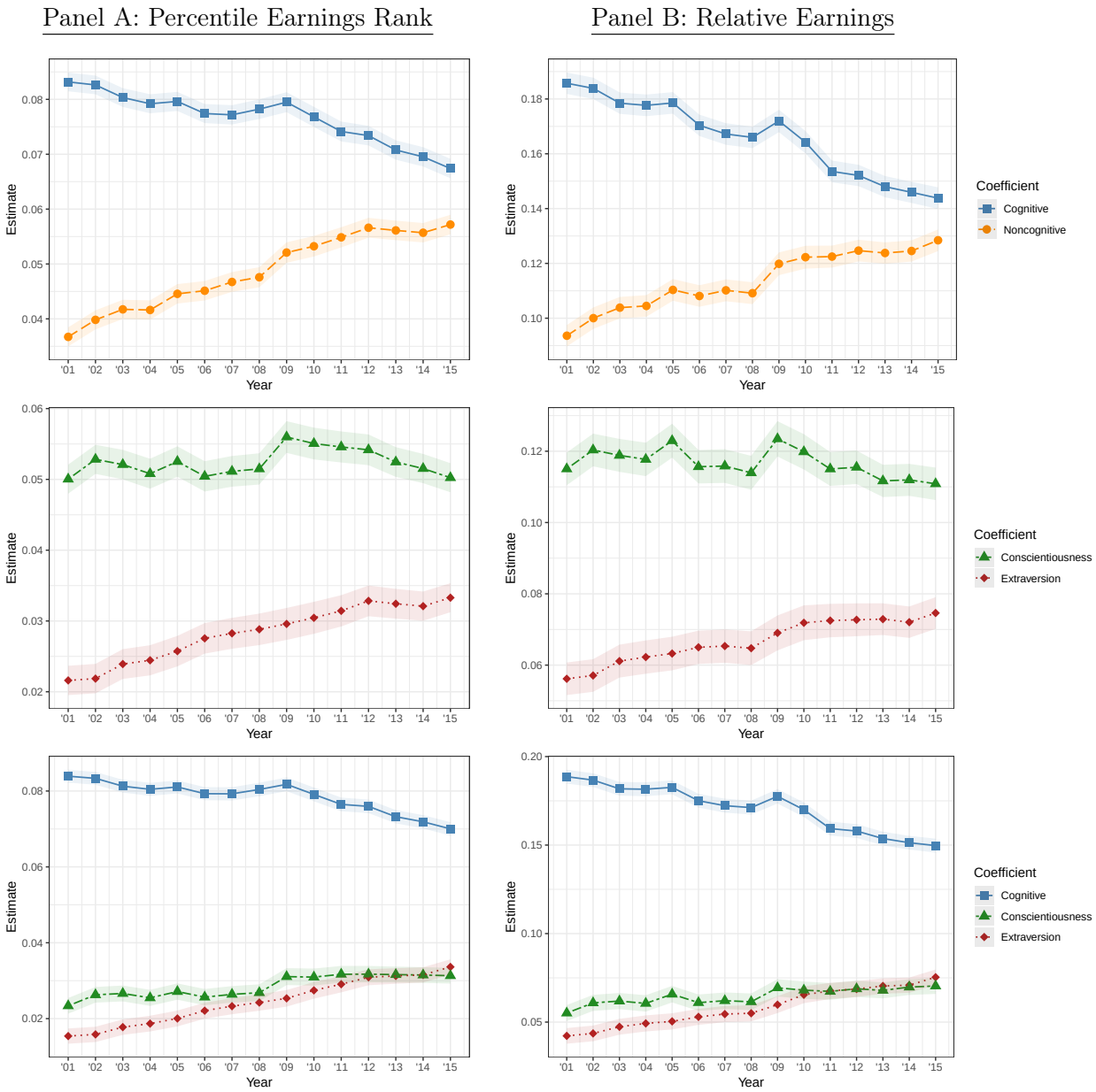
Notes: Trends in mean earnings and employment from 2001 to 2015 in the main sample of all males with military test scores. The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Employment status is defined by end-of-year employment. Back to Sections 2.4 and 4.2.

Figure A5: Trends Are Robust to Different Personality Groupings



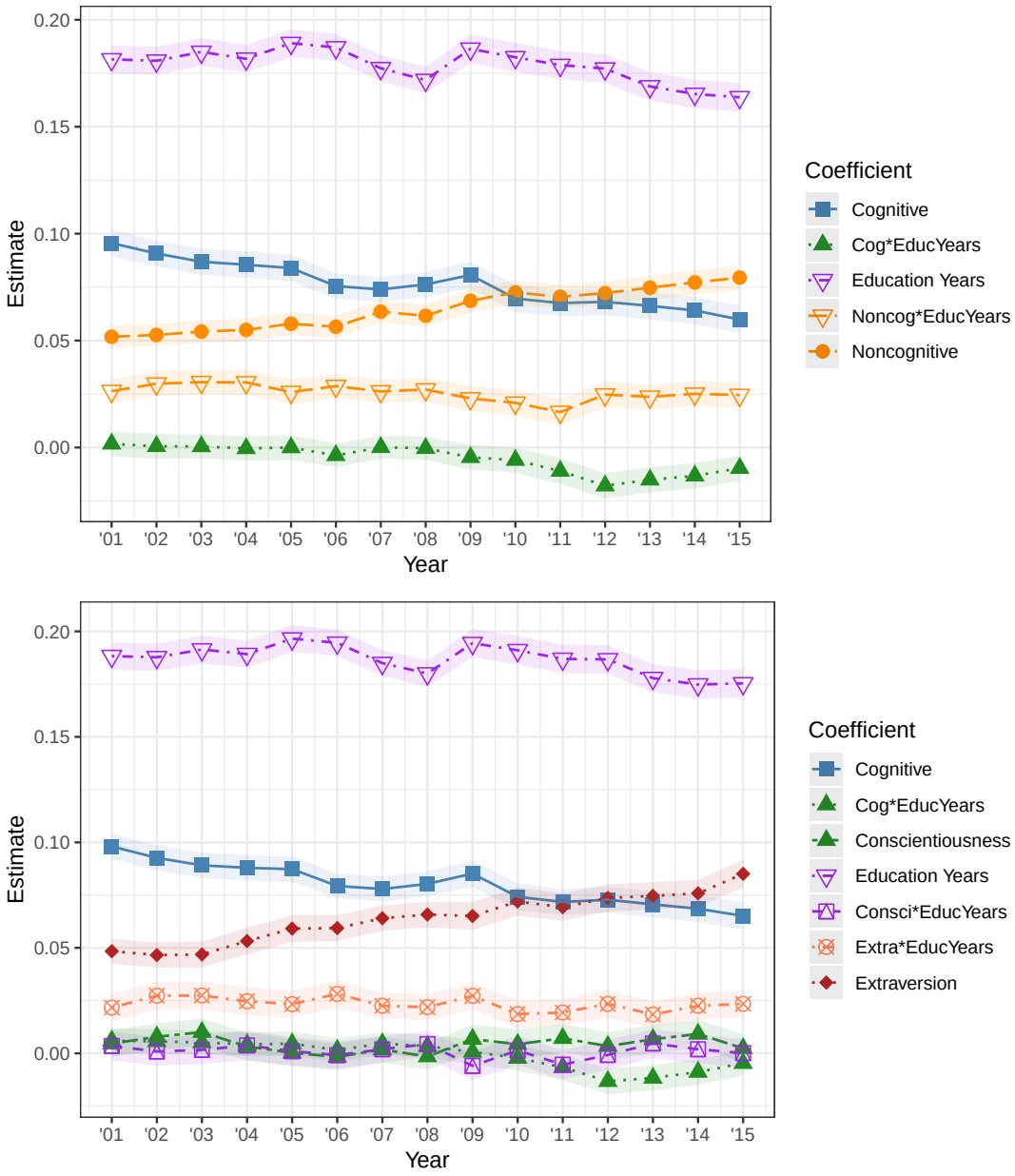
Notes: This re-estimates Figure 2 with different groupings of the raw trait measures. Panel A includes self-confidence and leadership motivation to extraversion. Panel B uses grouping suggested by exploratory factor analysis. Panel C includes the mean of leadership motivation and self-confidence as an additional term to Equation 1. Back to Section 3.3.

Figure A6: Trends Are Robust to Different Income Measures



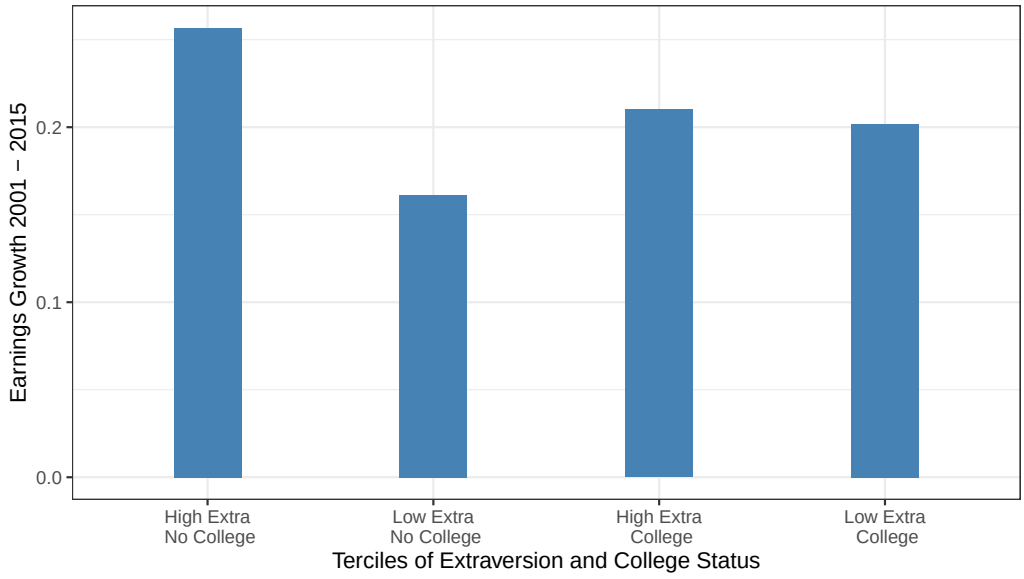
Notes: The figures re-estimate Figures 1 and 2 with different measures of income. Panel A estimates regressions with percentile earnings rank as the outcome variable. Panel B estimates regressions with earnings relative to the mean earnings as the outcome variable. Percentile ranks and means are calculated within observation years across men in the estimation sample. Both outcome variables include zeros. Back to Section 3.5.

Figure A7: Interactions with Education Years



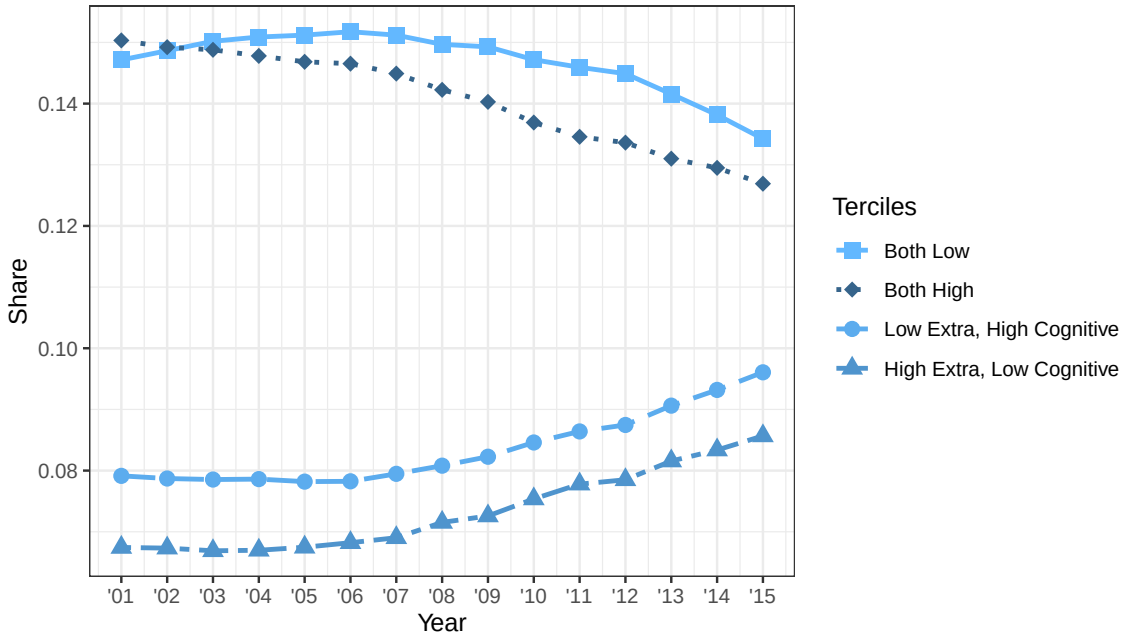
Notes: Each point in the figure corresponds to a regression coefficient from estimating Equation 1 separately for each year, with individual as the unit of observation. Interaction terms are included as indicated in the legend. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (7.4% of person-year observations). The sample contains males aged 36–39 with approximately 100,000 observations per year. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. 'Noncognitive' is the mean of sociability, activity-energy, dutifulness, deliberation, achievement striving, leadership motivation, and self-confidence. All covariates are standardized to have mean 0 and standard deviation 1 within birth cohorts (including 'EducYears'). Construction of the composite measures is described in more detail in Section 2. Confidence bands are based on robust standard errors. Back to Section 3.7.

Figure A8: Earnings Growth by Extraversion and College Status



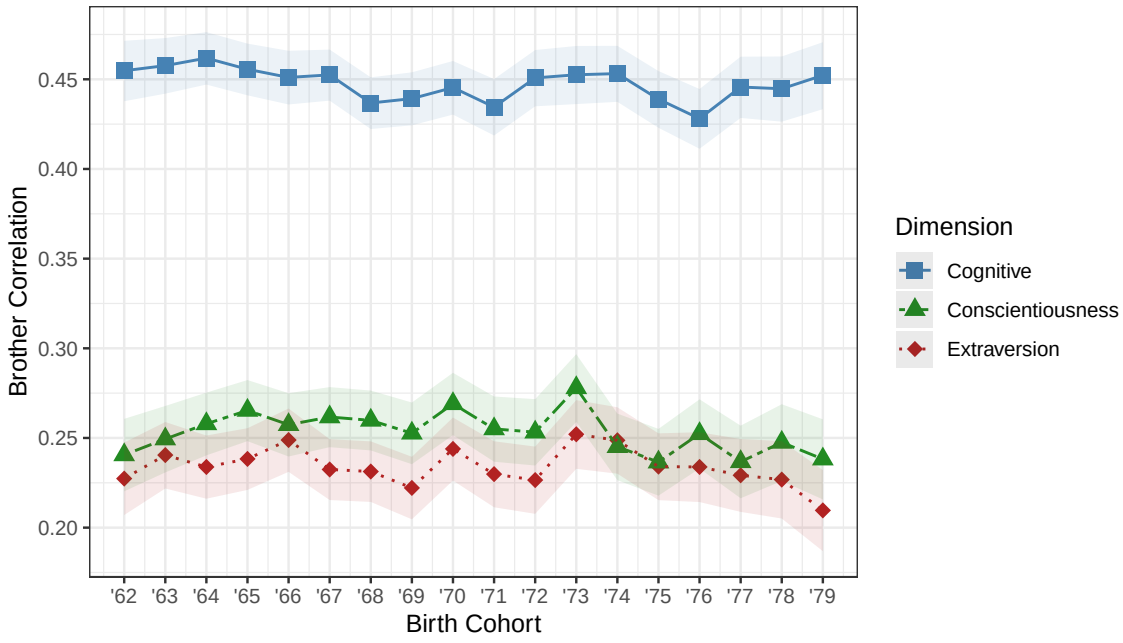
Notes: Each bar corresponds to the change in median earnings of that bundle in year 2015 relative to the base year 2001. The 'High Extra, No College' bundle includes persons who belong to the top tercile in extraversion and with no college degree. Other labels follow a similar logic. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. The sample contains males aged 36–39 with approximately 100,000 observations at the start and end years. Personality traits and cognitive ability are measured by the Finnish Defence Forces during basic training. 'Extraversion' is the mean of sociability and activity-energy. Back to Section 3.8.

Figure A9: Skill Specialization is Increasing



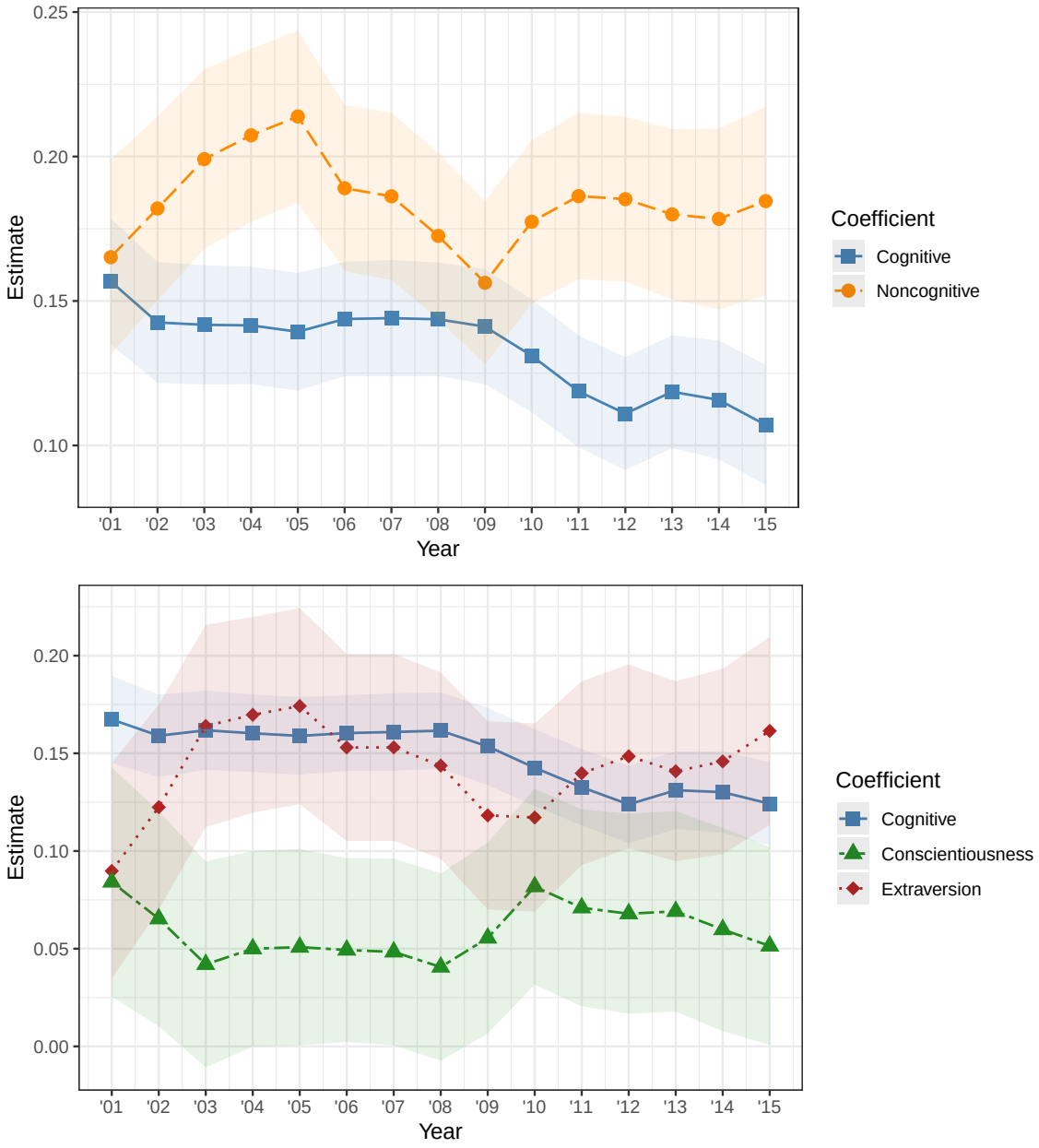
Notes: Each point corresponds to the share of persons belonging to the indicated group (bundle). The 'High Extra, Low Cognitive' bundle includes persons who belong to the top tercile in extraversion and the bottom tercile in cognitive skills within their birth cohort. Other labels follow a similar logic. The sample contains males aged 36–39 with approximately 100,000 observations per year. Personality traits and cognitive ability are measured by the Finnish Defence Force during training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extra' is the mean of sociability and activity-energy. Back to Section 3.8.

Figure A10: Brother Correlations Have Remained Stable



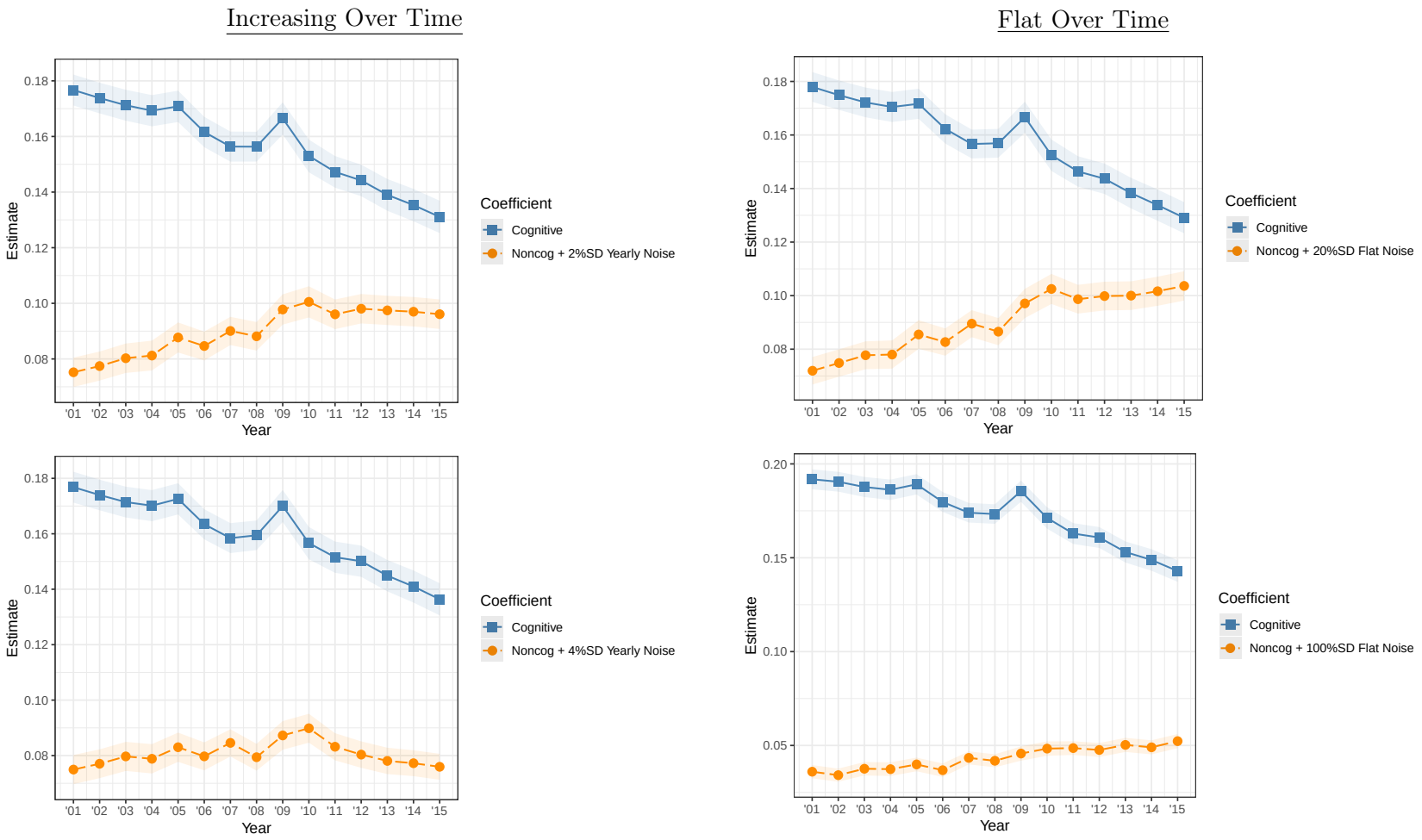
Notes: Raw pairwise correlations of traits across pairs of brothers. Each point is a separate correlation estimate. In case of multiple brothers, individuals are paired with the brother closest in age. The sample includes 178,000 pairs of brothers. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Construction of the composite measures is described in more detail in Section 2. Back to Section 3.9.

Figure A11: Brother IV Estimates



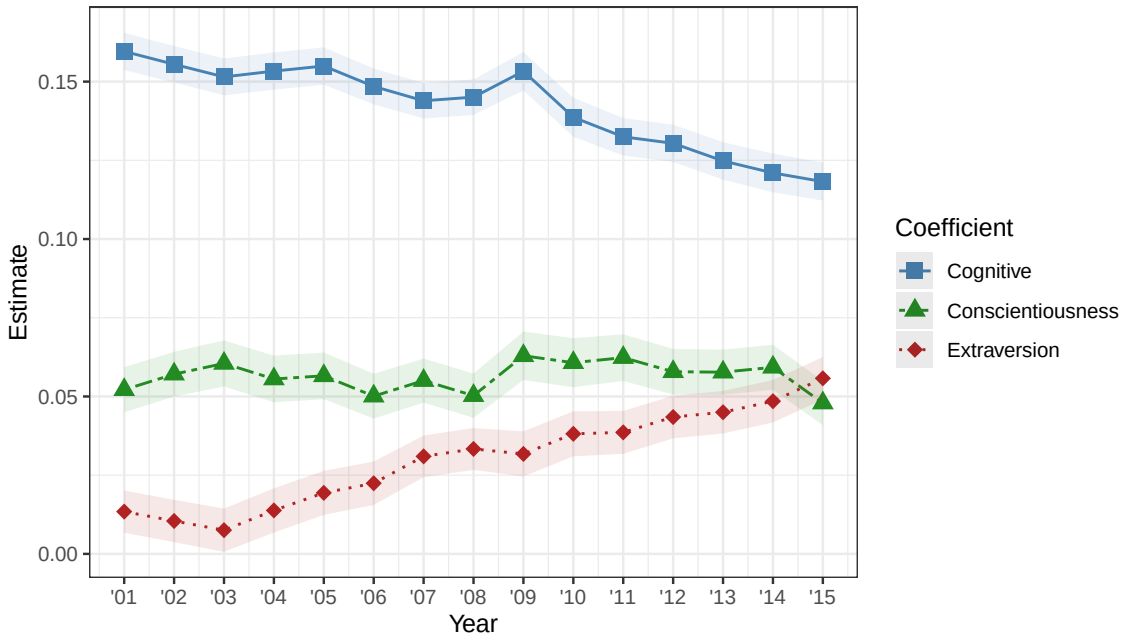
Notes: Each point corresponds to a 2SLS regression coefficient from estimating Equation 1 separately for each year. We use the traits of the brother as an instrument for own traits and log earnings as the outcome. In case of multiple brothers, individuals are paired with the brother closest in age. To decrease the variability in the estimates, we use data for the year in question ±2 years. The sample includes 178,000 pairs of brothers. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (6.9% of person-year observations). 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. 'Noncognitive' is the mean of sociability, activity-energy, dutifulness, deliberation, achievement striving, leadership motivation, and self-confidence. Traits are standardized to have mean 0 and standard deviation 1 within birth cohorts. Construction of the composite measures is described in more detail in Section 2. Confidence bands are based on robust standard errors, which are clustered at the individual level. Back to Section 3.9.

Figure A12: Simulated Measurement Error



Notes: This re-estimates Figure 1 with noise added to the noncognitive dimension. Noise is added for each individual according to the formula $NocognitiveNoise = Noncognitive + \epsilon_c$, where $\epsilon_c \sim N(0, (cp)^2)$ and c is the birth cohort. For Panel A: $c \in [0..18]$ and $p \in \{2\%, 4\%\}$. For Panel B and $c = 1$ and $p \in \{20\%, 100\%\}$. Back to Section 3.9.

Figure A13: Controlling for Validity Scales



Notes: This re-estimates Figure 2 with additional linear controls for three validity scales included in the FDF data that capture test-taking attitudes: L-scale (intended to identify people who deliberately try to avoid answering the test honestly and in a frank manner), F-scale (intended to detect unusual or atypical ways of answering the test items), and K-scale (designed to identify psychopathology in people who otherwise would have profiles within the normal range). These scales were also included in the original MMPI (Hathaway & McKinley, 1951). The scales are standardized to have mean 0 and standard deviation 1 within birth cohorts. Back to Section 3.9.

Table A1: Decomposing the Changes in Skill Premia

	Cognitive		Extraversion		Conscientiousness	
	Within	Residual	Within	Residual	Within	Residual
A. Industry	-0.0166	-0.0030	0.0107	0.0029	0.0032	-0.0042
B. Firm	-0.0143	-0.0053	0.0104	0.0033	0.0041	-0.0052
C. Occupation	-0.0139	-0.0057	0.0144	-0.0007	0.0002	-0.0013
D. Education	-0.0041	-0.0155	0.0109	0.0028	0.0046	-0.0057
Overall change:	-0.0196		0.0137		-0.0011	

Notes: Each row reports the difference between OLS estimates from Equation 3 estimated at the end (2013–2015) and in the beginning (2004–2006) of the observation period. The 'Overall change' row reports the difference in the OLS estimates without fixed effects. All regressions contain all three skill measures (cognitive, extraversion, and conscientiousness). The 'Within' column refers to the difference between the end and the beginning coefficients with the fixed effects included. These fixed-effects in each regression are indicated by the row name. The 'Residual' column is the difference between the bottom row baseline change (coefficient change without fixed-effects) and the 'Within' change. The sample contains males aged 36–39 with non-missing values for all fixed-effects. This limits the sample to private sector individuals post 2003; a sample for whom occupation and firm codes are available. $N \approx 200,000$ person-year observations in each three-year period. Industry and occupation are included at the two-digit level. Education is included at the field-of-study×degree-level. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Back to Section 3.10.

Table A2: Brother IV Estimates

	Dependent Variable: Log Earnings				
	(1)	(2)	(3)	(4)	(5)
Variables					
Cognitive	0.134		0.150		0.053
	(0.005)		(0.005)		(0.006)
Noncognitive	0.184				
	(0.008)				
Extraversion		0.146	0.145		0.185
		(0.013)	(0.013)		(0.013)
Conscientiousness		0.162	0.057		-0.072
		(0.012)	(0.013)		(0.015)
Education Years				0.097	0.083
				(0.0007)	(0.002)
Fixed-effects					
Year-Cohort (60)	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	561,114	566,087	566,087	571,229	566,087
R^2	0.06206	0.01284	0.05835	0.09729	0.09596
Within R^2	0.05022	0.00019	0.04627	0.08551	0.08436
Dep. Mean	10.4	10.4	10.4	10.4	10.4

Notes: Each column reports the 2SLS estimates from Equation 3, with person-year as the unit of observation. We use the traits of the brother as an instrument for own traits and log earnings as the outcome. In case of multiple brothers, individuals are paired with the brother closest in age. The sample includes 178,000 pairs of brothers. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Zero earnings are removed (6.9% of person-year observations). Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Standard errors are clustered at the individual level and reported in parentheses. Back to Section 4.2.

Table A3: Earnings in Levels

	Dependent Variable: Earnings (2015 euros)				
	(1)	(2)	(3)	(4)	(5)
Variables					
Cognitive	6,281		6,458		3,025
	(35)		(35)		(36)
Noncognitive	4,345				
	(35)				
Extraversion		2,545	2,228		2,948
		(41)	(40)		(38)
Conscientiousness		4,423	2,456		200
		(42)	(41)		(40)
Education Years				4,162	3,325
				(15)	(17)
Fixed-effects					
Year-Cohort (60)	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	1,580,916	1,587,535	1,587,535	1,592,223	1,587,535
R^2	0.13779	0.07729	0.13627	0.18197	0.21198
Within R^2	0.12547	0.06391	0.12375	0.17000	0.20055
Dep. Mean	38,090	38,060	38,060	38,038	38,060

Notes: Each column reports the OLS regression results from Equation 3, with person-year as the unit of observation. The outcome is earnings in 2015 euros. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. The sample contains males aged 36–39 in years 2001-2015. Most men appear in four consecutive years. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. 'Noncognitive' is the mean of sociability, activity-energy, dutifulness, deliberation, achievement striving, leadership motivation, and self-confidence. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Standard errors are clustered at the individual level and reported in parentheses. Back to Section 4.2.

Table A4: Personality and Earnings within Occupations

Group:	Managers	Professionals	Tech./Clerical	Service/Sales	Production	Other
ISCO classes:	(1)	(2)	(3–4)	(4–5)	(7–8)	(0,6,9)
Variables						
Cognitive	0.142	0.079	0.083	0.048	0.031	0.051
	(0.004)	(0.002)	(0.002)	(0.004)	(0.001)	(0.005)
Extraversion	0.034	0.050	0.048	0.057	0.016	0.053
	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)	(0.006)
Conscientiousness	0.068	0.034	0.023	0.016	0.003	-0.057
	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)	(0.006)
Fixed-effects						
Year-Cohort	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	76,612	219,309	219,206	80,406	365,958	68,271
R^2	0.08388	0.03428	0.03873	0.02226	0.00705	0.01058
Within R^2	0.07688	0.03193	0.03096	0.01805	0.00409	0.00643
Dep. Mean	11.1	10.8	10.6	10.3	10.4	10.1

Notes: Each column reports the OLS regression results from Equation 3, with person-year as the unit of observation. The column name indicates the estimation sample. Each sample is limited to individuals working in the indicated occupation at the end of the calendar year. Occupation codes are available in the data after 2003. The outcome is log earnings. Earnings are measured by the sum of wage and entrepreneurial income earned in a given year of observation as recorded by the tax authority. Personality traits and cognitive skills are measured by the Finnish Defence Forces during basic training. 'Cognitive' is the mean of visuospatial, arithmetic, and verbal test scores. 'Extraversion' is the mean of sociability and activity-energy. 'Conscientiousness' is the mean of dutifulness, deliberation, and achievement striving. Traits and subtraits are standardized to have mean 0 and standard deviation 1 within cohorts. Construction of the composite measures is described in more detail in Section 2. Standard errors are clustered at the individual level and reported in parentheses. Back to Section 4.3.1.

B Supplementary Details on Data

B.1 The Finnish Defence Forces Psychological Test Data[28]

Background Military conscription in Finland is universal and grants relatively few exceptions. The available data cover 79% of Finnish men born between 1962 and 1979 (n = 489,252). Finnish men are drafted in the year they turn 18, and most start their service at age 19 or 20. Military service lasts for 6–12 months, and most conscripts do not continue service in the military.

The Finnish Defence Forces (FDF) use psychological tests as one of the criteria to assess the suitability of conscripts suitability for officer training and to collect information about the military force. FDF has conducted psychological tests on all conscripts since 1955. Between 1955 and 1982, FDF used one test that measured cognitive skills: logical, mathematical, and verbal skills. Since 1982, the FDF has used two tests: a cognitive and a personality test. The test data have been described in Jokela et al. (2017) and validated in FDF's internal reports summarized in Nyman (2007). Our description here is closely based on Jokela et al. (2017).

Test Administration The cognitive ability and personality tests are typically taken in the second week of military service in a 2-h paper-and-pencil format in standardized group-administered conditions. The personality test contains 218 statements with a response scale of yes/no. The cognitive test contains 120 multiple-choice questions. The test questionnaires and test administration have been unchanged from 1982 to 2000 (the data available to this study), and the scores are designed to be comparable across cohorts. The main change in the test administration during the timeline of this study is that between 1995 and 2000, the personality test was administered already at the conscription, on average 18 months before entering the FDF service.

The Cognitive Ability Test The cognitive ability test has three subtests: visuospatial, arithmetic and verbal reasoning. The FDF cognitive ability test is similar to the The Armed Services Vocational Aptitude Battery (ASVAB), administered by the United States Military Entrance Processing Command. Each subtest has 40 multiple-choice questions. FDF reports test–retest reliabilities of the subtests between 0.76 and 0.88 (Nyman, 2007). The descriptions of tests are based on Nyman (2007) and Jokela et al. (2017):

1. *The visuospatial subtest* is similar to Raven's Progressive Matrices (Raven et al., 2000). The test shows a set of matrices, each with one removed part, and the participant choose a figure that completes the matrix.
2. *The arithmetic subtest* contains different tasks: executing arithmetic operations, identifying patterns in number sequences, interpreting and solving brief word problems, and recognizing relationships among numbers.
3. *The verbal subtest* assesses language skills, including understanding of synonyms and antonyms, categorical grouping, outlier identification in word groups, and recognition of analogous word pairs.

The Personality Test The personality test measures 8 personality traits. The test is similar to and partly based on the Minnesota Multiphasic Personality Inventory (MMPI). It contains 218 statements with a yes/no response, between 18 and 33 items for each personality trait. The test score for each personality trait is the sum of the binary answers aligned with the trait (for example, in reverse-coded statements, these mean cases where the task-taker disagrees). The data available for this study contain these sums of scores. FDF reports that internal reliability varies between 0.60 and 0.90 by trait and that the average Cronbach alpha is 0.75 (Nyman, 2007). The 8 personality traits measured in the test are, as described by Jokela et al. (2017):

[28] Back to Section 2.1.2.

1. *Sociability*: the person's level of gregariousness and preference for socializing with others (33 items; e.g., whether the person likes to host parties and not withdraw from social events).
2. *Activity–energy*: how much the person exerts physical effort in everyday activities and how quickly the person prefers to execute activities (28 items; e.g., whether the person tends to work fast and vigorously and prefers fast-paced work).
3. *Masculinity*: the person's occupational and recreational interests that are traditionally considered as masculine (27 items; e.g., whether the person would like to work as a construction contractor).
4. *Dutifulness*: how closely the person follows social norms and considers them to be important (18 items; e.g., whether the person would return money if given back too much change at a store).
5. *Deliberation*: how much the person prefers to think ahead and plan things before acting (26 items; e.g., whether the person prefers to spend money carefully).
6. *Achievement motivation*: how strongly the person wants to perform well and achieve important life goals (24 items; e.g., whether the person is prepared to make personal sacrifices to achieve success).
7. *Leadership motivation*: how much the person prefers to take charge in groups and influence other people; it includes 30 items.
8. *Self-confidence*: the person's self-esteem and beliefs about his abilities (32 items; e.g., whether the person feels to be as good and able as others and can meet other people's expectations).

The FDF personality test also includes questions about mental health and questions targeted at evaluating the answers' validity. The mental health part has four scales from the Minnesota Multiphasic Personality Inventory (MMPI): hypochondriasis, psychopathic deviate, psychasthenia, and schizophrenia. The validity part has three scales: L-scale ("Lie" scale, intended to identify people who deliberately try to avoid answering the test honestly and in a frank manner), F-scale (intended to detect unusual or atypical ways of answering the test items), and K-scale (designed to identify psychopathology in people who otherwise would have profiles within the normal range).

Selection Concerns The data are subject to two selection concerns. The first concern is selection into military service: Only those who enter the FDF service take the tests. It is possible to be exempted from military service due to severe health conditions, most often related to mental health problems, or due to religious or ethical convictions. For the analysis, this means that the sample is generally more representative of men with relatively higher labor-market prospects. Over the timeline of this study, selection into military service has been stable Jokela et al. (2017).

The second concern is selective test performance. The military uses the test results as one of the elements to select conscripts for officer training. To some extent, this feature is likely to induce higher performance from those who would like to be selected and lower performance from those who would like to avoid it. For personality data, the concern is alleviated by the fact that the scoring rules are not revealed to the conscripts. For cognitive data, test performance may reflect motivation-related factors, as is the case for most cognitive tests. Finally, the data excludes The Finnish Defense Forces personnel and Finnish Border Guard soldiers.

B.2 Harmonizing the High-School Mathematics Data

In high school, students can select between two mathematics tracks: basic and advanced. The exit exams are different for both tracks, and a small fraction opt out of both. We aim to construct a single measure of mathematics test scores that is commensurable across the three options. We do this by regressing:

$$\begin{aligned}\text{MilitaryMathScore}_{it} = \delta_1 D_i^{\text{BasicMath}} + \delta_2 D_i^{\text{AdvancedMath}} \\ + \delta_3 D_i^{\text{BasicMath}} \text{BasicMathScore}_i \\ + \delta_4 D_i^{\text{AdvancedMath}} \text{AdvancedMathScore}_i + \delta_t\end{aligned}$$

where D indicates that person i has participated in the exam. The indicator is interacted with the normalized test score. For those who did not participate, number -1 is imputed for the test score (the scalar used here does not matter for the estimation). Finally, δ_t is a fixed effect for the test-taking year.

The left-hand side variable is the military arithmetic test score. We use the fact that this standardized test is administered to everyone in our data. The military test is low stakes, relatively easy, and only moderately correlated with the high-school test scores (less than 0.4 with either track). While it does not share the same patterns as our main results (results not shown), it is a reasonable tool for this purpose.

Table B1: Math Anchoring

Outcome: FDF Arithmetic Test	
δ_1	0.334
	(0.006)
δ_2	0.810
	(0.005)
δ_3	0.255
	(0.003)
δ_4	0.270
	(0.002)
Num. obs.	165934
Adj. R^2 (full model)	0.269
Adj. R^2 (proj model)	0.255

Notes: Robust standard errors are in ().

Table B1 shows the estimation results. The marginal weights for better test scores are similar in both tracks. Both predict around a 0.26 standard deviation increase in the military test for each standard deviation increase in the high school score. The differences arise from a mean shift in the military arithmetic test. The mean performance of students taking the advanced mathematics track is almost 0.5 standard deviations higher than the mean performance of students taking the basic track ($\delta_2 - \delta_1$). The 'math' variable in all results except for Table 2 is the weighted average of the right hand side variables, where the weights are given by the δ values. The cohort fixed effects are not included.

C Model

We develop a simple model of multidimensional skill specialization that provides a structure for the relationships between personality, education, and labor-market performance.[29] We focus on the distinction between the production of human capital and productive activities in the labor market. Personality traits are viewed as a fixed type and skills are viewed as endogenous. For concreteness, the context can be thought as students in high school and the labor-market.

At the center of the model, there are two production functions for two types of human capital, formal skills ('education', H) and informal skills ('social capital', S),[30]

$$H(h; C, E) = a(C, E) \times h \tag{4}$$

$$S(s; C, E) = b(C, E) \times s \tag{5}$$

Formal skills H are produced by time investment h ('studying') and informal skills S are produced by time investment s ('socializing'). The productivities of human capital production, a and b, depend on the endowment of personality traits (C for 'conscientiousness' and E for 'extraversion').

In making a decision, the students face a time-allocation constraint:

$$h + s = T. \tag{6}$$

Time spent on studying is away from time spent on socializing. We normalize the time endowment as $T = 1$.

The objective function is:

$$U(s; C, E) = H(1 - s; C, E) + S(s; C, E) + V(s; C, E) \tag{7}$$

The students value both types of human capital, H and S, but also derive direct utility (or disutility) from studying and socializing, V, that depends on their endowment of traits.[31] We further assume that the direct utility function depends only on the relative allocation between h and s.[32]

Students choose how much time to spend on socializing (s) to maximize the objective function under the constraint. With no strategic behavior or dynamics, the optimal time-allocation decision between studying and socializing is a static individual optimization problem.[33] The first-order condition for socializing is:

$$\frac{\partial V(s; C, E)}{\partial s} = a(C, E) - b(C, E) \tag{8}$$

$$s^*(C, E) = g_s(a(C, E) - b(C, E); C, E) \tag{9}$$

where g_s is the inverse function of $\partial V(s, C, E)/\partial s$ with respect to s. For an interior solution to exist, Expression 8 must be positive. Intuitively, if at the optimal s^*, socializing is not only more fun ($\partial V(s; C, E)/\partial s > 0$) but also more productive ($b(C, E) > a(C, E)$), there would be no reason

[29] The model is related to Lleras-Muney et al. (2023).

[30] For simplicity, we consider two 'technologies of skill formation' (Cunha & Heckman, 2007). The case for C technologies is analogous.

[31] If U reflects log utility, the objective function arises under the canonical CES preferences. At this point, to keep the notation clear, we abstract from potential return multipliers for H and S in the objective function.

[32] Because time is spent between studying and socializing, V captures all direct costs/benefits of studying/socializing. For example, extraverted students could dislike studying but conscientious students might enjoy it.

[33] The model has an implied timing that corresponds to a typical path from adolescence to adulthood. Students enter a schooling period with an initial personality endowment (C, E). They then decide how much time to spend on socializing s. Their H and S are realized at the end of the schooling period. After the schooling period, they enter the labor market and receive earnings Y.

to study at all.

The theoretical analysis focuses on the decision to socialize, s; the analysis for the inverse decision of studying, $h = 1 - s$, is symmetric. We provide proofs at the end of the text.

This setup provides some flexibility by admitting at least three distinct interpretations. In the classic view, students gain utility from formal skills H and informal skills S because there is a return to different human-capital types in the labor market. Students also face a direct cost or benefit from studying and socializing V that depends on their endowments. In this view, socializing is an investment: students socialize not just because studying may be laborious but also because socializing builds people-skills and networks rewarded in the labor market.

From a more modern perspective (see, for example, Lavecchia et al. 2016), students might not be sufficiently forward-looking to consider their future earnings. However, the terms H and S can be interpreted as social norms that guide their choices, for example, through parental pressure. In this interpretation, the cost function V is the direct utility of socializing over and above the social-norm component S.[34]

Finally, we could abstract entirely from the source of utility derived from either type of human capital *stock*. Students simply enjoy the activity of spending time s with their friends. Performing well in tests requires time to study (h), which may be uninteresting and incurs a cost $-V$. From this perspective, V reflects the direct utility of time spent socializing, which may be different for students with different personality endowments.

Skill Specialization The fundamental trade-off between time investments in this model leads to skill specialization, where students with a comparative advantage in extraversion invest more time on socializing relative to students with a comparative advantage in conscientiousness. Taking a derivative of the first order condition in Equation 8 and solving for $\partial s^*(C,E)/\partial E$ gives:

$$\frac{\partial s^*(C,E)}{\partial E} = -\left[\underbrace{\frac{\partial^2 V(.)}{\partial s^2}}_{<0}\right]^{-1}\left[\underbrace{b^E(C,E) + \frac{\partial^2 V(.)}{\partial s \partial E}}_{\text{marginal benefit of } \Delta E} - \underbrace{a^E(C,E)}_{\text{marginal cost of } \Delta E}\right] > 0. \tag{10}$$

The first term is the gradient in the marginal direct utility of socializing (or marginal cost of studying). We assume the standard decreasing marginal utility. Hence, for socializing: $\partial^2 V(.)/\partial s^2 < 0$. We also assume that the productivity of informal-skill accumulation $b(C,E)$ is increasing in the extraversion trait-endowment E. This assumption is based on the idea that learning social skills, creating networks, and improving their social hierarchy position is easier for students who already have sociable and proactive personalities. Likewise, we assume that extraverted students enjoy a larger marginal utility of socialization s. Formally, $\partial^2 V(.)/\partial s \partial E > 0$. This reflects the idea that the opportunity cost for studying is higher for extraverted students who could be having fun with their friends instead. Finally, we assume that productivity of studying, $a(C,E)$, does not depend on extraversion, so that $a^E(C,E) = a^E(C) = 0$. With these key assumptions, the right-hand side of Equation 10 is positive, and an increase in extraversion leads to an increase in the time spent socializing.

Immediately following from these assumptions we also have:

$$\frac{\partial H(1-s;C,E)}{\partial E} = \frac{\partial a(C)(1-s^*(C,E))}{\partial E} = -a(C)\frac{\partial s^*(C,E)}{\partial E} < 0. \tag{11}$$

In other words, conditional on conscientiousness C, more extraverted students have worse test scores. It implies that comparative advantage determines the time-allocation decision.

[34] The cost of studying and the direct utility of socializing mirror each other, because students allocate time T between the two.

Figure C1 simulates the model with a quadratic cost function and linear productivity functions. Each line represents an isoquant where the optimal time allocation decision s^* does not change. Along each line, as long as the *comparative* proportion of endowments does not change, the *absolute* levels can vary substantially, still resulting in the same optimum allocation. For example, at the bottom right-hand corner, investment in s is highest; these are students who are high in E but low in C. At the upper left-hand corner are students high in C but low in E; their investment in s is lowest.

Returns to Personality The labor market rewards both types of human capital, H and S, and also directly the endowments, C and E. Earnings are determined by:

$$Y = r_H H(1-s;C,E) + r_S S(s;C,E) + r_N C + r_J E \tag{12}$$
$$= r_H a(C)(1-s^*(C,E)) + r_S b(C,E)s^*(C,E) + r_N C + r_J E \tag{13}$$

where r_H and r_S are the returns to the respective dimensions of human capital and r_N and r_J are the direct returns to the respective traits.

The marginal returns to extraversion are:

$$\frac{\partial Y}{\partial E} = \underbrace{r_S b^E(E,C)s^*(C,E) + r_J}_{\text{direct effect of } \Delta E} + \underbrace{(r_S b(E,C) - r_H a(C))}_{\text{net earnings change for } \Delta s} \underbrace{\frac{\partial s^*(C,E)}{\partial E}}_{\Delta s} \lessgtr 0. \tag{14}$$

The first term is the direct effect: the effect of the increase in the productivity of informal-skill production and the direct return from the increase in extraversion. By assumption, productivity $b(E)$ is increasing in extraversion, so this term is positive. The second term is the indirect effect: the change in earnings due to changes in the optimal time allocation s^*. As shown earlier, an increase in extraversion leads to an increase in the time investment (Δs). This reallocation results in a shift from formal skills to informal skills. However, at the optimum, as shown in Expression 8, the productivity of informal skills must be lower than the productivity of formal skills. Taken together, the indirect effect is negative.

Intuitively, students with a lower initial comparative advantage in socializing (low extraversion in relative terms) take a larger hit from investing more in s, because their comparative advantage is in formal skills (or educational capital), from which they are substituting away by increasing s. At the same time, $\partial s^*(C,E)/\partial E$ is smaller for students with a comparative advantage in studying.

In total, the sign of Expression 14 is ambiguous. If the gains from the direct effect are larger than the losses from the indirect effect, we should expect a positive return to extraversion conditional on conscientiousness.

Proofs

Optimal time allocation s^*

Proof. Using equation 8:

$$\begin{aligned}\frac{\partial U(s;C,E)}{\partial s} = -a(C,E) + b(C,E) + \frac{\partial V(s;C,E)}{\partial s} = 0\\ \frac{\partial C(s;C,E)}{\partial s} = a(C,E) - b(C,E)\\ s^* = g_s(a(C,E) - b(C,E);C,E)\end{aligned}$$

■

Comparative static: Optimal response of s to a change in E

Proof. Differentiate with respect to E from both sides of equation 8:

$$\begin{aligned}\frac{\partial^2 V(.)}{\partial s^2}\frac{\partial s^*}{\partial E} + \frac{\partial^2 V(.)}{\partial s^* \partial E} &= a^E(C,E) - b^E(C,E)\\ -\frac{\partial^2 V(.)}{\partial s^2}\frac{\partial s^*}{\partial E} &= b^E(C,E) + \frac{\partial^2 V(.)}{\partial s^* \partial E} - a^E(C,E)\\ \frac{\partial s^*}{\partial E} &= -\left[\frac{\partial^2 V(.)}{\partial s^2}\right]^{-1}\left[b^E(C,E) + \frac{\partial^2 V(.)}{\partial s^* \partial E} - a^E(C,E)\right]\end{aligned}$$

■

Comparative static: Marginal returns to a change in E

Proof. Earnings are given by

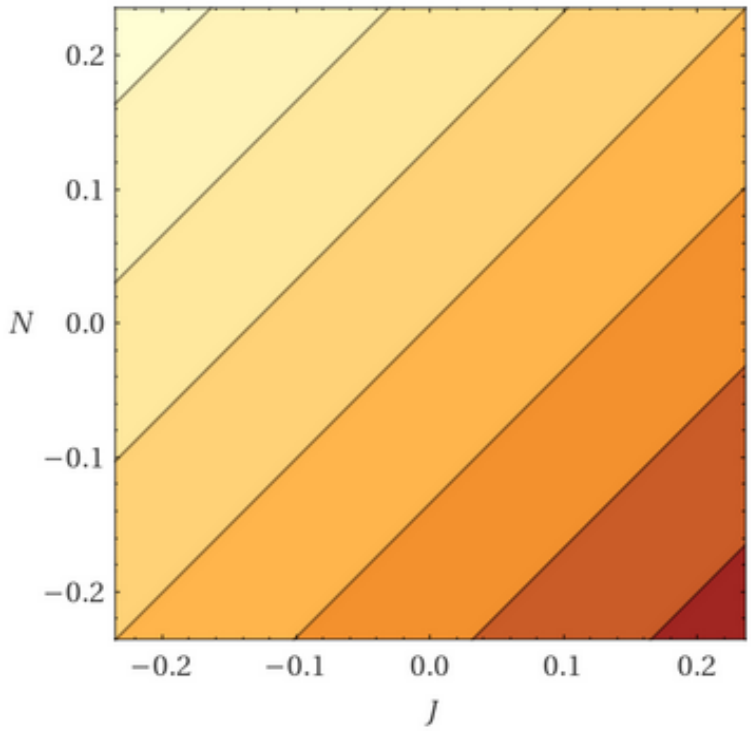
$$\begin{aligned}Y &= r_H H(1-s;C,E) + r_S S(s;C,E) + r_N C + r_J E\\ &= r_H a(C,E)(1-s^*(C,E)) + r_S b(C,E)s^*(C,E) + r_N C + r_J E\\ &= r_H a(C) - r_H a(C)s^*(C,E) + r_S b(E)s^*(C,E) + r_N C + r_J E\end{aligned}$$

Differentiate with respect to E:

$$\begin{aligned}\frac{\partial Y}{\partial E} &= -r_H a(C)\frac{\partial s^*(C,E)}{\partial E}\\ &\quad + r_S\left[b'(E)s^*(C,E) + b(E)\frac{\partial s^*(C,E)}{\partial E}\right] + r_J\\ &= \underbrace{r_S b'(E)s^*(C,E) + r_J}_{\text{direct effect}} + \underbrace{(r_S b(E) - r_H a(C))}_{\text{net earnings change}}\underbrace{\frac{\partial s^*(C,E)}{\partial E}}_{\text{change in } s}\end{aligned}$$

■

Figure C1: Comparative Advantage



Notes: Each line represents an isoquant in a plane where E and C are in the x and y axes and $s^*(C, E)$ is in the z-axis. Darker shades indicate higher values of z. Functional form choices are $a(C, E) = C$, $b(C, E) = E$, $C(1 - s, C, E) = (E + (1 - s))^2$.