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Personality characteristics and long-term labor market outcomes: Evidence from twins

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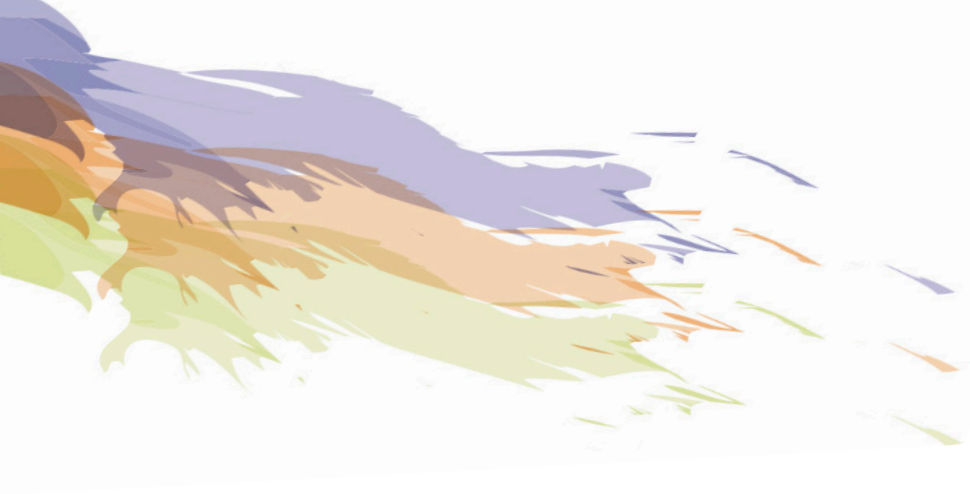

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Tiivistelmä

Tutkimuksessa tarkastellaan persoonallisuuden vaikutuksia pitkän aikavälin ansioihin ja työllisyyteen. Tarkastelu perustuu suomalaiseen kaksosaineistoon, jonka avulla on mahdollisuus ottaa huomioon perhetaustaan ja genetiikkaan liittyvien muuten havaitsemattomien tekijöiden vaikutus aikaisempia tutkimuksia paremmin. Tutkimuksessa käytetään faktorianalyysia mittaamaan latentteja persoonallisuuden piirteitä vuodelta 1981. Näitä ovat sosiaalisuus, miellyttävyys, suorituskeskeisyys, järjestelmällisyys, aktiivisuus ja rehellisyys. Tutkimuksessa hyödynnetään lisäksi tietoa neuroottisuudesta. Työmarkkinatulemia (työllisyyskuukausia ja ansiotasoa) mitataan vuosien 1990-2009 keskiarvolla. Tulosten mukaan suorituskeskeisten henkilöiden ansiotaso on selvästi korkeampi muihin ryhmiin verrattuna 20-vuoden seurantajakson aikana. Suorituskeskeisyys on myös positiivisessa yhteydessä korkeampiin pääomatuloihin. Tulokset eivät muutu, vaikka henkilöiden koulutus, aiempi terveydentila, negatiiviset elämäntilanteet ja terveyskäyttäytyminen otetaan huomioon.

Abstract

We use twin data matched to register-based individual information on earnings and employment to examine the association between personality and long-term labor market success. The average of an individual's earnings and employment were measured in adulthood over the 1990-2009 period. In contrast to previous studies, we use the within-twin dimension of the data to control for unobservable shared family background and genetic confounding factors. Our results suggest that these unobserved factors partly explain the well-documented relation between personality and labor market success. However, we find that achievement (a facet of conscientiousness) is related to higher earnings in the labor market.

Keywords: personality; earnings; employment; unobserved heterogeneity; twin studies

JEL codes: J24; J31

I. Introduction

The role of personality in the labor market has gained growing interest in economics, and as Heckman *et al*. (2006) noted, non-cognitive and cognitive skills are both important in personal achievement. Personality characteristics can be considered as determinants of workers' productivity. Therefore, similar to cognitive ability, personality characteristics are an essential element of human capital, which leads to variations in labor market success such as earnings or labor market attachment (Mueller and Plug, 2006).

The relationship between personality and earnings has been recently documented in many studies. Among the Big Five taxonomy, neuroticism has been linked to lower earnings and weaker extrinsic career success and job performance (Judge *et al*., 1999; Barrick *et al*., 2001; Heineck, 2011; Nandi and Nicoletti, 2014), as has agreeableness (Heineck, 2011; Nandi and Nicoletti, 2014).[1] Personality characteristics that have been related to favorable labor market outcomes include extraversion (Judge *et al*., 1999; Seibert and Kraimer, 2001; Nandi and Nicoletti, 2014; Viinikainen *et al*., 2010)[2], openness to new experiences (Nandi and Nicoletti, 2014), conscientiousness (Barrick and Mount, 1991; Judge *et al*., 1999; Barrick *et al*., 2001), and better self-esteem (e.g., Goldsmith *et al*., 1997; Murnane *et al*., 2001; Waddell, 2006; Heckman *et al*., 2006; Drago, 2011). Differences in personality characteristics have also been used to explain earnings differentials between genders (e.g., Mueller and Plug, 2006; Fortin, 2008) and second-generation immigrants and individuals with native-born parents (Hanes and Norlin, 2011).

[1] The Big Five consists of five personality traits: openness to new experiences, conscientiousness, extraversion, agreeableness and neuroticism (Costa and McCrae, 1992).

[2] Nyhus and Pons (2005) found a negative association between extraversion and wages, while Mueller and Plug (2006) found the association to be negligible.

Personality also matters in employment. Mohanty (2010) finds that positive attitude and optimism are positively related to employment probability and, according to Wichert and Pohlmeier (2010), the Big Five personality traits are important in explaining female labor force participation. Uysal and Pohlmeier (2011) find that conscientiousness has a positive and neuroticism has a negative association with the probability of finding a job following job loss.

This paper explores the consequences of personality for long-term earnings and employment. We contribute to the debate in three major ways. First, the identification of a personality effect is challenging because there are unobservable factors that are correlated with both personality and labor market success (e.g., Almlund *et al*., 2011; Fletcher, 2013). These confounding factors include, e.g., shared environmental factors, such as family background, neighborhood and peer effects, as well as genetic factors, such as risk and other preferences. Fletcher (2013) used data on siblings and found that extraversion is associated with favorable labor market success. Although the within-sibling analysis controls for shared environmental effects, it is unable to take into account inherited traits, leaving open the possibility that genetic-based unobserved heterogeneity remains. Our contribution is to use data on non-identical (dizygotic, DZ) and identical (monozygotic, MZ) twins, which allows us to control for both shared environments and inherited traits. Using data on DZ twins is the same as controlling for sibling effects as in Fletcher (2013) because DZ twins originate from the same family and neighborhood and share approximately 50 % of their genes. Using data on MZ twins allows us to further control for inherited traits because two MZ twins are genetically identical at the sequence level (e.g., Goldberger, 1979). MZ twins are also believed to have more similar environments than DZ twins (Griliches, 1979).

Second, we contribute to the literature by using register-based data on wages and employment that originate from accurate administrative registers. The use of self-reported

labor market outcomes would be problematic if personality affects the way individuals assess their job market performance (Hamermesh, 2004). Our outcome variables are independent in terms of data collection; therefore, the potential bias resulting from self-reported labor market information is eliminated.

Third, as Haider and Solon (2006) and Böhlmark and Lindquist (2006) noted, cross-sectional measures on wages and employment are inaccurate proxies for individuals' life-time labor market success. In the context of personality, this is particularly worrying because the relationship between personality and labor market success may be sensitive to both economic situations (e.g., occupational differences in vulnerability to macroeconomic shocks) and age. For example, the job market success effect of personality is arguably weaker at the beginning of the working career when individuals have had fewer opportunities to prove their abilities and promote their careers. In contrast to earlier studies, we focus on lifetime labor market information and use the average of an individual's earnings and employment over a 20-year period (1990-2009).

In accordance with earlier studies, our Ordinary Least Squares (OLS) results show that various personality characteristics such as neuroticism and facets of conscientiousness and extraversion are strongly associated with labor market outcomes. However, our within-twin estimates for identical twins show a much weaker contribution of personality. We find that achievement (a facet of conscientiousness) is positively related to lifetime earnings.

The remainder of this paper is organized as follows. Section II describes the data and the latent personality characteristics that are constructed via principal component analysis. The data also include information on neuroticism. Section III presents the econometric model, and Section IV presents the results and their various robustness tests. Finally, Section V concludes the paper.

II. Data description

Data sources and the sample

Our data are based on the Older Finnish Twin Cohort Study (of the Department of Public Health at the University of Helsinki), which has been linked to the Finnish Longitudinal Employer-Employee Data (FLEED) of Statistics Finland.[3] The Finnish Cohort Study was initially compiled from the Central Population Registry of Finland. Initial twin candidates were persons born before 1958 with the same birth date, commune of birth, sex, and surname at birth (Kaprio *et al.*, 1979). A questionnaire was mailed to these candidates in 1975 to collect baseline data and to determine their zygosity. Two follow-up surveys were conducted in 1981 and 1990. The 1990 survey was solely sent to twins who were born after 1930, and the response rate for this survey was 77 %, providing us with 12,502 twin pairs in total. Importantly, the twin survey contained information on psycho-social factors.

The twin data are linked to FLEED using personal identifiers. This is exact matching, and there are no misreported ID codes. Therefore, we avoid problems created by errors in record linkages (e.g., Ridder and Moffitt, 2007). FLEED is an annual panel over the years 1990-2009, which covers the working-age population of Finland. Thus, we are able to track the labor market behavior of the twins who participated in the original twin surveys. FLEED is constructed from a number of different administrative registers on individuals, firms and establishments that are maintained by Statistics Finland. The data include information on

[3] The twin study linked to FLEED has been used previously, and the earlier studies can be consulted for details about overall response rates, attrition and representativeness of the twin sample. For example, Hyytinen *et al.* (2013, p. 63) and Maczulskij (2013, p. 95) provide evidence for the representativeness of the twin sample by comparing it to a one-third random sample of all Finns using FLEED and covering the same age cohorts.

individuals' labor market status and earnings taken directly from tax and other administrative registers. Thus, our employment and earnings data do not suffer from underreporting, recall errors or top-coding. Our final sample comprises employed and unemployed men and women who were at least 33 years old in 1990. With regard to the analysis on earnings, we solely focus on employed individuals.

Dependent variables

The dependent variables are long-term earnings and employment. Our measure of long-term earnings is calculated as the logarithm of the average of annual wage and salary earnings and self-employment income over the 1990-2009 period. The income measure is deflated to 2009 euros by using the consumer price index. Our measure of long-term employment is calculated as the average employment months over the 1990-2009 period.

Latent personality traits

The data contain information on neuroticism that originates from the 1981 survey. Neuroticism was initially assessed by 10 items in the short form of the Eysenck Personality Inventory.

The data also contain information on 18 statements that describe different dimensions of personality. Statements such as 'unsure – self-confident' and 'lazy – studious' were self-assessed on a five-point scale (1 = strongly disagree, 5 = strongly agree). The correlations among these statements were, in many cases, high, which suggests that the clusters of the statements represent the same underlying personality dimensions. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO $\approx$ 0.772) and Bartlett's test of sphericity (χ^2 =

39818.16, df = 153, $p < 0.001$) both supported the factorability of our personality data. Therefore, we applied a principal component analysis to reduce multiple variables to a lesser number of underlying (latent) factors that are measured by the initial variables.

The results of the rotated factor loadings are presented in Table 1. As suggested by Matsunaga (2010), we specified the rotation method as 'Promax', which provides solutions with correlated components, i.e., oblique solutions. Based on Kaiser's criterion, six factors were retained, with their eigenvalues varying between the levels of 3.46 and 1.06. The cumulative variance explained by these six factors was 63.92 %.

Among the personality traits that characterize the first component with high scores (between 0.66 and 0.83) are talkative, emotional, open and communicative. Thus, the first rotated factor appears to be a 'talkative and socially poised' dimension. It may reveal a facet of extraversion, namely, a social individual. Factor 2 is moderately dominated by the dominant variable (loading = 0.79), although the loadings for ambitious, determined and confident are also fairly substantial (ranking from 0.63 to 0.72). This factor appears to describe an 'ambitious and self-confident' dimension, which reveals a high-profile, achievement-oriented individual. The significant loadings on the third rotated factor are also strong loadings (the smallest is 0.81): calm, amicable and peaceful. Factor 3 appears to measure a 'non-hostile and cooperative' dimension. Thus, factor 3 reveals a low-profile and agreeable individual. [4]

The personality aspects that load highest on factor 4 are quick, studious and prompt, with the loadings varying between 0.62 and 0.77. Thus, factor 4 appears to describe a

[4] Using the same sample of twins, Koskenvuo *et al*. (1988) examined hostility as a risk factor in mortality and heart diseases. In the researchers' epidemiological study, the hostility scale was also factor-analytically constructed and included three items: irritability, ease of anger arousal and argumentativeness; these are exactly the same items that we have in our latent factor.

'hardworking, productive and responsible' dimension. High scores on this dimension reveal a high-order individual, which is one of the facets of conscientiousness. Factor 5 is dominated by the variables truthful (loading = 0.87) and honesty (loading = 0.82). Factor 5 evidently measures an honest individual. The loadings that are significant on the sixth factor are inactive (loading = -0.68) and multitasking (loading = 0.79). Thus, the sixth rotated factor appears to describe an active individual who possesses a lower-order trait of extraversion.

We tested the generalizability of the factor analysis by using similar personality data from the 1990 survey. The communalities and factor loadings were the same on both analyses, suggesting that the findings are generalizable and valid.[5]

We then computed standardized factor scores with the following names: sociability, achievement, agreeableness, order, activity and honesty. Our latent factors of sociability and activity contain aspects that are related to the Big Five extraversion trait, and achievement and order are related to the Big Five conscientiousness trait (Costa and McCrae, 1992; Dudley *et al*., 2006). Interestingly, a sixth factor of personality beyond the Big Five traits has also been proposed: honesty-humility. This trait describes individual differences in sincerity, fairness, greed avoidance and modesty (e.g., Ashton and Lee, 2005). Thus, all of our personality measures are closely related to previously well-established traits. Therefore, we are inclined to interpret those traits in a similar fashion. The personality variables are standardized to have a mean of zero and a standard deviation of one to obtain easily comparable regression coefficients.

[Table 1 in here]

[5] We use the personality characteristics measured in 1981 because the sample size for the 1990 survey is nearly one-half of that for the 1981 survey.

Other control variables

There may be unshared experiences between siblings of the family that shape both personality and labor market success (e.g., Riese *et al*., 2013). Therefore, we control for number of diseases, past adverse shocks and pre-determined labor market attachment in all specifications. The number of chronic diseases (as measured in the 1975 survey) is used to account for pre-existing health endowments.[6] These diseases include, among others, emphysema, chronic obstructive pulmonary disease, high blood pressure, angina pectoris, peptic ulcer, diabetes, and gout. The adverse shocks were selected from the 17 Holmes and Rahe items as measured in the 1981 survey. These include death of a spouse, death of another close person, a radical change in the health of a close person and disease or injury causing more than three weeks disability from work. These shocks are pre-determined for our personality measures because the prevalence of each negative life event was determined by 'happened to me during the last five years or earlier'. For a proxy for past adverse shocks, we also include information on the employment status from 1975 into our model. For example, a less intense labor market attachment in 1975 may be a result of certain unobserved initial endowments outside negative life events and pre-existing health.

We also include gender and age in the OLS specification to be more comparable to the specifications that are estimated using the within-twin pair regression that automatically controls for such invariant within-twin variables. However, we include no other control variables in the models because many of the variables are considered 'bad' controls (e.g.,

[6] Low birth weight has been linked with worse health in adulthood and also with weaker labor market success (e.g., Behrman and Rosenzweig, 2004). Because even MZ twins can differ in their birth weight, there may be an endogeneity problem caused by omitted variables in the within-twin-based analyses. Unfortunately, we have no information on birth weight; however, the number of chronic diseases may capture, at least partly, the potential adverse effects of low birth weight on both personality and outcomes.

Angrist and Pischke, 2009, p. 64). For example, education is a potentially bad control because personality characteristics are likely to affect educational outcomes; therefore, education is not predetermined (Almlund *et al*., 2011). However, the results are subjected to robustness testing.

Descriptive statistics and within-twin differences

Table 2 reports the average long-term earnings in euros and average employment months, conditional on personality traits in 1981. Each personality trait is divided into a low dimension (personality trait score under the median) and high dimension (personality trait score over the median). Persons who have high scores on neuroticism, honesty, sociability and order have significantly weaker labor market earnings compared with persons who have low scores on those characteristics. In turn, those who have higher scores on agreeableness have significantly higher earnings compared with persons who have low scores on these traits. Activity and achievement appear to be favorable both for earnings and labor market attachment.

[Table 2 in here]

Individual differences in personality arise from three distinct sources: genetic inheritance, shared environment and non-shared environment (Krueger and Johnson, 2008). The research using twin data shows that approximately one-half of the variation in each Big Five personality trait is accounted for by genetic factors (Bouchard and Loehlin, 2001). The distinction between shared and non-shared experiences is subtle. Although family members may experience objectively similar events (e.g., a household move), the event is a shared

experience only to the extent that it makes family members similar. Based on earlier studies (Krueger and Johnson, 2008), different perceptions of objectively similar environments and non-shared experiences (e.g., having different friends) are likely to cause differences in personality characteristics, also among identical twins. This is necessary for model identification.[7] The descriptive evidence shows that, within DZ and MZ twins, over 40 % of pairs belong to different personality dimensions, whether under the median or over the median (e.g., low neuroticism vs. high neuroticism). Differences in personality traits are smaller for MZ twins; however, approximately one-third of those twins belong to a different 2-group classification of personality traits.

III. Empirical model

Our econometric analysis builds on the following model:

$$Y_{ij} = \alpha + \boldsymbol{\beta}'\mathbf{P}_{ij} + f_j + g_{ij} + \varepsilon_{ij} \quad (1)$$

where Y_{ij} represents long-term earnings or employment of twin *i* in twin-pair *j*. $\mathbf{P}_{ij}$ is a vector of seven personality characteristics, f_j is unobserved family endowments common to both twins of pair *j*, g_{ij} is unobserved genetic endowments specific to twin *i* of pair *j* and ε_{ij} is a random shock to twin *i* of pair *j*.

The labor market equation is first estimated by OLS. This provides estimates for $\boldsymbol{\beta}$ that are denoted by $\boldsymbol{\beta}_{OLS}$. For $\boldsymbol{\beta}_{OLS}$ to be a consistent estimator of the coefficient vector of

[7] If non-shared experiences and different perceptions of similar environments affect both personality characteristics and labor market outcomes, omitted variable bias will be introduced. To control for this possibility, we add several adverse life shocks and previous employment to the model.

personality traits, $\boldsymbol{\beta}$, the moment condition $E\left[f_j + g_{ij} + \varepsilon_{ij}|\mathrm{P}_{ij}\right] = 0$ should hold. This condition does not hold if f_j or g_{ij} is correlated with people's personality characteristics. Because f_j and g_{ij} are generally unobserved (or poorly measured), Equation (1) omits these terms and may yield biased estimates of the association between personality traits and labor market outcomes. For example, a negative correlation between risk-aversion and personality traits (such as sociability, a facet of extraversion) will lead $\boldsymbol{\beta}_{OLS}$ to underestimate the true value of $\boldsymbol{\beta}$.

We use within-twin variation among the DZ twins to difference out the family effects, f_j. In the twin-differenced DZ sample, the estimator is consistent if $E\left[\left(g_{2j} - g_{1j}\right) + \left(\varepsilon_{2j} - \varepsilon_{1j}\right)|\left(\boldsymbol{P}_{2j} - \boldsymbol{P}_{1j}\right)\right] = 0$, where the terms inside the brackets refers to the within-sibling differences of variables. The condition does not hold if $\left(g_{2j} - g_{1j}\right)$ is correlated with $\left(\boldsymbol{P}_{2j} - \boldsymbol{P}_{1j}\right)$. Furthermore, if the twins are identical, then $\left(g_{2j} - g_{1j}\right) = 0$, and so the genetic effects can also be differenced out. Using the within-twins variation among the MZ twins thus yields an estimator denoted by $\boldsymbol{\beta}_{MZ}$. The assumption is that $\boldsymbol{\beta}_{MZ}$ is a consistent estimate of $\boldsymbol{\beta}$ and less biased than $\boldsymbol{\beta}_{OLS}$.

Although twin data are used to control for otherwise unobservable family background and genetic factors, it is not without problems. As previously discussed in Gerdtham *et al.* (2015), there are two well-known potential problems with within-twin-based design. First, twin data are not a silver bullet to endogeneity problems caused by omitted variables because there may be exogenous life-events, which affect both personality and labor market outcomes. To mitigate this problem, we augment the model with several adverse life-events and prior employment. Accordingly, MZ twins can differ in their initial endowments, such as birth weight (Bound and Solon, 1999). Higher birth weight has further been linked to personality, such as higher mental stability (i.e., lower neuroticism), extraversion (e.g., Eryigit-Madzwamude *et al.*, 2015), and labor market success (e.g., Behrman and

Rosenzweig, 2004). If birth weight is positively related to both personality characteristics and earnings/employment, our within MZ twin-pair results would be upward biased because we have no data on birth weight.[8] We discuss these potential problems in the conclusion chapter with the findings. The second problem is that twin-differencing may exacerbate the measurement error problem compared with ordinary cross-section analysis (Griliches, 1979; Bound and Solon, 1999). If personality measures were subject to classical measurement error, our results would be downward biased and lead to conservative estimates for personality characteristics.

IV. Results

Main results

We present our results for the earnings regression in Table 3. The table reports standardized coefficients and standard errors that are clustered by twin pair, allowing for within-twin pair variation. The baseline estimates using the standard OLS specification indicate that higher neuroticism and sociability are related to lower earnings, whereas activity and achievement are associated with favorable earnings (Column 1). For example, the point estimates imply that a one-standard deviation increase in neuroticism score and sociability score is associated with a decrease in the average life-time earnings of approximately 2 and 3 %, respectively. Similar increases in activity and achievement are related to 5-8 % higher earnings. Our result for neuroticism is well in accordance with earlier findings. The coefficients for activity and

[8] MZ twins are also found to differ in their ability, which is highly correlated with education and income. However, most personality characteristics are, in fact, very weakly correlated with IQ (e.g., Almund *et al*., 2011).

achievement are also positive, as expected, because they are the facets of extroversion and conscientiousness from the Big Five that prior literature has found to positively affect job market performance. Interestingly, Dudley *et al*. (2006) found that, in particular, the achievement dimension is favorably associated with earnings.

Sociability, which is related to extraversion, has a negative coefficient. Although extraversion has been mainly linked to better labor market performance, it is possible that certain facets contribute in the opposite direction. For example, if sociability leads to counterproductive behavior such as spending excessive time talking and socializing with others, it can reduce productivity and therefore earnings. Social individuals may also be more present-oriented, which could lead to more short-sighted choices in the labor market. The relationship between agreeableness and earnings is positive, and the relationship between honesty and earnings is negative. These results are not entirely in accordance with earlier studies (e.g., Nandi and Nicoletti, 2011; Heineck, 2011; Johnson *et al*., 2011). These discrepancies could be attributed to differences between the personality measures used in our study and those in earlier literature.

The point estimates for personality traits typically decrease when we focus on the twin-differenced DZ-MZ model (Column 2) and the smaller DZ sample (Column 3), both of which control for the shared environment. Finally, the results of the within MZ twin-pair regressions (Column 4) reveal that only achievement remains statistically significant. Our main result indicates that a one-standard deviation increase in the achievement score is associated with an earnings increase of 3 %. Our findings also demonstrate that the personality coefficients in Column 1, to a great extent, reflect family background and genetic differences. Many earlier studies have reported a positive relationship between conscientiousness and earnings (e.g., Barrick and Mount, 1991; Judge *et al*., 1999; Barrick *et al*., 2001). Using data on siblings,

Fletcher (2013) similarly found a positive connection between conscientiousness and any earnings that is about the same magnitude as our MZ coefficient for achievement.

It is interesting to note that the coefficient of activity is positive and statistically significant in the DZ sample but not in the MZ sample. This finding indicates that some of the genetic effects are positively correlated with activity, which may lead to an upward bias in the DZ estimates. There are many potential explanations for the differences in the DZ and MZ estimates. One is that personality and risk preferences are correlated (e.g., Nicholson *et al*., 2005). In particular, risk-loving behavior is positively correlated with extraversion (and therefore probably with activity). Because risk preferences are at least partially genetically inherited (e.g., Cesarini *et al*., 2009), they are better differenced out in the MZ sample than in the DZ sample.

Our results for the employment regression are presented in Table 4. The baseline estimates using the standard OLS specification (Table 4, Column 1) are somewhat similar to those from the earnings regression presented in Table 2. In particular, neuroticism and sociability are related to lower labor market attachment, whereas activity and achievement are associated with higher labor market attachment. Again, our preferred results are those from a within MZ twin-pair specification, presented in Column 4, which fully accounts for the effects of shared environment and genetics. These results show that none of the personality characteristics remain statistically significant at the conventional level. The point estimate for achievement is large; however, it is statistically significant at the 12 % significance level. Fletcher (2013) found similarly that only conscientiousness was positively associated with employment in a model that controls for the effects of shared environment.

[Tables 3-4 in here]

According to Barrick *et al*. (2001), high conscientiousness (i.e., achievement) is related to better success in the labor market because being dependable, responsible and productive (high conscientiousness) is likely to promote performance. In empirical research, high conscientiousness has been related to effective job-seeking behavior, reduced work absences and decreased counterproductive behavior (for a review, see Judge *et al*., 1999). Conscientiousness can also promote success in teamwork because this trait should facilitate interaction with co-workers and customers (Buch and Anderson, 2009; Barrick *et al*., 2001).

Robustness checks

Our within MZ twin-pair estimations are suggestive of a non-negligible positive association between achievement and long-term earnings. However, our baseline models did not include any control variables other than adverse life experiences. We included education years and marital status measured in 1981 as additional controls to the MZ-differenced model. The result for achievement remained intact, which is not surprising because the use of twin differences controls for many potentially confounding factors.

Our results are not highly sensitive to the way that we measure long-term earnings either. As a robustness test, we used another measure for earnings, namely monthly earnings, as the dependent variables. The rationale behind the use of monthly earnings as the outcome variable comes with the possibility that the association between personality characteristics and earnings is due to the differences in labor market attachment instead of greater earnings per unit of labor supplied. In this analysis, we also excluded all of the individuals with zero employment months per year from the sample. The estimate for achievement remained statistically similar. For brevity, we do not tabulate these analyses in detail, but the results are available from the authors.

We further stratified our MZ twin-differenced model for earnings based on gender and wage level to examine potential heterogeneity of associations (Table 5). The wage level is classified as 'high' or 'low'. The category 'high' includes those whose lifetime earnings are above sex-specific median earnings, and the category 'low' includes those whose lifetime earnings are below sex-specific median earnings. This approach allows us to move beyond the mean impacts and address the question of whether the connections are constant across the lifetime earnings distribution.[9] The positive relationship between achievement and earnings appears to be relevant only for women; however, the point estimate is also large and marginally statistically significant for men. Achievement and activity are also positively related and honesty is negatively related to high-wage individual earnings. Extraversion (such as activity) has typically been connected to better job performance, particularly in occupations in which interaction with others plays a significant role (Barrick *et al*., 2001). High extraversion is also associated with leadership (see Buch and Anderson 2009, for a review), which could explain the positive correlation between Activity and the labor market success of high-wage individuals.

[Table 5 in here]

Extensions

We now move beyond the estimates and consider three potential sources of bias in our findings regarding earnings. These within-twin MZ results are reported in Table 6. First, we examine the possibility that the relationship between achievement and labor market success is driven by reverse causality. Early income is strongly correlated with subsequent income.

[9] With regard to employment, none of the personality characteristics mattered for males or females or for low-wage individuals or high-wage individuals. For brevity, these results are not reported.

Thus, if the early labor market success or failure has already shaped personality in 1981, as the prior work suggests (see, e.g., Roberts *et al*., 2003), our estimates might reflect reverse or two-way causality. Reverse causality can be ignored if personality characteristics were stable. There is, however, increasing evidence that the Big Five personality traits do change both at the aggregate level (Specht *et al*., 2011) and particularly at the individual level (Roberts *et al*., 2008). Our measure of early labor market success is the individual's annual taxable income in 1980, which is one year before the personality characteristics were measured. It is unlikely that our results reflect two-way causality because the estimate of Achievement remains intact.

There are several potential mechanisms that could explain the connection between personality and labor market outcomes. Thus, second, we examine whether health behavior differences drive the personality effects. For example, conscientiousness is associated with a number of health-promoting behaviors that include responsible drinking and smoking habits, healthy diet (Lunn *et al*., 2014) and physical activity (e.g., Raynor and Levine, 2009). Thus, the estimated positive effect of achievement (a facet of conscientiousness) may be due to health-promoting behaviors that affect work absences and productivity, for instance. Therefore, we add smoking, alcohol use, body-mass index (BMI) and leisure time physical activity (conditioning exercise) taken from the 1981 survey into our within MZ-twin model.[10] Again, the estimate for achievement remains intact.

Finally, we estimate our earnings model using capital income as the dependent variable. Capital income includes capital gains, rents, dividends and taxable interest payments, as well

[10] Our measure for smoking is self-reported retrospective cigarette pack-years. The quantity of alcohol consumption is measured by daily average consumption in grams using self-reported data from 1981. BMI is calculated as height in meters/(weight in kilograms^2). Physical activity (conditioning exercise) is classified as follows: those who have reported exercising at least 6 times per month for a mean duration of at least 30 min and with a mean intensity corresponding to at least vigorous walking to jogging.

as income for a business-owner. This addition is an interesting extension to the previous literature, which usually focuses on earnings because capital income may provide additional information regarding the role of personality on earnings ability. The advantage of using data on siblings is that bequests are divided equally by default among all children in Finland; therefore, the bequests do not generate unobserved differences in capital income. Our dependent variable is now long-term capital income, which is calculated as the average of capital income for 1993-2009. During this period, Finland had a dual income taxation system.

There is a possibility that capital income earners are a selected group of individuals. Selection could be based on labor market earnings: individuals with lower earnings face budget constraints, which make it more difficult to invest in the capital market. Certain personal characteristics also affect the individual's decision to become self-employed and thus receive capital income from the business he or she owns (e.g., Caliendo *et al*., 2014). Therefore, we augment our within MZ twin-pair model (Table 6, column 3) with lifetime earnings that also include entrepreneurial income. This augmentation explicitly controls for budget constraints and also implicitly controls for the decision of being self-employed.

The results show that, as in the case of earnings, achievement is related to higher capital income. Additionally, agreeableness was also negative and statistically significant in the capital income regression. The divergent role of agreeableness in the labor and capital income markets could reflect two possible processes. The first tentative conclusion is that personality characteristics that contribute to productivity are different in the labor and capital income markets. Second, as far as the determinants of productivity in the labor and capital income markets are the same, the role of personality on economic success should be the same in both of these markets. Because the role of discrimination is likely to be less prevalent in the capital income market compared to the labor market, the differences in our results may provide

suggestive evidence of hiring-based discrimination in favor of agreeable individuals in the labor market.

[Table 7 in here]

V. Conclusions

The importance of personality characteristics has been acknowledged in economics, and it is likely that, in the future, technological and organizational changes will further increase the importance of people skills in the work place (Borghans *et al*., 2006). This paper adds to the literature by examining the role of personality using twin data. The major advantage of this approach is that, by using within-twin differences, we are able to control for genetic endowments and family background effects, which could drive the observed relationship between personality and labor market success.

Based on our results, it appears that genetic differences and family background partly drive the relationship between personality and labor market success. Therefore, studies that are unable to control for these typically unobservable factors are likely to suffer from endogeneity bias, which raises concerns regarding the causal interpretation of the results. Accounting for unobserved genetic endowments and family fixed effects, we found that achievement (a facet of conscientiousness) was related to higher earnings.

Our analysis does not completely rule out non-causal explanations of the association between personality characteristics and labor market outcomes later in life. Our within-twin coefficients are subjected to omitted variable bias if there are differences in initial endowments (such as birth weight) and non-shared experiences (such as adverse shocks), which affect both personality and earnings. Twin-differencing may also exacerbate the measurement error problem compared with ordinary cross-section analysis (Bound and

Solon, 1999). We acknowledge these potential problems. If personality measures were subject to classical measurement error, our results would be downward biased and lead to conservative estimates for personality characteristics. We also address the problem of omitted variables, at least to some extent, by controlling for pre-existing differences in health and negative life shocks. The possibility for omitted variables remains, for example, with regard to birth weight. Studies on the relationship between birth weight and personality are scarce. Pesonen *et al*. (2008) found that birth weight is negatively related to conscientiousness, whereas Eryigit-Madzwamuse *et al*. (2015) found no connection between conscientiousness and birth weight. These previous studies thus suggest that our estimate for achievement (i.e., conscientiousness) could be downward biased. If this is true, together with the notion regarding classical measurement error, our estimate of the effect of achievement on earnings is therefore likely to be conservative.

Our results are not easily reconciled with the explanations of personality characteristics enhancing long-term earnings solely via education, health-promoting behaviors or reverse causality, although it appears that personality characteristics contribute differently to success in the labor and in the capital income market. It is plausible that personality characteristics that contribute to productivity are divergent in the labor and capital income market. In this case, our results concerning personality and earnings are likely to reflect the employers' and employees' utility- and profit-maximizing behaviors. However, if the determinants of productivity in the labor and capital income markets are the same, our results suggest personality-based discrimination in the labor market.

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Tables

Table 1. Rotated factor loadings

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Talkative	**0.738**	0.119	-0.024	0.012	-0.079	0.108
Emotional	**0.661**	0.016	-0.188	-0.148	0.197	-0.038
Open	**0.827**	-0.000	0.045	0.057	0.084	-0.013
Communicative	**0.797**	0.012	0.075	0.023	-0.076	-0.026
Determined	0.111	**0.657**	0.097	0.251	0.036	-0.128
Confident	0.176	**0.717**	0.100	0.109	-0.027	-0.081
Dominant	0.021	**0.792**	-0.162	-0.105	-0.004	0.043
Ambitious	-0.146	**0.630**	0.007	-0.047	0.024	0.341
Amicable	-0.011	-0.033	**0.808**	0.044	0.013	0.007
Peaceful	-0.021	0.012	**0.887**	-0.023	0.002	-0.002
Calm	0.040	0.030	**0.807**	-0.076	0.042	-0.027
Quick	0.261	0.056	-0.029	**0.650**	-0.119	0.176
Studious	-0.023	-0.032	0.034	**0.766**	0.095	0.088
Prompt	-0.154	0.086	-0.102	**0.623**	0.105	-0.302
Honest	-0.026	0.006	0.042	0.100	**0.824**	0.019
Tuthful	0.054	-0.005	0.016	-0.023	**0.867**	0.025
Inactive	-0.004	0.011	0.052	-0.375	-0.035	**-0.683**
Multitasking	0.017	-0.016	-0.007	-0.114	0.020	**0.791**
Factor name	**Sociability**	**Achievement**	**Agreeableness**	**Order**	**Honesty**	**Activity**

Note: High factor loadings are bolded.

Table 2. Long-term labor market outcomes by personality

	Average earnings (€)	F-test statistics	Average employment months	F-test statistics
Low Neuroticism	24,418		10.37	
High Neuroticism	22,830	39.65 ***	10.32	0.98
Low Sociability	23,839		10.43	
High Sociability	23,274	5.10 **	10.26	9.28 ***
Low Agreeableness	23,023		10.30	
High Agreeableness	24,089	18.14 ***	10.38	2.03
Low Achievement	21,543		10.29	
High Achievement	25,569	266.78 ***	10.40	3.21 *
Low Order	23,862		10.31	
High Order	23,250	5.99 **	10.38	1.63
Low Activity	22,620		10.27	
High Activity	24,492	56.26 ***	10.41	6.03 **
Low Honesty	23,964		10.33	
High Honesty	23,149	10.61 ***	10.36	0.38

Heteroscedasticity-robust F-test statistics for the null hypothesis of equal group means. *** ($p < 0.01$), ** ($p < 0.05$).

Table 3. Regressions of long-term earnings

	(1)	(2)	(3)	(4)
	All twins	DZ – MZ sample	DZ sample	MZ sample
	OLS regressions	Twin-differences	Twin-differences	Twin-differences
Neuroticism	-0.020 (0.006) ***	0.0002 (0.008)	0.004 (0.010)	-0.010 (0.014)
Sociability	-0.032 (0.006) ***	-0.017 (0.008) **	-0.018 (0.009) **	-0.015 (0.014)
Agreeableness	0.016 (0.006) ***	0.009 (0.008)	0.007 (0.009)	0.015 (0.013)
Order	-0.021 (0.006) ***	0.011 (0.008)	0.016 (0.009) *	-0.002 (0.013)
Achievement	0.079 (0.006) ***	0.055 (0.008) ***	0.064 (0.010) ***	0.034 (0.014) **
Activity	0.047 (0.006) ***	0.031 (0.007) ***	0.037 (0.009) ***	0.016 (0.013)
Honesty	-0.015 (0.006) ***	-0.004 (0.007)	-0.001 (0.009)	-0.012 (0.012)
Obs.	8322	4161	2720	1441

Notes: Standardized coefficients. Standard errors are robust to within-twin variation. *** ($p < 0.01$), ** ($p < 0.05$), * ($p < 0.10$). OLS regression in Column (1) includes controls for gender and average square of age. Each regression also include the following life-events measured before long-term earnings: pre-existing health, employment and negative life shocks.

Table 4. Regressions of long-term employment

	(1)	(2)	(3)	(4)
	All twins	DZ – MZ sample	DZ sample	MZ sample
	OLS regressions	Twin-differences	Twin-differences	Twin-differences
Neuroticism	-0.062 (0.034) *	0.010 (0.048)	0.049 (0.059)	-0.088 (0.080)
Sociability	-0.109 (0.033) ***	-0.051 (0.045)	-0.044 (0.052)	-0.064 (0.087)
Agreeableness	0.045 (0.031)	0.096 (0.042) **	0.103 (0.052) **	0.080 (0.070)
Order	0.055 (0.032) *	0.113 (0.043) ***	0.119 (0.052) **	0.099 (0.076)
Achievement	0.059 (0.034) *	0.076 (0.046) *	0.057 (0.057)	0.124 (0.080)
Activity	0.122 (0.032) ***	0.098 (0.043) **	0.113 (0.053) **	0.062 (0.075)
Honesty	0.043 (0.030)	0.054 (0.044)	0.085 (0.055)	-0.011 (0.074)
Obs.	8322	4161	2720	1441

Notes: Standardized coefficients. Standard errors are robust to within-twin variation. *** ($p < 0.01$), ** ($p < 0.05$), * ($p < 0.10$). OLS regression in Column (1) includes controls for gender and average square of age. Each regression also include the following life-events measured before long-term employment: pre-existing health, employment and negative life shocks.

Table 5. Within-MZ twins regressions of long-term earnings by sex and earnings level

	(1)	(2)	(3)	(4)
	MZ sample	MZ sample	MZ sample	MZ sample
	Twin-differences	Twin-differences	Twin-differences	Twin-differences
Earnings	Men	Women	Low earnings	High earnings
Neuroticism	-0.006 (0.020)	-0.016 (0.019)	-0.006 (0.019)	0.008 (0.016)
Sociability	-0.012 (0.021)	-0.018 (0.018)	-0.007 (0.019)	-0.022 (0.018)
Agreeableness	0.003 (0.021)	0.025 (0.016)	0.020 (0.018)	0.015 (0.016)
Order	0.008 (0.020)	-0.015 (0.018)	-0.007 (0.019)	0.014 (0.015)
Achievement	0.036 (0.024)	0.032 (0.017) *	0.018 (0.021)	0.049 (0.016) ***
Activity	0.012 (0.019)	0.019 (0.016)	-0.003 (0.017)	0.031 (0.016) *
Honesty	-0.008 (0.020)	-0.015 (0.015)	0.010 (0.019)	-0.023 (0.014) *

Notes: Standardized coefficients. Standard errors are robust to within-twin variation. *** ($p < 0.01$), ** ($p < 0.05$), * ($p < 0.10$). Each regression also include the following life-events measured before long-term earnings: pre-existing health, employment and negative life shocks.

Table 6. Within-MZ twins regressions of long-term earnings (or capital income) with additional mediator/control variables

	(1)	(2)	(3)[a]
	MZ sample	MZ sample	MZ sample
	Twin-differences	Twin-differences	Twin-differences
Neuroticism	-0.002 (0.013)	-0.011 (0.014)	-0.053 (0.084)
Sociability	-0.017 (0.014)	-0.017 (0.014)	0.121 (0.091)
Agreeableness	0.015 (0.013)	0.017 (0.013)	-0.173 (0.074) **
Order	-0.008 (0.013)	0.0005 (0.014)	0.021 (0.085)
Achievement	0.032 (0.015) **	0.032 (0.014) **	0.130 (0.076) *
Activity	0.011 (0.013)	0.015 (0.013)	0.052 (0.080)
Honesty	-0.009 (0.013)	-0.012 (0.012)	0.049 (0.080)
Income80	0.095 (0.017) ***	-	-
Conditioning			
exercise	-	0.054 (0.033) *	-
Alcohol use	-	-0.003 (0.001) ***	-
Smoking	-	0.003 (0.003)	-
BMI	-	-0.003 (0.007)	-
Obs.	1253	1374	1426

Notes: Standardized coefficients. Standard errors are robust to within-twin variation. *** ($p < 0.01$), ** ($p < 0.05$), * ($p < 0.10$). [a] Column (3) reports the within MZ-twin pair regression results by using capital income as dependent variable. This specification includes a control for earnings. Because of missing observations for the added control variables, the sample size varies from column to column. Each regression also include initial endowments: pre-existing health, employment and negative life shocks.