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The Impact of Apprenticeship Training on Personality Traits: An Instrumental Variable Approach
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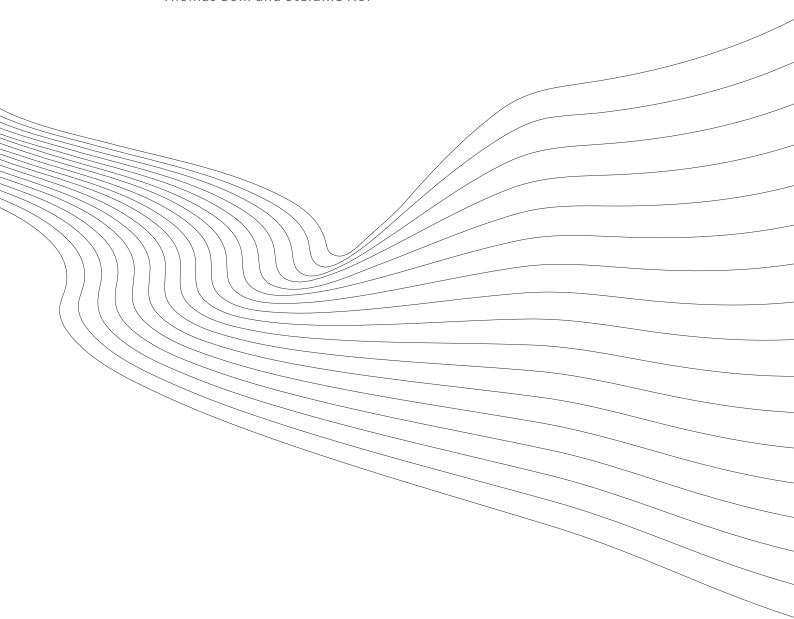**Rights / License:**
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Abstract

This paper analyzes how apprenticeship training, i.e., work-based secondary education, affects personality traits compared to full-time school-based vocational or general education. Employing an instrumental variable approach that exploits the regional differences in the relative weight of school- and work-based secondary education across Switzerland and Europe, we determine that apprenticeship training reduces neuroticism and increases agreeableness and conscientiousness, while openness and extraversion remain unaffected. These results validate the socializing function of work-based education. However, heterogeneous treatment effects are found, indicating positive effects for students with less favorable personality traits but insignificant or even reducing effects in the case of extraversion for those with already high values in personality traits.

1. Introduction

"The most promising adolescent programs integrate aspects of work into traditional education. […] In earlier times, adolescents took apprenticeships and jobs where they were supervised and mentored by adults. Mentoring involved teaching valuable character skills – showing up for work, cooperating with others, and persevering on tasks" (Heckman & Kautz, 2013, p. 35).

The relationship between non-cognitive skills and personality traits[1] and success in life has been widely demonstrated, as such skills and traits have been found to be strong predictors of academic performance and life outcomes (Almlund, Duckworth, Heckman, & Kautz, 2011; Borghans, Duckworth, Heckman, & Weel, 2008; Brunello & Schlotter, 2011; Fletcher, 2013; Heckman & Kautz, 2012; Lindqvist & Vestman, 2011). Though they may change as a result of educational experience, there is surprisingly little evidence on the effect of education on personality traits (Hanushek, Welch, Machin, & Woessmann, 2011; Heckman, Stixrud, & Urzua, 2006), and none of the studies focuses on apprenticeship training (work-based secondary education). Therefore, this paper aims to provide first evidence on the causal effect of apprenticeship training on personality traits as measured with an approximation of the Big Five personality traits concept (Costa & Mac-Crae, 1992; McCrae & Costa, 1987).

Breaking down the rigid separation between school and work, work-based secondary education may affect personality traits differently than full-time school-based education. We distinguish four potential channels of influence. The first suggests that a trade-off between teaching cognitive and non-cognitive skills exists (*Trade-off channel*). The second channel posits that the direct feedback from clients and colleagues has a different and stronger socializing effect than feedback from school peers and teachers (*Feedback Channel*). The third channel suggests that apprentices have more responsibility (*Responsibility Channel*). Finally, the fourth channel contends that school-based education provides more freedom (*Freedom Channel*).

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[1] Other terms used for similar concepts in the literature include soft skills, character skills, character, personality factors or socio-emotional skills (Borghans, Duckworth, Heckman, & Weel, 2008; Heckman & Kautz, 2013).

We exploit a dataset that follows participants of the 2000 Swiss Programme for International Student Assessment (PISA) examination at grade 9 up to the age of 25. To address endogeneity concerns due to selection and unobserved heterogeneity, we apply an instrumental variable approach that exploits regional differences in the relevance of general secondary education across Switzerland and in the share of work-based secondary education across the child's country of birth. Findings show that apprenticeship training reduces neuroticism and increases agreeableness compared to both school-based vocational and school-based general secondary education. Furthermore, there is evidence that conscientiousness is improved, while openness and extraversion remain unaffected. The results suggest that the impact on openness and neuroticism represent permanent shifts, while the difference in conscientiousness disappears over time.

Analyzing the heterogeneity of the effects reveals that apprenticeship training is most beneficial for individuals with less favorable personality traits. This is true regarding both openness and neuroticism. For individuals with high values in conscientiousness and extraversion, attending apprenticeship training may actually have a detrimental effect.

The remainder of this paper is organized as follows. Section 2 reviews the existing evidence on the effects of education on personality traits and discusses how apprenticeship training may affect personality traits. Section 3 reveals the data, and section 4 presents the estimation strategy. Section 5 reports our results of the impact of apprenticeship training on personality traits, and section 6 presents our paper's conclusions.

2. Literature and Theoretical Framework

Recent literature finds that non-cognitive skills, such as personality traits especially those related to conscientiousness, neuroticism and openness – have a significant impact on a wide range of outcomes (Almlund et al., 2011; Borghans et al., 2008; Brunello & Schlotter, 2011; Fletcher, 2013; Gensowski, 2013; Heckman & Kautz, 2012; Lindqvist & Vestman, 2011). However, persons with different endowments of personality traits choose different tasks and sort into different occupations and educations (Hanushek et al., 2011; Heckman et al., 2006).

These personality traits are not permanently entrenched at birth (Hanushek et al., 2011). While the literature claims that genetic factors are responsible for the stability of the personality, environmental factors are responsible for personality changes (Blonigen, Hicks, Krueger, Patrick, & Iacono, 2006; Borghans et al., 2008; Lykken, Bouchard, McGue, & Tellegen, 1993). Late adolescence and early adulthood seem to be critical and sensitive periods, i.e., a time when personality traits are still very fluid compared to adulthood (Roberts & Mroczek, 2008; Roberts, Walton, & Viechtbauer, 2006). As the predominant environment during adolescence and early adulthood is the educational environment, it may influence personality traits. Therefore, it is important to understand how personality traits can change, in particular, to what extent education influences the development of personality traits.

Only a few empirical studies have examined the causal relationship between education and personality traits. Heckman, Stixrud and Urzua (2006) formulate an economic model that identifies the effect of school years on cognitive skills and personality traits, taking into account the possibility of reverse causality. They find evidence that the number of years of schooling affects personality traits. For example, an additional year of high school and college positively affects self-esteem, while the locus of control is primarily affected by high school attendance, but not by college attendance. These two personality measures are not part of the traditional Big Five typology used in this research; however, they are associated with neuroticism, which is a Big Five factor.[2]

Some studies have analyzed the impact of different interventions[3] before or during school on personality traits. Studies based on the randomized Perry Preschool and STAR projects find that home visits, better peers and smaller classes positively impact personality traits (Dee & West, 2011; Heckman, Pinto, & Savelyev, 2012). While these two projects do not focus directly on the effect on personality traits, there are studies that do. For example, a randomized 3-year socio-emotional learning program, the Promoting Alternative Thinking Strategies (PATHS) curriculum,

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[2] Self-esteem refers to an individual's subjective sense of his own worth (De Wals & Meszaros, 2011). Locus of control refers to an individual's belief about whether the determinants of one's life are determined internally or externally (Rotter, 1966).

[3] For an overview, see Almlund et al. (2011), Brunello and Schlotter (2011) or Heckman and Kautz (2013).

is associated with an increase in authority acceptance, concentration and social competence (Bierman et al., 2010). Other interventions are more short-term and designed to isolate a particular effect. In a randomized experiment in Switzerland (Behncke, 2009), the treatment group received positive affirmation intervention before taking a math test. The test scores for the treatment group were significantly raised, which the author attributes to a change in non-cognitive abilities, such as an increase in student motivation and self-confidence and a decrease in test anxiety. Accordingly, the learning environment, e.g., teacher characteristics, seems to be crucial for the development of personality traits. In addition to providing limited guidance for the study at hand, by analyzing short-term interventions, these studies may measure an effect on short-term behavior, e.g., motivation, rather than on personality traits.

Others relate systemic features of school systems to personality traits (Falck & Woessmann, 2010). Luedemann (2011), for example, finds a small but significantly positive impact on students' personality traits results from the monitoring of teacher lessons by the principal or external inspectors according to assessments used to compare the school to district or national performance standards.

Theoretical Framework

Given the impact of personality traits on outcomes and the impact of environmental factors (i.e., education) on personality traits, the question whether apprenticeship training causes a change in personality traits is addressed in this research. Good-quality workplace learning – one aspect of an apprenticeship - provides students with valuable labor market experience before graduation by enabling apprentices to develop technical skills and gain real word experiences (OECD, 2013). There are at least four channels through which a causal effect of apprenticeship training compared to full-time school-based secondary education might arise.

The *Trade-off channel* stems from the possibility that schools face a trade-off between investments in cognitive skills and personality skills. Full-time schools measure student achievement by cognitive tests, as personality traits are difficult to measure. Moreover, general secondary education teachers are not allowed to rate or assess students' personality traits. Accordingly, full-time schools do not fo-

cus on the development of personality traits. Standardized tests assess cognitive skills and are subject to the possible teaching-to-the-test effect. Because apprentices, on the other hand, come into contact with clients, instructors are more inclined to invest resources in the development of personality traits.

The *Feedback Channel* arises because of the co-education of apprentices in both the school environment and the workplace as apprentices are supervised and mentored by professionals in the training firm and have contact with clients. Therefore, education in the workplace may involve the teaching of different personality traits (Heckman & Kautz, 2013; Lerman, 2013). For example, apprentices must report for work on time (punctuality), and they do not have the option of 'skipping' the first lesson. They must also cooperate with others (team work (OECD, 2013)), including not only students of the same age but adults and professionals who are older and more experienced. Therefore, apprentices face a much older and more experienced peer group. By serving as role models, these older peers may affect the personality traits of individuals. Furthermore, peers have the potential to sanction non-conforming social behaviors. Relatedly, as apprentices earn wages, the training firms also have the possibility to sanction non-conforming behaviors. Persevering on tasks (work discipline) and reliability represent examples of skills that apprentices must acquire to be successful in their workplace environment.

The *Responsibility Channel* arises because apprentices face more responsibility. First, they interact directly with clients. Second, they are responsible for valuable equipment, and third they serve as role models for the younger apprentices. Hence, during their education, they assume a supervisory and parental role for younger apprentices. Accordingly, acting responsibly is important and may lead to increased self-confidence and reliable behavior.

The *Freedom Channel* stems from the fact that students in general education profit from a higher degree of freedom and more leisure time. This includes the way students learn as well as the amount of leisure time they have each week as school-based education offers more than twice as much vacation time for students compared to apprenticeship programs, which typically offer 5 to 6 weeks of vacation time per year.

3. Data

In this research, we make use of the Transition to Education and Employment survey (TREE) [4]. The TREE is a longitudinal follow-up study to the PISA 2000 that was conducted in Switzerland. The TREE survey is administered each year between 2001 and 2007 and in 2010. The sample is representative of both the country as a whole and its three main language regions (German, French, and Italian). This unique database combines the variables in the standard PISA survey, such as parental background, PISA test scores and living conditions with information on personality factors and employment/education status.

Swiss Education System

After completing the Swiss compulsory school (9th grade), adolescents can choose among several possibilities. Almost half of the students (43%) enter apprenticeship training programs. Apprenticeships – dual vocational education or work-based education - are a core element of the vocational education and training (VET) in Switzerland and combine on-the-job training with classroom learning in a vocational school. The VET typically lasts three or four years. Apprentices attend school one or two days a week. Of the students finishing lower secondary education, 30% begin a general secondary educational program (high school), i.e., a full-time school that allows entry to universities upon successful completion, 9% choose another full-time school-based secondary educational program (HMS, DMS, FMS), i.e., a more vocational-oriented education with no direct access to universities (in this paper, we use the term "school-based vocational secondary education"), 16% follow an alternative education path, 1% enter the workforce and 1% do nothing. However, these percentages differ substantially among the various Swiss cantons (member states), and these differences have been highly persistent for the last 20 years (SKBF, 2011).

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[4] The Swiss youth panel study TREE (Transitions from Education to Employment; www.tree-ch.ch) has been ongoing since 2000 and is funded by the Swiss National Science Foundation, the University of Basel, the Swiss Federal Office of Statistics, the Federal Office of Professional Education and Technology, and the cantons of Berne, Geneva and Ticino. Distribution: Data service, FORS, Lausanne: http://www2.unil.ch/daris/spip.php?rubrique141&lang=en

Measures of Personality Traits

The five dependent variables represent the psychological concept of the Big Five personality traits. Each of these variables incorporates a large number of distinct, more specific personality characteristics. The Big Five factors are openness, conscientiousness, extraversion, agreeableness, and neuroticism. Because the TREE data do not contain direct information about these personality dimensions, we approximate each dimension with a number of self-reports[5], as summarized in Table 1a. Concretely, conscientiousness (CONSC) is captured as structured and determined approaches to difficult situations. The tendency to react emotionally to difficult situations approximates the dimension of neuroticism or emotional stability (NEURO). Openness to experience (OPEN) is modeled as intrinsic work motivation related to learning something new and utilizing competences. Extraversion (EXTRA) is captured by how active and enthusiastic the individual feels. Turning to other people when facing difficult situations approximates agreeableness (AGREE). Table 1d shows summary statistics for the factor scores divided by the educational path.

Factor analysis is the standard approach for defining constructs in personality psychology (Borghans et al., 2008). Using the within-cluster correlations of the measures, we isolate a latent factor for each of the Big Five personality traits. The factor loadings displayed in Table 1b confirm that the employed proxies represent independent dimensions.

4. Estimation Strategy

To assess the impact of attending apprenticeship training on personality traits, we start by estimating an OLS equation of the following form:

$$P_{it} = \alpha_t + \beta_1 A_i + \beta_2 B_{it} + \varepsilon_{it}, \qquad\qquad [1]$$

where A is a dummy variable indicating apprenticeship training and P represents the Big Five personality traits for student i at time t. B is a set of control variables,

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[5] Measurement of latent factors with self-reports may be false when false responses are made because of impression management or due to self-deception (Paulhus & Reid, 1991; Paulhus, 1984).

specifically, gender, age, PISA reading scores, socioeconomic background of mother and father, family structure, urban living. Tables 1c and 1d contain a description of all control variables included in the estimations as well as descriptive statistics. ε is a random error with mean 0, clustered at the individual level.

We construct our treatment group from individuals who start apprenticeship training in 2001 and remain apprentices until 2003, and we compare the outcomes to two control groups[6] that participate in full-time schooling (see description of Swiss education system in section 2). The first control group is comprised of individuals starting general secondary school (direct access to universities) in 2001 and remains in general secondary school until 2003. The second control group starts school-based vocational-oriented secondary education in 2001 and remains enrolled in the program until 2003. While this second control group is a rather small sample, it is meaningful because selection into apprenticeship (work-based education) might be more comparable to another educational program that does not allow direct access to the university, but is full-time school-based.

We extend the analysis of the average effect of apprenticeship training on the personality traits of adolescents in two directions. First, we use information in 2007 and 2010 to evaluate whether the estimated effects are merely transitory or whether work-based education has a permanent effect on personality traits. Second, we are interested in whether the effect is heterogeneous across the sample. Therefore, we split the sample according to the mean of the dependent variable and check whether work-based education affects individuals with low and high values in the corresponding personality traits differentially.

However, OLS estimates may suffer from an endogeneity bias due to selection, reverse causality or unobserved heterogeneity. For example, high neuroticism might lead the student to choose a high school rather than apprenticeship training. Because we can never observe the same student under different secondary education treatments, the credibility of an empirical analysis depends on the plausibility of the identification strategy. Therefore, we apply an instrument variable (IV) ap-

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[6] Using observations of individuals in the respective track in 2001, 2002, 2003 and 2004 yields qualitatively similar results.

proach (Angrist, Imbens, & Rubin, 1996). In this case, A in formula (1) represents predicted values based on the following first-stage model:[7]

$$A_i = \delta + \delta_t + \delta_1 B_{it} + \theta_1 z_{1j} + u_{it}, \qquad\qquad [2]$$

where z denotes our instrument variables and u is a random error term. Subscript j refers to a region (explained below), that is, either the canton or the country where the individual was born. Identification in our model results from the fact that the share of general secondary education among cantons in Switzerland varies highly (see Swiss Education System) as depicted in Table 1e.

The internal validity of our IV approach relies on the assumption that cantons and personality traits are independent. This assumption, however, may be violated, e.g., because of culture. We address this issue in four ways. First, we include a broad range of control variables. Second, we add dummies for seven areas in our estimation, implying that we only exploit within-area variation for the identification of the effect and thereby homogenize the variation in terms of, e.g., culture. Third, we include the average dependent variable in canton j in the model, thereby accounting for cantonal variation in the dependent variable trait. Fourth, we use an alternative instrument, namely, the share of work-based secondary education across Europe in the country in which the individual was born. This allows us to test formally the validity of our instrument using a Sargan test.

Using the inter-cantonal differences in the shares of general secondary students as an instrument, we measure the local average treatment effect (LATE) of apprenticeship training, that is, the impact on personality traits for individuals whose decision is affected by the share of general secondary education students in the canton (compliers). Those choosing apprenticeship training regardless (always-takers) are not affected by the instrument. Similarly, school leavers that would never attend apprenticeship training (never-takers) are also not affected by the instrument. Accordingly, our approach may not fully capture the externally valid causal effect. We gauge the relevance of this issue by comparing the estimates for different subgroups, i.e., gender, mother's education above and below ISCED 3A and values on PISA reading scores above and below the sample mean (Table 6). The qualita-

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[7] Due to the binary character of the endogenous variable, we estimate the model with the treatreg command of Stata 12.

tively similar results for these subgroups suggest that external validity is rather high. Further, external validity may be impaired by the fact that we drop changeovers and dropouts between education tracks from the sample. Assuming that the improvement in personality traits increases the probability of following through in a chosen education track, we interpret our estimates as a lower bound of the effect of apprenticeship training. However, our data suggest that the share of students changing educational tracks is fairly low.

5. Results

Table 2 displays the OLS estimates of the effects of apprenticeship training on personality traits, i.e., openness, conscientiousness, extraversion, agreeableness and neuroticism compared to the effects of school-based vocational (left hand panel) and general (right hand panel) secondary education. These estimates suggest that apprenticeship training compared to other vocational-oriented school-based secondary education has a positive impact on extraversion and lowers neuroticism. Compared to general secondary education, apprenticeship training lowers openness, conscientiousness and neuroticism, but has a positive impact on extraversion and agreeableness. However, these results may occur due to selection into work-based education.

The IV estimates are displayed in Table 3. Apprenticeship is instrumented by the cantonal average of the general secondary education share in 1998, and the instrumental variable coefficients for the instrument (Canton 1998) are significantly different from zero. Apprentice refers to the second-stage coefficients of the endogenized variable indicating apprenticeship status. The left and right panels compare apprentices to school-based vocational secondary students and general secondary students, respectively. All estimates include covariates that may affect the choice for apprenticeship training, i.e., socio-demographic and socio-economic background, age, gender, language, cantonal religion. We report Kleibergen-Paap weak instrument statistics, which substantially exceed critical values of 16 in all regressions.

Compared to school-based vocational or general secondary education, apprenticeship training significantly increases agreeableness and lowers neuroticism. No ef-

fect is found on openness, however. To aid in interpreting the magnitude of the estimated effects, remember that the dependent variables take values between -6 and 4, have a mean of 0 and a standard deviation of 1. Hence, a coefficient of 1 suggests that attending apprenticeship training (a change from 0 to 1) results in a change in the order of one standard deviation. Therefore, the estimated effects are economically significant.

To test whether omitted variables confound the cantonal share of the general secondary education identification strategy, we report robustness checks (Table 4) for seven areas (AREA), cantonal averages of the dependent variable (LDV) and the cantonal share of general secondary education in 1980 (1980) rather than 1998. All instruments have a significant correlation with the apprenticeship dummy, and all estimates include time dummies to increase precision and account for overall trends in personality development. The estimates confirm the baseline results in Table 3.

Moreover, using the share of work-based secondary education in a child's origin as an instrument variable (COUNTRY) confirms these results (Table 4). The models using country averages reported in Table 1e add controls for different covariates, as shown in Table 1c. Because origin may affect skills and, hence, educational choice, it is particularly important to add the control vector for estimates using country averages as instruments. The results confirm the baseline results and indicate a positive effect of work-based education on conscientiousness compared to school-based secondary education, a positive effect on extraversion compared to school-based vocational education, and a negative effect on extraversion compared to general secondary education.

Including both sets of instruments, i.e., child origin (COUNTRY) and cantonal (CANTON) instrument variables, we test whether the additional instrument is statistically valid. We report the p-values of Sargan's over-identification tests, which suggest that the instruments are uncorrelated with the error term with the exception of extraversion.

However, in the long term, the differences may diminish. As we conduct a 10-year follow-up study, we are able to analyze the medium- and long-term impact of apprenticeship training at age 22 and 25 (Table 5). Our results indicate that the im-

pact on personality traits remains in the long term. Only the effect on conscientiousness disappears over time.

Table 6 displays estimates for different subgroups. Most important are the results for the low and high values of the dependent variables. Individuals with high neuroticism profit most from attending apprenticeship training, while the opposite holds for extraversion (DV LOW, DV HIGH), thus indicating a heterogeneous treatment effect. These results suggest that apprenticeship training can enhance personality traits for individuals who start secondary education with less favorable personality traits. This is true regarding extraversion as well. Individuals with high values in this personality trait, however, who attend apprenticeship training may experience a detrimental effect.

Furthermore, Table 6 allows us to assess a potential problem in terms of external validity by revealing the respective results for subpopulations of the sample. In general, the results hold for all subpopulations. However, boys seem to benefit more than girls from work-based training as they exhibit higher values in conscientiousness and agreeableness.

6. Conclusion

Recent evidence documents that personality traits predict a wide range of life outcomes including educational achievement and labor market outcomes. Hence, information about how education impacts personality traits is crucial. Following the hypotheses of Heckman and Kautz (2013) that work-based education, e.g., apprenticeship training, may involve the teaching of valuable personality traits, we provide first evidence regarding the effect of work-based secondary education (apprenticeship training) compared to school-based secondary education on the Big Five personality traits.

We make use of a large representative PISA 2000 follow-up sample in Switzerland (TREE) and apply an IV approach to control for endogeneity. Identification in our model results from the fact that the share of general secondary education between cantons in Switzerland is highly varied.

The evidence in this paper indicates that education can change personality traits. Our estimates suggest that apprenticeship training has a relevant and significantly positive impact on agreeableness, it lowers neuroticism, and it might improve conscientiousness. These results validate the socializing function of work-based education. However, the estimates indicate heterogeneous treatment effects. Apprenticeship training can enhance personality traits for individuals with less favorable personality traits. In particular, conscientiousness, the tendency to be organized and responsible, which is observed as the most predictive across a variety of outcomes (Borghans et al., 2008; Heckman & Kautz, 2013), can be enhanced in apprenticeship training for students with less favorable personality traits. However, individuals with high values in extraversion may suffer from a detrimental effect of apprenticeship training.

Significant long-term effects are found regarding increase in agreeableness and the decrease in neuroticism, while the effect on conscientiousness disappears over time. The results further indicate that in the long run, extraversion may be negatively affected by apprenticeship training.

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8. Tables

Table 1a: Definitions of Dependent Variables

Big Five Item	Facets	American Psychology Association Dictionary	Approx-imation	Questionnaire Items	Likert Scale
Openness	Fantasy, Aesthetics, Feelings, Actions, Ideas, Values	The tendency to be open to new aesthetic, cultural, or intellectual experiences	**Intrinsic Work Motiva-tion**	Thinking about the future, how important is it to have a job, where I can always learn something new.	1=totally subordinate; 2=rather subordinate; 3=rather important; 4=very important
				Thinking about the future, how important is it to pursue an occupation in which I can fully deploy my competences.	1=totally subordinate; 2=rather subordinate; 3=rather important; 4=very important
Consci-entious-ness	Competence, Order, Dutifulness, Achievement, Self-discipline, Deliberation	The tendency to be organized, responsible, and hardworking	**Task-centered coping**	When I am stressed or find myself in a difficult situation, I analyze my problem before reacting.	1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical
				When I am stressed or find myself in a difficult situation, I focus on the problem and see how I can solve it.	1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical
				When I am stressed or find myself in a difficult situation, I think about the event and learn from my mistakes.	1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical
				When I am stressed or find myself in a difficult situation, I try to be organized, so I can effectively address the situation.	1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical

Extra-version	Warmth, Gregarious-ness, Assertiveness, Active, Excitement seek-ing, Positive emotions	An orientation of one's interest and energies to-ward the outer world of people and things rather than the inner world of subjective experience; characterized by positive affect and sociability	**Feeling active or enthusi-astic**	Over the last month, how active did you feel? Over the last month, how enthusi-astic did you feel?	1=not at all; 2=a little bit; 3=somewhat; 4=rather; 5=very 1=not at all; 2=a little bit; 3=somewhat; 4=rather; 5=very
Agreea-bleness	Trust, Straight-forwardness, Altruism, Compliance, Modesty, Tender-mindedness	The tendency to act in a cooperative, unselfish manner	**Contact-centered coping**	When I am stressed or find my-self in a difficult situation, I try to be with other people. When I am stressed or find my-self in a difficult situation, I visit a friend.	1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical 1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical
Neuroti-cism	Anxiety, Anger, Depres-sion, Self-consciousness, Impul-siveness, Vulnerability	Neuroticism is "a chronic level of emotional insta-bility and proneness to psychological distress". Emotional stability is "Predictability and con-sistency in emotional re-actions, with absence of rapid mood changes."	**Emotion-centered coping**	When I am stressed or find my-self in a difficult situation, I get angry. When I am stressed or find my-self in a difficult situation, I feel anxious about not being able to cope. When I am stressed or find my-self in a difficult situation, I blame myself for not knowing	1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical 1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very typical 1=very atypical; 2=rather atypical; 3=so, so; 4=rather typical; 5=very

	what to do.	typical
	When I am stressed or find my-	1=very atypical; 2=rather
	self in a difficult situation, I wish	atypical; 3=so, so;
	I could change what has hap-	4=rather typical; 5=very
	pened.	typical

Source: Rows two and three adapted from Costa and MacCrae (1992) and Heckman and Kautz (2013), respectively.

Table 1b: Rotated Factor Loadings of Items to Construct Big Five Personality Trait Approximations

Item	Conscien-tiousness	Neuro-ticism	Agree-ableness	Open-ness	Extra-version
Intrinsic Work Motivation	0.0706	-0.0194	0.0711	0.8658	0.0853
Intrinsic Work Motivation	0.0789	-0.0019	0.0486	0.8725	0.0572
Task-centered coping 1	0.7018	-0.2253	-0.0021	0.0987	0.004
Task-centered coping 2	0.7565	-0.0906	-0.0236	0.0361	0.1184
Task-centered coping 3	0.6592	0.0214	0.1454	0.1162	0.0845
Task-centered coping 4	0.7696	-0.0802	0.0432	0.078	0.1666
Feeling Active	0.1214	-0.1011	0.0057	0.0834	0.8497
Feeling Enthusiastic	0.0849	-0.1245	0.1099	0.0698	0.839
Contact-centered coping 1	0.0434	-0.0367	0.8687	0.0778	0.0706
Contact-centered coping 2	0.0159	0.0474	0.8767	0.0406	0.0325
Emotion-centered coping 1	-0.3144	0.584	0.0389	0.0285	0.0045
Emotion-centered coping 2	-0.0823	0.7805	-0.02	0.0061	-0.1203
Emotion-centered coping 3	-0.0816	0.7909	-0.0012	-0.0265	-0.1359
Emotion-centered coping 4	-0.0355	0.7305	0.0291	-0.0316	-0.0951

Table 1c: Explanatory Variables

Variable Name	
Endogenous Variable	
Apprenticeship	Dummy variable that takes the value 1 if an individual is continuously enrolled in apprenticeship training between 2001 and 2003, and 0 otherwise.
Control Variables	
PISA Read	PISA score in reading in the year 2000
Books	Variable taking values 1 to 7 for 0, 1-10, 11-50, 51-100, 101-250, 251-500, more than 500 books at home in 2000.
ISEI Father	Social status of father according to ISEI in 2000
Age	Age of the individual
Male	Dummy variable that takes the value 1 if the individual is male, and 0 otherwise.
Male*Age	Interaction term of Age and Male
Urban	Dummy variable that takes the value 1 if the individual lives in an urban area in 2000, and 0 otherwise.
Family Structure	Dummy variables that take the value 1 for nuclear, mixed and other family structures, and 0 otherwise. Single is the base category.
Education Mother	Dummy variables that take the value 1 if the mother has the highest education of ISCED2, ISCED3B/ISCED3C and ISCED3A, and 0 otherwise. Mother's education of ISCED5A/ISCED5B/ISCED6 represents the base category.
Live with Parent	Dummy variable that takes the value 1 if the individual lives

	with at least one parent, and 0 otherwise.
Language	Dummy variable that takes the value 1 if the individual speaks the PISA test language at home in 2000, and 0 otherwise.
Swiss Born	Dummy variable that takes the value 1 if the individual was born in Switzerland, and 0 otherwise.
Swiss Time	Number of years living in Switzerland
Catholic Share	Cantonal share of Catholic inhabitants
Instruments	
Canton 1998	Canton average of the share of general secondary education degrees in 1998
Canton 1980	Canton average of the share of general secondary education degrees in 1980
Country 1998	1998 share of work-based education[8] in the country (CH, DE/AT, FR/BE, IT, ES, PT, YU, TR, OTHER) the individual was born. Due to missing values, YU and OTHER are set to 0.

Notes: We use the PISA Reading Score as opposed to the PISA Math Score due to fewer observations. However, the qualitative results are the same.

Table 1d: Summary Statistics of Dependent and Control Variables

Variable	Apprenticeship					School-based Vocational Secondary Education					General Secondary Education				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Openness	2100	-0.09	0.95	-5.33	1.51	523	0.04	0.93	-4.18	1.40	2218	0.02	0.94	-5.40	1.49
Conscientious-ness	2100	-0.11	0.99	-4.69	2.58	523	-0.17	1.05	-3.64	2.55	2218	-0.07	1.02	-4.18	2.62
Extraversion	2100	0.05	0.98	-3.76	2.38	523	-0.12	1.04	-4.17	1.95	2218	0.00	1.02	-3.88	2.26
Agreeableness	2100	0.03	0.97	-2.70	2.11	523	0.09	1.04	-2.59	2.07	2218	-0.05	1.03	-2.86	2.07
Neuroticism	2100	0.01	0.93	-2.43	3.35	523	0.40	0.96	-3.38	3.10	2218	0.26	0.97	-2.85	3.16
PISA Read	2100	511.50	73.72	256.74	738.72	523	527.16	65.32	323.89	728.91	2218	584.98	65.00	338.97	804.70
Books	2100	4.48	1.42	1	7	523	4.66	1.43	1	7	2218	5.48	1.32	1	7
ISEI Father	2100	42.47	15.42	16	90	523	46.54	16.36	16	88	2218	55.32	18.07	16	90
Age	2100	18.36	0.81	17	22	523	18.16	0.81	17	21	2218	18.14	0.82	16	22
Male	2100	0.56	0.50	0	1	523	0.24	0.43	0	1	2218	0.35	0.48	0	1
Urban	2100	0.56	0.50	0	1	523	0.69	0.46	0	1	2218	0.73	0.44	0	1
Single Family	2100	0.08	0.27	0	1	523	0.11	0.31	0	1	2218	0.10	0.30	0	1
Nuclear Family	2100	0.85	0.36	0	1	523	0.83	0.38	0	1	2218	0.86	0.35	0	1
Mixed Family	2100	0.05	0.22	0	1	523	0.04	0.19	0	1	2218	0.02	0.16	0	1
Other Family	2100	0.02	0.16	0	1	523	0.02	0.14	0	1	2218	0.02	0.13	0	1

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[8] Based on the OECD indicator "Students enrolled by type of institution" available at http://stats.oecd.org/.

ISCED2	2100	0.25	0.44	0	1	523	0.16	0.37	0	1	2218	0.09	0.29	0	1
ISCED3B/3C	2100	0.58	0.49	0	1	523	0.59	0.49	0	1	2218	0.47	0.50	0	1
ISCED3A	2100	0.15	0.36	0	1	523	0.23	0.42	0	1	2218	0.43	0.49	0	1
ISCED5A/5B/6	2100	0.01	0.08	0	1	523	0.02	0.12	0	1	2218	0.01	0.09	0	1
Live Parent	2100	0.89	0.32	0	1	523	0.89	0.31	0	1	2218	0.92	0.28	0	1
Language	2100	0.12	0.32	0	1	523	0.15	0.36	0	1	2218	0.11	0.31	0	1
Swiss Born	2100	0.92	0.27	0	1	523	0.88	0.33	0	1	2218	0.92	0.27	0	1
Swiss Time	2100	14.95	2.22	1	17	523	14.57	2.25	3	17	2218	14.77	1.94	1	17
Catholic Share	2100	47.67	21.23	16	81.2	523	51.93	22.77	16	81.2	2218	50.36	22.02	16	81.2

Table 1e: Summary Statistics of Instruments

Canton	N	Area	1980	1998
ZH	224	4	12.5	18.90
BE	522	2	7	13.30
LU	76	6	5.8	11.80
UR	0	6	8.6	11.50
SZ	49	6	5.9	11.90
OW	76	6	6.3	10.60
NW	30	6	5.6	17.50
GL	4	5	10.3	16.00
ZG	43	6	10.7	15.10
FR	365	2	10	20.50
SO	72	2	9	13.90
BS	56	3	18.2	21.10
BL	106	3	16.5	21.10
SH	62	5	6.5	18.80
AR	10	5	7.7	14.60
AI	0	5	6.3	12.70
SG	576	5	6.1	12.60
GR	61	5	7.9	12.50
AG	263	3	9.5	16.30
TG	70	5	6.1	10.50
TI	590	7	17	26.00
VD	303	1	12.5	20.90
VS	343	1	8.4	19.60
NE	273	2	13.5	24.00
GE	481	1	21.3	31.80
JU	186	2	9	25.40
Country	N			1998
CH	4437			0.58

DEAT	19		0.47
ES	10		0.03
FRBE	29		0.11
IT	24		0.00
PT	121		0.00
TR	76		0.00
YU	13		0.00
OTHER	112		0.01

Table 2: OLS Estimates

	School-based Vocational Secondary Education					General Secondary Education				
	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Apprenticeship	-0.073	-0.035	0.126**	0.066	-0.198***	-0.069	-0.071	0.105**	0.121**	-0.260***
	(0.065)	(0.073)	(0.062)	(0.070)	(0.061)	(0.047)	(0.051)	(0.044)	(0.049)	(0.046)
PISA Read	-0.000	-0.001	0.000	-0.001	-0.001	-0.001**	0.000	0.000	-0.001**	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Books	-0.000	0.042**	-0.004	0.022	-0.025	0.008	0.026	-0.005	-0.004	-0.018
	(0.021)	(0.021)	(0.017)	(0.020)	(0.018)	(0.016)	(0.017)	(0.014)	(0.016)	(0.015)
ISEI Father	0.001	-0.002	-0.001	0.001	-0.001	0.002	0.001	0.002	0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.014	0.008	-0.147***	-0.003	-0.090*	0.086**	0.020	-0.169***	-0.024	-0.075**
	(0.053)	(0.048)	(0.048)	(0.053)	(0.049)	(0.036)	(0.038)	(0.037)	(0.039)	(0.036)
Male	-0.578	-0.858	-0.607	-0.682	-1.386	0.362	-0.211	-0.762	-1.195	0.397
	(0.962)	(0.882)	(0.877)	(0.940)	(0.869)	(0.702)	(0.720)	(0.712)	(0.739)	(0.681)
Male*Age	0.024	0.055	0.044	0.011	0.047	-0.031	0.025	0.048	0.040	-0.051
	(0.053)	(0.048)	(0.048)	(0.051)	(0.047)	(0.038)	(0.039)	(0.039)	(0.040)	(0.037)
Urban	0.068	-0.089*	-0.009	0.037	0.006	0.062	-0.113***	-0.084**	0.013	-0.037
	(0.051)	(0.053)	(0.047)	(0.052)	(0.049)	(0.041)	(0.043)	(0.038)	(0.043)	(0.041)
Nuclear Family	-0.030	-0.045	0.196**	-0.135	-0.116	-0.045	-0.058	0.207***	-0.038	-0.058
	(0.091)	(0.089)	(0.083)	(0.100)	(0.089)	(0.068)	(0.073)	(0.064)	(0.072)	(0.067)
Mixed Family	-0.024	-0.175	0.282**	0.060	0.120	0.009	-0.166	0.121	0.110	0.038
	(0.136)	(0.154)	(0.127)	(0.147)	(0.143)	(0.108)	(0.135)	(0.112)	(0.125)	(0.119)
Other Family	-0.294	0.123	0.192	0.381**	-0.042	-0.231	0.119	0.029	0.307**	-0.021
	(0.188)	(0.158)	(0.166)	(0.175)	(0.152)	(0.154)	(0.134)	(0.133)	(0.142)	(0.138)
ISCED2	0.008	-0.110	0.055	0.045	0.164	0.165	0.118	0.201	0.249	0.164
	(0.216)	(0.312)	(0.258)	(0.255)	(0.231)	(0.199)	(0.284)	(0.250)	(0.192)	(0.214)
ISCED3B/3C	0.070	-0.208	0.137	0.031	0.166	0.204	0.036	0.303	0.306	0.164
	(0.212)	(0.309)	(0.254)	(0.250)	(0.227)	(0.195)	(0.281)	(0.248)	(0.187)	(0.211)
ISCED3A	0.060	-0.180	0.206	-0.022	0.133	0.252	0.049	0.345	0.246	0.156

	(0.217)	(0.312)	(0.257)	(0.254)	(0.230)	(0.196)	(0.282)	(0.248)	(0.188)	(0.212)
Live Parent	-0.007	-0.004	0.075	-0.092	0.001	0.003	0.053	0.117**	-0.074	-0.011
	(0.060)	(0.063)	(0.059)	(0.064)	(0.054)	(0.048)	(0.053)	(0.049)	(0.053)	(0.046)
Language	-0.126	0.189**	-0.239***	-0.029	0.002	-0.126*	0.217***	-0.071	0.038	-0.027
	(0.089)	(0.096)	(0.079)	(0.094)	(0.085)	(0.069)	(0.076)	(0.063)	(0.070)	(0.065)
Swiss	-0.060	0.267*	0.117	0.304**	-0.041	0.089	0.121	0.123	0.151	-0.049
	(0.133)	(0.149)	(0.126)	(0.144)	(0.142)	(0.115)	(0.125)	(0.099)	(0.112)	(0.119)
Swiss Time	-0.004	0.003	-0.012	-0.003	-0.015	-0.012	0.004	-0.016	0.005	-0.003
	(0.018)	(0.019)	(0.015)	(0.018)	(0.017)	(0.014)	(0.016)	(0.012)	(0.014)	(0.014)
Catholic Share	0.000	-0.001	0.001	-0.002	0.007***	0.000	0.001	0.001	-0.001	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.511	-0.106	2.223**	0.404	2.486***	-1.402**	-1.076	2.463***	0.565	2.681***
	(1.015)	(0.984)	(0.950)	(1.057)	(0.962)	(0.698)	(0.781)	(0.751)	(0.773)	(0.721)
N	2623	2623	2623	2623	2623	4318	4318	4318	4318	4318

Notes: The table displays OLS coefficients and standard errors clustered at the individual level in parentheses and based on the TREE dataset for 2002 and 2003. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. The left and right panels compare apprentices in 2001, 2002 and 2003 to school-based vocational secondary students in 2001, 2002 and 2003 and general secondary students in 2001, 2002 and 2003, respectively. All estimates include time dummies.

Table 3: IV Estimates

Second Stage	School-based Vocational Secondary Education					General Secondary Education				
	Openness	Conscientious-ness	Extraversi-on	Agreeablen-ess	Neuroti-cism	Openness	Conscientious-ness	Extraversi-on	Agreeablen-ess	Neuroti-cism
Apprenticeship	-0.087	0.169*	0.187	0.376**	-0.816***	0.101	0.176*	-0.271**	0.526***	-1.026***
	(0.346)	(0.098)	(0.129)	(0.160)	(0.173)	(0.193)	(0.094)	(0.120)	(0.135)	(0.105)
PISA Read	-0.000	-0.000	0.000	-0.000	-0.001**	-0.000	0.001**	-0.001*	0.000	-0.003***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Books	-0.001	0.044*	-0.004	0.025	-0.031	0.015	0.036	-0.021	0.013	-0.051***
	(0.021)	(0.025)	(0.021)	(0.025)	(0.022)	(0.016)	(0.024)	(0.015)	(0.019)	(0.017)
ISEI Father	0.001	-0.002	-0.001	0.002	-0.003	0.002**	0.002	0.000	0.003***	-0.004***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.013	-0.004	-0.151***	-0.022	-0.052	0.078***	0.009	-0.153***	-0.042	-0.041
	(0.073)	(0.053)	(0.045)	(0.050)	(0.061)	(0.028)	(0.041)	(0.045)	(0.040)	(0.041)
Male	-0.571	-0.971	-0.641	-0.853	-1.045	0.403	-0.152	-0.852	-1.099	0.215
	(1.152)	(0.838)	(0.755)	(1.079)	(0.836)	(0.653)	(0.673)	(0.578)	(0.713)	(0.734)
Male*Age	0.024	0.059	0.045	0.017	0.035	-0.034	0.020	0.056*	0.032	-0.035
	(0.063)	(0.044)	(0.040)	(0.059)	(0.045)	(0.036)	(0.035)	(0.031)	(0.038)	(0.040)
Urban	0.067*	-0.077	-0.005	0.056	-0.033	0.083**	-0.083**	-0.131*	0.063	-0.132**
	(0.039)	(0.050)	(0.065)	(0.062)	(0.070)	(0.033)	(0.039)	(0.069)	(0.040)	(0.053)
Nuclear Family	-0.030	-0.056	0.192***	-0.151**	-0.084	-0.053	-0.070	0.226***	-0.058	-0.020
	(0.106)	(0.070)	(0.074)	(0.062)	(0.104)	(0.070)	(0.070)	(0.061)	(0.071)	(0.066)
Mixed Family	-0.023	-0.190	0.278*	0.038	0.165	-0.012	-0.196**	0.166*	0.061	0.130
	(0.150)	(0.154)	(0.158)	(0.110)	(0.189)	(0.109)	(0.090)	(0.094)	(0.097)	(0.095)
Other Family	-0.292*	0.105	0.187	0.353***	0.015	-0.252**	0.089	0.075	0.257*	0.073
	(0.164)	(0.150)	(0.147)	(0.133)	(0.162)	(0.115)	(0.111)	(0.138)	(0.156)	(0.139)
ISCED2	0.011	-0.155	0.041	-0.023	0.300***	0.137	0.077	0.263	0.182	0.291**
	(0.127)	(0.267)	(0.218)	(0.198)	(0.108)	(0.136)	(0.239)	(0.282)	(0.137)	(0.148)
ISCED3B/3C	0.072	-0.244	0.127	-0.023	0.274***	0.184	0.006	0.348	0.258**	0.256*
	(0.112)	(0.259)	(0.209)	(0.165)	(0.086)	(0.119)	(0.233)	(0.272)	(0.121)	(0.136)
ISCED3A	0.062	-0.205	0.199	-0.060	0.209***	0.254**	0.052	0.341	0.250**	0.147
	(0.085)	(0.288)	(0.184)	(0.156)	(0.081)	(0.125)	(0.221)	(0.295)	(0.116)	(0.142)
Live with Parent	-0.007	-0.005	0.075*	-0.092	0.002	0.012	0.066	0.096**	-0.052	-0.052**
	(0.050)	(0.063)	(0.041)	(0.089)	(0.043)	(0.038)	(0.063)	(0.043)	(0.049)	(0.024)
Language	-0.127	0.203**	-0.235**	-0.008	-0.039	-0.110	0.240**	-0.105	0.075	-0.098**
	(0.080)	(0.099)	(0.094)	(0.092)	(0.079)	(0.079)	(0.107)	(0.087)	(0.072)	(0.050)
Swiss Born	-0.059	0.251*	0.112	0.279**	0.008	0.086	0.117	0.130	0.144	-0.036
	(0.163)	(0.142)	(0.109)	(0.141)	(0.171)	(0.114)	(0.133)	(0.106)	(0.090)	(0.172)
Swiss Time	-0.004	0.002	-0.013	-0.004	-0.013	-0.014	0.001	-0.011	0.001	0.005
	(0.018)	(0.027)	(0.010)	(0.014)	(0.016)	(0.014)	(0.017)	(0.009)	(0.016)	(0.020)
Catholic Share	0.000	-0.001	0.001	-0.002	0.006***	0.001	0.002**	0.001	-0.000	0.004
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)
Constant	0.506	-0.026	2.247***	0.526	2.243*	-1.593*	-1.353**	2.886***	0.110	3.541***
	(1.231)	(1.025)	(0.861)	(1.068)	(1.166)	(0.856)	(0.638)	(0.892)	(0.998)	(0.876)
First Stage										
Canton 1998	-0.070***	-0.071***	-0.070***	-0.073***	-0.073***	-0.069***	-0.069***	-0.071***	-0.070***	-0.077***
	(0.012)	(0.011)	(0.011)	(0.012)	(0.013)	(0.016)	(0.016)	(0.015)	(0.015)	(0.012)
PISA Read	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.011***	-0.011***	-0.011***	-0.011***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Books	-0.046	-0.045	-0.045	-0.044	-0.048	-0.128***	-0.129***	-0.126***	-0.127***	-0.119***
	(0.050)	(0.052)	(0.052)	(0.052)	(0.054)	(0.019)	(0.020)	(0.020)	(0.020)	(0.019)
ISEI Father	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***	-0.015***	-0.015***	-0.015***	-0.015***	-0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age	0.034	0.031	0.035	0.028	0.039	-0.034	-0.032	-0.049	-0.044	-0.070
	(0.067)	(0.066)	(0.067)	(0.068)	(0.070)	(0.088)	(0.087)	(0.083)	(0.086)	(0.083)
Male	0.125	0.097	0.142	0.236	0.723	-1.297	-1.241	-1.380	-1.309	-1.263
	(1.278)	(1.184)	(1.213)	(1.211)	(1.278)	(0.957)	(0.936)	(0.915)	(0.948)	(0.935)
Male*Age	0.039	0.040	0.038	0.032	0.005	0.097*	0.094*	0.102**	0.098*	0.095*
	(0.071)	(0.066)	(0.068)	(0.067)	(0.071)	(0.053)	(0.052)	(0.051)	(0.052)	(0.052)
Urban	-0.124	-0.121	-0.124	-0.115	-0.146	-0.311**	-0.310**	-0.304**	-0.305**	-0.275*
	(0.122)	(0.122)	(0.122)	(0.125)	(0.120)	(0.151)	(0.150)	(0.150)	(0.151)	(0.142)
Nuclear Family	0.113	0.108	0.113	0.103	0.118	0.109	0.106	0.096	0.103	0.109

	(0.129)	(0.129)	(0.127)	(0.128)	(0.124)	(0.136)	(0.135)	(0.135)	(0.141)	(0.145)
Mixed Family	0.210	0.212	0.217	0.209	0.175	0.356**	0.362**	0.327*	0.370*	0.357*
	(0.248)	(0.252)	(0.256)	(0.258)	(0.257)	(0.176)	(0.181)	(0.179)	(0.192)	(0.199)
Other Family	0.252	0.240	0.257	0.236	0.267	0.409	0.381	0.381	0.354	0.381
	(0.361)	(0.366)	(0.367)	(0.364)	(0.369)	(0.275)	(0.278)	(0.268)	(0.281)	(0.262)
ISCED2	0.844***	0.845***	0.847***	0.838**	0.878***	0.545	0.546	0.512	0.572	0.576
	(0.311)	(0.319)	(0.315)	(0.327)	(0.289)	(0.418)	(0.416)	(0.415)	(0.423)	(0.392)
ISCED3B/3C	0.632**	0.631**	0.634**	0.622*	0.680**	0.341	0.351	0.319	0.373	0.368
	(0.312)	(0.320)	(0.317)	(0.332)	(0.291)	(0.368)	(0.370)	(0.367)	(0.376)	(0.347)
ISCED3A	0.564*	0.560*	0.566*	0.570*	0.639**	-0.053	-0.044	-0.066	-0.015	-0.001
	(0.327)	(0.335)	(0.329)	(0.345)	(0.304)	(0.381)	(0.386)	(0.384)	(0.390)	(0.359)
Live with Parent	0.071	0.072	0.072	0.072	0.070	-0.143	-0.152*	-0.146*	-0.140*	-0.122
	(0.117)	(0.119)	(0.119)	(0.115)	(0.112)	(0.088)	(0.087)	(0.088)	(0.085)	(0.083)
Language	-0.292	-0.294	-0.292	-0.273	-0.279	-0.381**	-0.392***	-0.369***	-0.376***	-0.347**
	(0.229)	(0.230)	(0.229)	(0.222)	(0.223)	(0.149)	(0.151)	(0.141)	(0.145)	(0.143)
Swiss Born	0.178	0.170	0.176	0.158	0.162	0.216	0.206	0.215	0.211	0.228
	(0.206)	(0.196)	(0.198)	(0.197)	(0.201)	(0.185)	(0.185)	(0.178)	(0.186)	(0.176)
Swiss Time	0.008	0.008	0.009	0.011	0.005	0.001	0.001	-0.000	0.004	-0.005
	(0.020)	(0.018)	(0.019)	(0.019)	(0.018)	(0.031)	(0.032)	(0.031)	(0.032)	(0.029)
Catholic Share	-0.003	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	2.605	2.705	2.580	2.719	2.614	8.931***	8.940***	9.299***	9.052***	9.550***
	(1.694)	(1.670)	(1.709)	(1.705)	(1.723)	(2.424)	(2.432)	(2.311)	(2.374)	(2.259)
N	2623	2623	2623	2623	2623	4318	4318	4318	4318	4318
Kleibergen	94.886	94.886	94.886	94.886	94.886	177.755	177.755	177.755	177.755	177.755

Notes: The table displays coefficients and robust standard errors clustered at the cantonal level in parentheses of an IV regression with a binary endogenous variable. Apprentice refers to the second stage coefficients of the endogenized variable indicating apprenticeship status, while Canton 1998 represents first stage coefficients of the instruments. Kleibergen refers to the Kleibergen-Paap F statistic, which has a critical value of 16.38 for 10% maximal IV size. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. The left and right panels compare apprentices in 2001, 2002 and 2003 to school-based vocational secondary students in 2001, 2002 and 2003 and general secondary students in 2001, 2002 and 2003, respectively. Apprenticeship is instrumented by the cantonal average of the general secondary school degree share in 1998. All estimates include time dummies. The data stem from the TREE project and refer to the years 2002 and 2003.

Table 4: Robustness of IV estimates

	School-based Vocational Secondary Education (N=2623)					General Secondary Education (N=43184)				
	Openness	Conscientious-ness	Extraver-sion	Agreeablen-ess	Neuroti-cism	Open-ness	Conscientious-ness	Extraver-sion	Agreeablen-ess	Neuroti-cism
AREA										
Apprenticeship	-0.179	0.119	0.353**	0.037	-0.448**	-0.057	0.173	-0.071	0.308***	-0.614***
	(0.228)	(0.122)	(0.180)	(0.155)	(0.210)	(0.117)	(0.144)	(0.098)	(0.091)	(0.162)
Canton 1998	-0.047***	-0.049***	-0.048***	-0.048***	-0.049***	-0.083***	-0.083***	-0.084***	-0.083***	-0.086***
	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.013)	(0.013)	(0.012)	(0.013)	(0.011)
Kleibergen	21.701	21.701	21.701	21.701	21.701	153.984	153.984	153.984	153.984	153.984
LDV										
Apprenticeship	-0.139	0.128	0.267**	0.177	-0.638***	0.021	0.130	-0.183*	0.328**	-0.837***
	(0.216)	(0.092)	(0.131)	(0.123)	(0.163)	(0.134)	(0.100)	(0.131)	(0.109)	(0.109)
Canton 1998	-0.067***	-0.076***	-0.068***	-0.062***	-0.062***	-0.067***	-0.070***	-0.071***	-0.062***	-0.072***
	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.016)	(0.016)	(0.016)	(0.015)	(0.014)
Kleibergen	85.612	104.305	82.551	63.452	58.957	167.714	178.699	174.884	119.212	137.541
1980										
Apprenticeship	-0.251	0.168	0.463*	0.179	-0.520**	0.013	0.203**	-0.010	0.495***	-0.852***
	(0.275)	(0.109)	(0.267)	(0.243)	(0.262)	(0.246)	(0.097)	(0.188)	(0.172)	(0.171)
Canton 1980	-0.077***	-0.079***	-0.079***	-0.079***	-0.078***	-0.071***	-0.072***	-0.072***	-0.073***	-0.078***
	(0.021)	(0.021)	(0.020)	(0.022)	(0.022)	(0.025)	(0.025)	(0.025)	(0.024)	(0.023)
Kleibergen	72.773	72.773	72.773	72.773	72.773	124.451	124.451	124.451	124.451	124.451
COUNTRY										
Apprenticeship	-0.278	0.082	0.303	0.239	-0.673**	0.094	0.160	0.217	0.427**	-0.299*
	(0.214)	(0.208)	(0.249)	(0.227)	(0.277)	(0.157)	(0.154)	(0.171)	(0.172)	(0.178)
Country 1998	0.975***	0.986***	0.996***	1.016***	0.995***	0.825***	0.810***	0.825***	0.877***	0.818***
	(0.191)	(0.193)	(0.193)	(0.200)	(0.188)	(0.172)	(0.172)	(0.172)	(0.175)	(0.173)
Kleibergen	23.324	23.324	23.324	23.324	23.324	25.433	25.433	25.433	25.433	25.433
COUNTRY+CANTON										
Apprenticeship	0.052	0.240***	0.254**	0.533***	-0.839***	0.149	0.178*	-0.269**	0.591***	-1.024***
	(0.450)	(0.080)	(0.110)	(0.171)	(0.160)	(0.191)	(0.094)	(0.132)	(0.139)	(0.110)
Country 1998	0.619**	0.656**	0.649**	0.732**	0.605**	0.629***	0.620***	0.543**	0.702***	0.560**
	(0.258)	(0.267)	(0.276)	(0.293)	(0.265)	(0.222)	(0.225)	(0.216)	(0.250)	(0.274)
Canton 1998	-0.071***	-0.071***	-0.070***	-0.073***	-0.073***	-0.069***	-0.069***	-0.071***	-0.070***	-0.078***
	(0.012)	(0.011)	(0.011)	(0.011)	(0.013)	(0.016)	(0.016)	(0.014)	(0.015)	(0.012)
Kleibergen	68.748	68.748	68.748	68.748	68.748	114.463	114.463	114.463	114.463	114.463
Sargan p-value	0.557	0.214	0.055	0.117	0.486	0.506	0.463	0.007	0.579	0.014
COUNTRY AREA										
Apprenticeship	0.020	0.082	0.301	-0.021	-0.382*	-0.097	0.107	0.211	0.309**	-0.347***
	(0.538)	(0.169)	(0.198)	(0.178)	(0.178)	(0.153)	(0.131)	(0.147)	(0.140)	(0.128)
Country 1998	0.699***	0.717***	0.728***	0.696***	0.710***	0.775***	0.781***	0.787***	0.826***	0.782***
	(0.210)	(0.205)	(0.207)	(0.211)	(0.204)	(0.179)	(0.178)	(0.178)	(0.180)	(0.178)
Kleibergen	11.598	11.598	11.598	11.598	11.598	17.843	17.843	17.843	17.843	17.843
COUNTRY+CANTON AREA										
Apprenticeship	0.656	0.172	0.404**	0.199	-0.477**	0.013	0.170	-0.080	0.368***	-0.621***
	(0.527)	(0.138)	(0.177)	(0.209)	(0.204)	(0.122)	(0.142)	(0.101)	(0.097)	(0.161)
Country 1998	0.448	0.608**	0.622**	0.636**	0.583**	0.660***	0.659***	0.608**	0.714***	0.621**
	(0.374)	(0.289)	(0.293)	(0.315)	(0.293)	(0.245)	(0.252)	(0.253)	(0.262)	(0.282)
Canton 1998	-0.047***	-0.050***	-0.050***	-0.051***	-0.050***	-0.084***	-0.084***	-0.085***	-0.084***	-0.087***
	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)	(0.013)	(0.013)	(0.012)	(0.013)	(0.011)
Kleibergen	21.956	21.956	21.956	21.956	21.956	96.310	96.310	96.310	96.310	96.310
Sargan p-value	0.647	0.508	0.232	0.239	0.758	0.130	0.610	0.021	0.144	0.106

Notes: The table displays coefficients and robust standard errors clustered at canton level in parentheses of IV regression with binary endogenous variable. Apprentice refers to the second stage coefficients of the endogenized variable indicating apprenticeship status, while Canton 1998, Canton 1980 and Country 1998 represent first stage coefficients of the instruments. Kleibergen refers to the Kleibergen-Paap F statistic, which has a critical value of 16.38 for 10% maximal IV size. Sargan P refers to the p-value of a Sargan over-identification test. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. The left and right panels compare apprentices in 2001, 2002 and 2003 to school-based vocational secondary students in 2001, 2002 and 2003 and general secondary students in 2001, 2002 and 2003, respectively. Apprenticeship is

instrumented by the cantonal average of the general secondary school degree share in 1998. In the 1980 estimates, cantonal averages in 1980 serve as the instrument. All estimates include time dummies and the control variables as shown in Table 1c. The COUNTRY and COUNTRY+CANTON estimates include the share of work-based training in the individual's country of birth as the instrument. These estimates exclude control variables Language, Swiss Born and Swiss Time. Standard errors in the COUNTRY estimates are clustered at the level of the individual's origin. Corresponding to the respective dependent variable, LDV estimates further include the averages of the dependent variable in 2002. AREA estimates include dummy variables for four greater areas. The data stem from the TREE project and refer to the years 2002 and 2003.

Table 5: Medium and Long Run Effects

| | School-based Vocational Secondary Education | | | | | General Secondary Education | | | | |
	Openness	Conscientious-ness	Extraver-sion	Agreeablen-ess	Neuroti-cism	Openness	Conscienti-ousness	Extraver-sion	Agreeablen-ess	Neuroti-cism
2007										
Apprentice-ship	-0.736**	0.470**	-0.100	0.198	-1.112***	-0.177	0.109	-0.111	0.092	-1.194***
	(0.286)	(0.239)	(0.198)	(0.239)	(0.351)	(0.209)	(0.120)	(0.464)	(0.188)	(0.118)
Canton 1998	-0.066***	-0.067***	-0.067***	-0.068***	-0.070***	-0.063***	-0.064***	-0.064***	-0.064***	-0.075***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.014)	(0.016)	(0.016)	(0.016)	(0.017)	(0.010)
N	990	990	990	990	990	1731	1731	1731	1731	1731
Kleibergen	35.586	35.586	35.586	35.586	35.586	66.965	66.965	66.965	66.965	66.965
2010										
Apprentice-ship	-0.413*	0.131	-0.217*	0.556**	-0.853**	-0.449*	0.146	-0.412**	0.415***	-1.141***
	(0.228)	(0.241)	(0.128)	(0.225)	(0.414)	(0.257)	(0.146)	(0.166)	(0.118)	(0.169)
Canton 1998	-0.061***	-0.061***	-0.064***	-0.064***	-0.066***	-0.063***	-0.066***	-0.070***	-0.066***	-0.070***
	(0.014)	(0.014)	(0.015)	(0.014)	(0.015)	(0.013)	(0.013)	(0.012)	(0.012)	(0.011)
N	800	800	800	800	800	1433	1433	1433	1433	1433
Kleibergen	23.510	23.510	23.510	23.510	23.510	52.289	52.289	52.289	52.289	52.289

Notes: The table displays coefficients and robust standard errors clustered at the cantonal level in parentheses of IV regression with a binary endogenous variable. Apprentice refers to the second stage coefficients of the endogenized variable indicating apprenticeship status, while Canton 1998, Canton 1980 and Country 1998 represent first stage coefficients of the instruments. Kleibergen refers to the Kleibergen-Paap F statistic, which has a critical value of 16.38 for 10% maximal IV size. Sargan P refers to the p-value of a Sargan over-identification test. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. The left and right panels compare apprentices in 2001, 2002 and 2003 to school-based vocational secondary students in 2001, 2002 and 2003 and general secondary students in 2001, 2002 and 2003, respectively. Apprenticeship is instrumented by the cantonal average of the general secondary school degree share in 1998. All estimates include time dummies and control variables as shown in Table 1c. The data stem from the TREE project and refer to the years 2007 and 2010 for the 2007 and 2010 estimates, respectively.

Table 6: Estimates Subgroups

	School-based Vocational Secondary Education					General Secondary Education				
	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
DV LOW										
Apprenticeship	0.434***	0.176	0.589	0.863***	-0.116	0.018	0.233***	-0.041	0.464***	-0.197*
	(0.076)	(0.131)	(0.414)	(0.147)	(0.207)	(0.150)	(0.055)	(0.122)	(0.129)	(0.119)
Canton 1998	-0.070***	-0.072***	-0.082***	-0.058***	-0.081***	-0.070***	-0.070***	-0.060***	-0.061***	-0.056***
	(0.016)	(0.015)	(0.016)	(0.012)	(0.014)	(0.017)	(0.016)	(0.021)	(0.018)	(0.018)
N	1190	1258	1163	1278	1395	1961	2077	1946	2089	2239
Kleibergen	43.045	44.221	72.899	26.643	54.733	81.084	87.814	62.294	67.586	50.761
DV HIGH										
Apprenticeship	-0.033	0.092	-0.660***	0.023	-0.887***	0.076	-0.092	-0.224***	0.018	-0.597***
	(0.100)	(0.077)	(0.091)	(0.106)	(0.140)	(0.054)	(0.181)	(0.080)	(0.078)	(0.106)
Canton 1998	-0.073***	-0.069***	-0.048***	-0.084***	-0.053***	-0.071***	-0.068***	-0.082***	-0.083***	-0.086***
	(0.010)	(0.012)	(0.015)	(0.012)	(0.017)	(0.015)	(0.017)	(0.012)	(0.013)	(0.012)
N	1433	1365	1460	1345	1228	2357	2241	2372	2229	2079
Kleibergen	54.764	49.183	35.263	70.164	35.340	105.146	89.301	121.774	106.872	109.711
MEN										
Apprenticeship	0.082	0.574***	0.260	0.515***	-0.814***	0.025	0.382***	-0.293**	0.551***	-0.995***
	(0.479)	(0.163)	(0.265)	(0.193)	(0.240)	(0.149)	(0.125)	(0.138)	(0.155)	(0.146)
Canton 1998	-0.081***	-0.081***	-0.081***	-0.082***	-0.082***	-0.090***	-0.091***	-0.092***	-0.092***	-0.098***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.018)	(0.018)	(0.017)	(0.018)	(0.015)
N	1326	1326	1326	1326	1326	2360	2360	2360	2360	2360
Kleibergen	95.111	95.111	95.111	95.111	95.111	189.200	189.200	189.200	189.200	189.200
WOMEN										
Apprenticeship	-0.118	-0.038	-0.003	0.610	-1.003***	0.260	-0.207	-0.249	0.288	-0.990***
	(0.254)	(0.137)	(0.294)	(0.447)	(0.366)	(0.327)	(0.305)	(0.160)	(0.302)	(0.218)
Canton 1998	-0.053***	-0.053***	-0.053***	-0.057***	-0.060***	-0.047***	-0.046***	-0.050***	-0.047***	-0.057***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.014)	(0.015)	(0.013)	(0.015)	(0.011)
N	1297	1297	1297	1297	1297	1958	1958	1958	1958	1958
Kleibergen	19.406	19.406	19.406	19.406	19.406	24.906	24.906	24.906	24.906	24.906
MOTHER<3A										
Apprenticeship	-0.039	0.056	0.202	0.452**	-0.865***	0.046	0.137	-0.267**	0.480***	-0.966***
	(0.815)	(0.111)	(0.175)	(0.192)	(0.199)	(0.211)	(0.178)	(0.110)	(0.161)	(0.133)
Canton 1998	-0.074***	-0.074***	-0.074***	-0.076***	-0.076***	-0.072***	-0.072***	-0.074***	-0.073***	-0.083***
	(0.016)	(0.013)	(0.013)	(0.014)	(0.014)	(0.019)	(0.018)	(0.018)	(0.018)	(0.014)
N	2155	2155	2155	2155	2155	3016	3016	3016	3016	3016
Kleibergen	85.588	85.588	85.588	85.588	85.588	136.535	136.535	136.535	136.535	136.535
MOTHER>=3A										
Apprenticeship	-0.239	0.831	0.271	0.394	-1.042**	0.126	0.364	-0.625***	0.503**	-1.293***
	(0.567)	(0.602)	(0.357)	(0.289)	(0.438)	(0.268)	(0.237)	(0.234)	(0.215)	(0.169)
Canton 1998	-0.061**	-0.063**	-0.060**	-0.066**	-0.051*	-0.057***	-0.058***	-0.059***	-0.061***	-0.060***
	(0.026)	(0.027)	(0.028)	(0.027)	(0.030)	(0.016)	(0.017)	(0.012)	(0.016)	(0.014)
N	468	468	468	468	468	1302	1302	1302	1302	1302
Kleibergen	10.650	10.650	10.650	10.650	10.650	32.786	32.786	32.786	32.786	32.786
PISA LOW										
Apprenticeship	-0.032	0.147	0.431	0.528***	-0.603*	0.145	0.268***	-0.058	0.355**	-0.879***
	(0.446)	(0.135)	(0.327)	(0.138)	(0.322)	(0.339)	(0.103)	(0.144)	(0.177)	(0.100)
Canton 1998	-0.095***	-0.097***	-0.095***	-0.097***	-0.093***	-0.092***	-0.092***	-0.092***	-0.092***	-0.096***
	(0.016)	(0.016)	(0.017)	(0.015)	(0.018)	(0.015)	(0.015)	(0.015)	(0.015)	(0.013)
N	1217	1217	1217	1217	1217	2061	2061	2061	2061	2061
Kleibergen	74.691	74.691	74.691	74.691	74.691	166.587	166.587	166.587	166.587	166.587
PISA HIGH										
Apprenticeship	-0.126	0.077	-0.033	0.258	-1.012***	0.167	0.098	-0.700***	0.821***	-1.121***
	(0.601)	(0.158)	(0.120)	(0.255)	(0.246)	(0.134)	(0.257)	(0.200)	(0.179)	(0.145)
Canton 1998	-0.051***	-0.051***	-0.051***	-0.053***	-0.064***	-0.047***	-0.046**	-0.054***	-0.051***	-0.064***
	(0.019)	(0.016)	(0.016)	(0.017)	(0.015)	(0.017)	(0.018)	(0.014)	(0.016)	(0.014)
N	1406	1406	1406	1406	1406	2257	2257	2257	2257	2257
Kleibergen	27.060	27.060	27.060	27.060	27.060	37.549	37.549	37.549	37.549	37.549

Notes: The table displays coefficients and robust standard errors clustered at the cantonal level in parentheses
of IV regression with a binary endogenous variable. Apprentice refers to the second stage coefficients of the

endogenized variable, indicating apprenticeship status, while Canton 1998, Canton 1980 and Country 1998 represent first stage coefficients of the instruments. Kleibergen refers to the Kleibergen-Paap F statistic, which has a critical value of 16.38 for 10% maximal IV size. Sargan P refers to the p-value of a Sargan over-identification test. *, ** and *** denote significance on the 10%, 5% and 1% levels, respectively. The left and right panels compare apprentices in 2001, 2002 and 2003 to school-based vocational secondary students in 2001, 2002 and 2003 and general secondary students in 2001, 2002 and 2003, respectively. Apprenticeship is instrumented by the cantonal average of the general secondary school degree share in 1998. All estimates include time dummies and control variables as shown in Table 1c. LOW and HIGH estimations display the results if the sample is split according to the mean of the dependent variable. Testing the equality of coefficients between LOW and HIGH models using seemingly unrelated equations with robust standard errors clustered at cantonal level yields p-values for openness/conscientiousness/extraversion/agreeableness/neuroticism of 0.01/0.00/0.00/0.00/0.00, respectively, for school-based vocational secondary education and 0.71/0.11/0.17/0.00/0.01, respectively, for general secondary education. Comparing the estimates of men and women yields p-values of 0.00/0.00/0.51/0.87/0.00, respectively, for school-based vocational secondary education and 0.42/0.11/0.82/0.38/0.98, respectively, for general secondary education. Comparing the estimates of individuals with low and high education of the mother yields p-values of 0.87/0.23/0.87/0.86/0.73, respectively, for school-based vocational secondary education and 0.75/0.51/0.12/0.92/0.15, respectively, for general secondary education. Comparing the estimates of individuals with low and high PISA reading scores yields p-values of 0.90/0.76/0.18/0.35/0.30, respectively, for school-based vocational secondary education and 0.95/0.55/0.01/0.10/0.13, respectively, for general secondary education.