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The Returns to Cognitive Abilities and Personality in Germany

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Non-cognitive Skills: Acquisition and Economic
Consequences
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1. Introduction

- Traditionally, 'hard-wired' human capital aspects - e.g. education, experience, job-specific training – in focus of labor economists
- Growing research additionally incorporates cognitive abilities, but restricted data availability (NLSY in the US: AFQT, NCDS in the UK: GAT)
- Even smaller literature on the labor market outcomes of psychological and/or behavioral components
 - for a long time personality was not considered relevant
 - lack of appropriate data

Importance of personality for labor market success

- Similar to cognitive skills, personality traits may likewise result in job performance differentials
- Differences in skills and differences in preferences may exert direct and indirect effects on productivity:
 - Direct effect: Personality (its effects on behavior) might be thought of as part of an individual's set of productive traits
 - Indirect effect through the type of schooling or occupation chosen

2. Previous Research

Mixed evidence on the relationship between cognitive abilities and earnings:

- Positive effects of ability on earnings (US, UK):
Cameron and Heckman, 1993; Neal and Johnson, 1996;
Green and Ridell, 2003; Gould, 2005; Bronars and
Oettinger, 2006
- No effects of ability on earnings (US, UK, Germany):
Bound, Griliches and Hall, 1986; Murnane, Willett and
Levy, 1995; Cawley, Heckman and Vytlaçil, 2001; Zax and
Rees, 2002, Anger and Heineck, 2006

Studies on the relationship between personality traits and labor market outcomes suggest that

- openness & conscientiousness are rewarded
 - agreeableness & neuroticism are penalized
 - no clear evidence for extraversion
 - external LOC is penalized & internal LOC is rewarded
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- Osborne Groves (2005): locus of control, aggression & withdrawal
 - Semykina and Linz (2007): LOC, challenge & affiliation
 - Heckman and Rubinstein (2001): LOC, self-esteem
 - Nyhus and Pons (2005): FFM taxonomy
 - Heineck (2007): FFM taxonomy
 - Isengard (2006): LOC, FFM taxonomy
 - Flossmann et al. (2007): LOC

Evidence on the relationship between cognitive abilities, personality, and labor market outcomes in the U.S.

- Mueller & Plug (2006): FFM taxonomy, general intelligence (WLS)
 - Non-agreeableness, openness, emotional stability positively related to men's earnings (women: being conscientious, open)
 - positive linear relationship between intelligence and earnings
- Cebi (2007): LOC, AFQT (NLSY)
Internal LOC rewarded in the labor market even when cognitive ability scores are included
- Heckman et al. (2006): LOC/self-esteem, AFQT (NLSY)
Cognitive skills and personality important for economic success

3. Aim of this Study

- First joint evidence on the relationship between cognitive abilities, personality, and earnings for Germany
- Find out whether results for the U.S. carry over to a
 - less meritocratic society (more labor market regulations)
 - a society with mainly free access to schooling (at no or very low cost)
- Using the LOC, reciprocity and the FFM taxonomy as unifying framework to describe an individual's personality
- Employ panel estimators to account for unobservable heterogeneity

4. Data

- Two cross-sections from the SOEP: 2005, 2006
- Measures of cognitive ability: 2 ultrashort tests (Lang, 2005)
 - Word fluency test (crystallized pragmatics)
 - 90 seconds to name as many animals as possible
 - Symbol correspondence test (fluid mechanics, speed of cognition)
 - 90 seconds to assign as many correct signs as possible to digits, displayed on screen



- Use standardized test scores

- Measures of personality
 - Five Factor Model indicators: openness to experience, conscientiousness, extraversion, agreeableness, neuroticism (set of 15 questions instead of full inventory)
 - Locus of control: internal and external LOC (10 items)
 - Positive and negative reciprocity (6 items)
- Use standardized average scores from the dimension-specific questions on FFM, LOC, and reciprocity

Variable label	FFM Personality trait
FFM: I see myself as someone who ...	
... is original, comes up with new ideas ... values artistic experiences	Openness to Experience
... does a thorough job ... does things effectively and efficiently	Conscientiousness
... is communicative, talkative ... is outgoing, sociable	Extraversion
... is considerate and kind to others ... has a forgiving nature	Agreeableness
... worries a lot ... gets nervous easily	Neuroticism

- Dependent variable: gross hourly wage
- Explanatory variables:
 - Standard human capital control variables: education, age
 - Socio-demographic characteristics: being married, East German, foreign citizenship
 - job-related variables: public sector, firm size, temporary job, part-time job, white-collar worker (occupation, industry)
- Sample: East and West-German male and female workers of age 20 to 60, years 1991-2006
 - ~ 12,879 person-year observations (1,554 individuals)
- Separate regressions for males and females

5. Earnings Equations

- Selection corrected Mincer-type earnings functions

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

y_i individual i 's gross hourly wage

x_i worker characteristics

c_i vector of indicators on cognition and personality

β, γ parameter vectors to be estimated

u_i idiosyncratic error term

Problems and Solutions

Stability of personality over time?

- Conflicting evidence indicating both stability (Costa and McCrae, 1994) / instability (Srivastava et al., 2003) for adult personality
- Workaround (Nyhus and Pons, 2005, Osborne Groves, 2005):
Use residuals from regressions of personality traits on age, gender, IA age-gender, and other background variables
 - free from age and gender effects
 - picks up possible feedback effects of an individual's job

Cognitive abilities stable over time?

- Workaround: Again use residuals

Measurement error in personality traits?

- Cronbach's alphas:
 - FFM traits: openness 0.64; conscientiousness 0.65, extraversion 0.73, agreeableness 0.54, and neuroticism 0.63.
 - internal LOC 0,22; external LOC 0,61
 - positive reciprocity 0,66; negative reciprocity 0,83
 - relatively low, but satisfactory given that only 3 items per personality trait are available in the SOEP (internal LOC excluded from the analysis)
- Correct for measurement error: Error-in-variables estimator to adjust both parameter estimates and standard error
 - c_i is measured with error: $c_i = c_i^* + e$
 - impose reliability ratios: $r = 1 - \text{var}(e)/\text{var}(c_i)$

Unobservable heterogeneity?

- Personality traits only observed in 2005, cognition only in 2006
- We match 'residualized' indicators to prior waves of the SOEP and applying appropriate panel estimators to account for further individual specific heterogeneity
- Hausman-Taylor IV estimator:

$$\ln y_{it} = \beta_0 + x'_{1,it} \beta_1 + x'_{2,it} \beta_2 + z'_{1i} \gamma_1 + z'_{2i} \gamma_2 + \alpha_i + u_{it}$$

$x_{1,it}$ $z_{1,it}$ time-varying/-invariant and uncorrelated with α_i

$x_{2,it}$ $z_{2,it}$ time-varying/-invariant, but need not be uncorrelated with α_i

6. Results

Pooled
OLS

	Females: OLS	Females: EIV	Males: OLS	Males: EIV
Personality traits				
FFM: Openness	0.016** (0.007)	0.053*** (0.017)	-0.015** (0.006)	-0.033* (0.019)
FFM: Conscientiousness	-0.007 (0.007)	-0.022* (0.013)	0.015*** (0.006)	0.016 (0.010)
FFM: Extraversion	-0.006 (0.007)	-0.027 (0.018)	0.004 (0.005)	0.006 (0.014)
FFM: Agreeableness	-0.032*** (0.006)	-0.068*** (0.016)	-0.003 (0.005)	-0.001 (0.012)
FFM: Neuroticism	0.005 (0.006)	0.023** (0.011)	-0.002 (0.005)	0.003 (0.009)
External locus of control	-0.046*** (0.006)	-0.096*** (0.015)	-0.046*** (0.005)	-0.083*** (0.010)
Positive reciprocity	0.025*** (0.006)	0.056*** (0.012)	0.018*** (0.005)	0.033*** (0.010)
Negative reciprocity	0.004 (0.006)	0.013 (0.008)	0.016*** (0.005)	0.028*** (0.007)
Cognitive abilities				
Symbol corresp. Test	0.001 (0.007)	0.003 (0.007)	0.023*** (0.005)	0.024*** (0.005)
Word fluency Test	-0.006 (0.007)	-0.010 (0.007)	0.010* (0.006)	0.007 (0.006)
Individ. controls	+	+	+	+
Occ. / industry controls	+	+	+	+

Panel Estimates

	Females: RE	Females: HT-IV	Males: RE	Males: HT-IV
Personality traits				
FFM: Openness	0.016 (0.015)	0.026 (0.024)	-0.001 (0.014)	0.010 (0.023)
FFM: Conscientiousness	-0.004 (0.015)	-0.008 (0.024)	0.014 (0.013)	0.005 (0.021)
FFM: Extraversion	-0.007 (0.016)	-0.005 (0.025)	0.003 (0.013)	-0.001 (0.021)
FFM: Agreeableness	-0.023* (0.013)	-0.033 (0.022)	-0.009 (0.012)	-0.006 (0.019)
FFM: Neuroticism	0.001 (0.013)	-0.002 (0.022)	-0.005 (0.012)	-0.006 (0.019)
External locus of control	-0.060*** (0.014)	-0.072*** (0.023)	-0.064*** (0.012)	-0.079*** (0.019)
Positive reciprocity	0.020 (0.014)	0.024 (0.022)	0.025** (0.012)	0.030 (0.020)
Negative reciprocity	0.005 (0.013)	0.002 (0.022)	0.016 (0.012)	0.012 (0.019)
Cognitive abilities				
Symbol corresp. Test	0.012 (0.015)	0.013 (0.025)	0.029** (0.013)	0.032 (0.021)
Word fluency Test	-0.009 (0.016)	0.003 (0.026)	0.017 (0.013)	0.018 (0.022)
Individ. controls	+	+	+	+
Occ. / industry controls	+	+	+	+

Non-linearities

	Females			Males		
	OLS	RE	HT-IV	OLS	RE	HT-IV
Non-cognitive abilities						
FFM Openness: Bottom 25%	-0.004 (0.016)	-0.025 (0.035)	-0.039 (0.056)	0.019 (0.013)	-0.007 (0.031)	-0.033 (0.049)
FFM Openness: Top 25%	0.014 (0.015)	-0.007 (0.031)	0.009 (0.050)	-0.018 (0.012)	-0.002 (0.029)	0.001 (0.046)
FFM Conscientiousness: Bottom 25%	0.007 (0.016)	-0.032 (0.034)	-0.022 (0.054)	-0.028** (0.013)	-0.008 (0.030)	0.009 (0.048)
FFM Conscientiousness: Top 25%	-0.010 (0.014)	-0.008 (0.032)	-0.013 (0.052)	0.029** (0.012)	0.052* (0.029)	0.054 (0.046)
FFM Extraversion: Bottom 25%	-0.011 (0.016)	-0.010 (0.035)	-0.013 (0.056)	-0.049*** (0.013)	-0.056* (0.031)	-0.038 (0.049)
FFM Extraversion: Top 25%	-0.004 (0.014)	-0.019 (0.031)	-0.011 (0.050)	-0.048*** (0.012)	-0.046 (0.029)	-0.055 (0.047)
FFM Agreeableness: Bottom 25%	0.067*** (0.017)	0.077** (0.035)	0.086 (0.056)	0.026** (0.012)	0.050* (0.029)	0.047 (0.046)
FFM Agreeableness: Top 25%	-0.031** (0.014)	0.002 (0.031)	-0.022 (0.050)	0.008 (0.012)	0.001 (0.028)	0.020 (0.045)
FFM Neuroticism: Bottom 25%	0.023* (0.014)	0.014 (0.030)	0.024 (0.049)	-0.038*** (0.012)	-0.054* (0.029)	-0.076 (0.047)
FFM Neuroticism: Top 25%	0.025* (0.015)	0.007 (0.034)	0.002 (0.054)	-0.028** (0.011)	-0.027 (0.028)	-0.038 (0.045)

External LOC: Bottom 25%

0.058***	0.058*	0.077	0.051***	0.087***	0.090**
(0.015)	(0.031)	(0.051)	(0.012)	(0.028)	(0.045)

External LOC: Top 25%

-0.073***	-0.107***	-0.118**	-0.074***	-0.081***	-0.114**
(0.015)	(0.033)	(0.053)	(0.012)	(0.029)	(0.047)

Positive Reciprocity: Bottom 25%

-0.047***	-0.001	0.005	-0.053***	-0.026	-0.028
(0.015)	(0.032)	(0.051)	(0.013)	(0.028)	(0.044)

Positive Reciprocity: Top 25%

0.028*	0.018	0.017	0.006	0.011	-0.008
(0.015)	(0.033)	(0.053)	(0.012)	(0.030)	(0.048)

Negative Reciprocity: Bottom 25%

-0.007	-0.019	-0.037	-0.022*	-0.072**	-0.099**
(0.014)	(0.032)	(0.052)	(0.011)	(0.030)	(0.048)

Negative Reciprocity: Top 25%

0.018	0.039	0.030	0.018	0.006	-0.005
(0.015)	(0.032)	(0.052)	(0.012)	(0.029)	(0.045)

Cognitive abilities

Symbol corresp. Test: Bottom 25%

-0.026*	-0.040	-0.048	-0.051***	-0.042	-0.033
(0.016)	(0.034)	(0.054)	(0.012)	(0.030)	(0.047)

Symbol corresp. Test: Top 25%

-0.024*	-0.016	-0.012	0.003	0.033	0.046
(0.014)	(0.031)	(0.051)	(0.012)	(0.028)	(0.045)

Word fluency Test: Bottom 25%

0.034**	0.019	0.009	0.035***	0.027	0.035
(0.016)	(0.034)	(0.054)	(0.012)	(0.030)	(0.048)

Word fluency Test: Top 25%

0.022	0.010	0.022	0.057***	0.052*	0.064
(0.015)	(0.032)	(0.052)	(0.012)	(0.029)	(0.046)

Individ. controls

+	+	+	+	+	+
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Occ. / industry controls

+	+	+	+	+	+
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7. Conclusions

- Weak effect of cognitive abilities on males' wages once individual heterogeneity is accounted for (positive effect in the pooled OLS specification)
- Personality is an important predictor of earnings, even if a large set of control variables and cognitive abilities are included.
- Very robust result: negative association between high external locus of control and earnings: wage penalty of almost 12% for workers who score in the top25% of the LOC scale (effect of comparable size as in the US).
- Relatively greater importance of certain personality traits compared to cognitive abilities

Implications

- No straightforward policy implications
- Yet,

„... personality traits are more malleable than cognitive ability over the life cycle and are more sensitive to investment by parents and to other sources of environmental influences at later ages than are cognitive traits. Social policy designed to remediate deficits in achievement can be effective by operating outside of purely cognitive channels.“

(Borghans, Duckworth, Heckman & ter Weel, 2008, p. 4)