Kiel Institute
for the World Economy

Worker Personality: Another Skill Bias beyond Education in the Digital Age

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Motivation

- High uncertainty about future labor market effects of digitalization
  - Many jobs will disappear (e.g., Frey/Osborne 2017)
    → Depreciation of skills replaced by digital technologies
  - Many new jobs will be created
    → Appreciation of skills that complement digital technologies
  - Skill mismatch
  - Unemployment or widening wage gaps ↔ labor shortage
  - Social deprivation, political unrest (?)

Motivation

- What kinds of skills will be needed in the digital age?
  - Important to know
    - For education & labor market policies (adjust curricula)
    - For workers who may lose their jobs (which skills to invest in?)

? Just higher educational attainment

? "21st-century" skills (Pellegrino and Hilton 2012)
(= 'complex' or 'collaborative problem solving' skills)

? "Social" / "people" skills (Weinberger 2014 /Borghans et al. 2014)

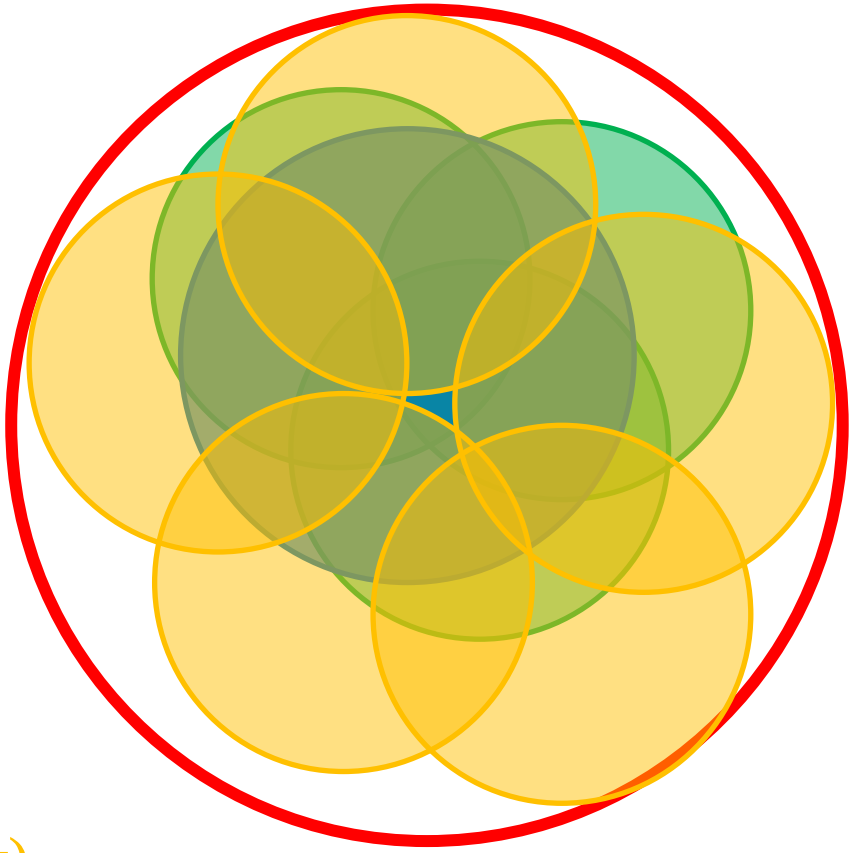
Motivation

What is human **skills** (human capital)?

Mainstream economics

- Growth accounting (Solow 1957)
- Skill-biased technological change (Acemoglu 1998)
- Task approach (Autor, Levy & Murnane 2003)

Skills = formal education



Hanushek/Woessmann (2008):

Skills = cognitive skills

Heckman & coauthors:

Skills = cognitive skills

+ noncognitive skills (personality)

Motivation

- **Evidence from recent decades**
  - **Job polarization**
    - Computers complemented abstract tasks
      ➔ Relative employment of high-educated workers ↗
    - Computers replaced routine tasks
      ➔ Relative employment of middle-educated workers ↘
    - Income effects of computerization favored manual & interpersonal tasks
      ➔ Relative employment of low-educated workers ↗

This paper: <u>Future</u> digitalization will likely replace jobs for less educated workers disproportionately

Motivation

- **Evidence from recent decades**
  - **Noncognitive skills have become more important**
    - Remuneration of "social" skills ↗ …
      (Borghans et al. 2014, Weinberger 2014)
    - … Even more so, if combined with high cognitive skills
      (Deming 2015, Deming & Kahn 2017, Edin et al. 2017)

This paper: <u>Future</u> digitalization will likely continue favoring high proficiencies in noncognitive skills

Empirical approach

Future change in relative labor demand by occupations (induced by tech. change)

Worker's skill endowments in these occupations **today**

$$\Delta D_{it+1}(o) = f(\mathbf{S}_{it}(o), \mathbf{X}_{it}(o))$$

i: workers

$$P_i(o) = f(\mathbf{S}_{it}(o), \mathbf{X}_{it}(o))$$

Probability of digitalization within **next 2 decades** (Frey/Osborne 2017)
low prob: relative demand ↗
high prob: relative demand ↘

Education, personality (**recent** worker surveys, SOEP)
high proficiencies
low proficiencies

Controls (SOEP)
- Gender, nationality
- Industry FE
- Region type FE

Empirical approach

Dependent variable: Computerization prob. (P_o)

- Estimated by Frey/Osborne (2017) for 702 SOC 2010 occupations in US
  Converted to ISCO-88 available in SOEP
- Forward looking: Next about 20 years
- Subjective expert opinions (machine learning and robotics experts)
- Plus objective workplace characteristics (O*Net)

Explanatory variables

- From German Socio-Economic Panel (SOEP)
- 2005, 2009, 2013 waves, pooled
- 29,545 observations (worker-year), 297 ISCO-88 occupations
- Personality: 15-items Big Five inventory (see next slide)
- Robustness checks: 3 other German worker surveys (NEPS, PASS, LPP)

Empirical approach

Explanatory variables: Big Five personality traits

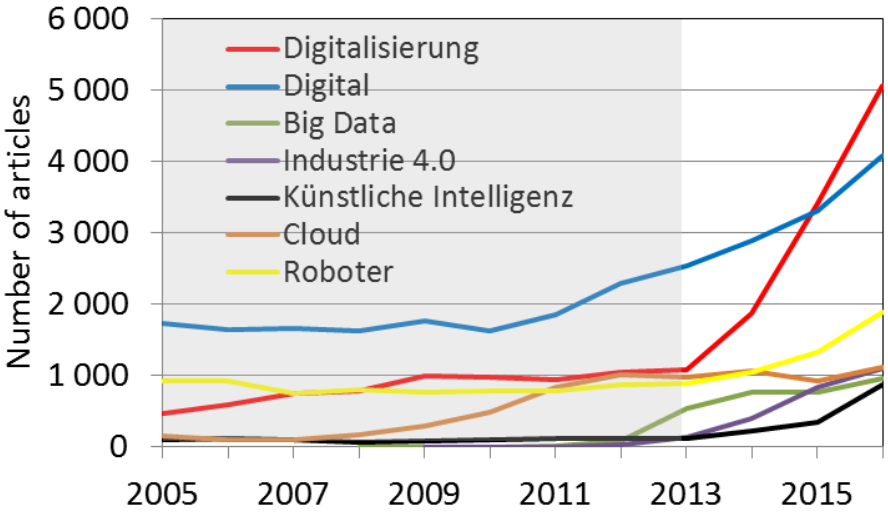
Openness to Experience (vs. Closedness)	Tendency to be open to new aesthetic, cultural or intellectual experience
Conscientiousness (vs. Lack of Direction)	Tendency to be organized, responsible and hardworking
Extraversion (vs. Introversion)	Orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experience; characterized by positive affect and sociability
Agreeableness (vs. Antagonism)	Tendency to act in a cooperative, unselfish manner
Neuroticism (vs. Emotional Stability)	Neuroticism: Chronical level of emotional instability and proneness to psychological distress Emotional Stability: Predictability and consistency in emotional reactions, with absence of rapid mood changes

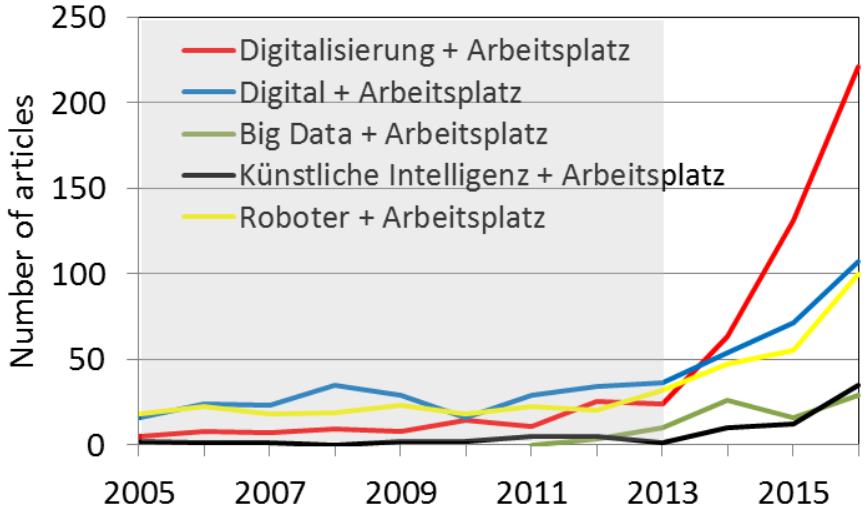
Scores for each trait standardized to $\mu=0$, $\sigma=1$

Empirical approach

Identifying assumption:

Workers have not yet anticipated direction of future digitalization in their job choices





Keyword search in Gruner & Jahr archive (German newspapers & magazines)

Estimation

- **Fractional response (FR) regression**
  - Dependent variable: $P_o \in (0,1)$
  - FR allows for $P_o=0$, $P_o=1$
- **Computerization probabilities available only for occupations**
  - P_o does not vary across jobs within occupations
  - Computerization probability of jobs is measured with an error
  - Residuals clustered by occupation
  - Industry and region (state) FE capture systematic variations of digitalization probabilities across industries and regions
  - **Assumption: Measurement errors within occupations, industries and regions are unrelated to workers' skills**

Results

Dep.var: Computerization prob	**Estimate**
Openness	–0.056***
Conscientiousness	–0.003
Extraversion	–0.005
Agreeableness	0.018***
Neuroticism	0.018***
Years of schooling	–0.007
Years of schooling, squared	–0.004
Age	–0.006
Age, squared	0.000
Male	–0.216***
Foreigner	0.021
Constant	1.381***
Industry fixed effects	Yes
Bundesland fixed effects	Yes
# Individuals	29,454
# Occupations	297
Log-likelihood	–13,509

Curious, imaginative, excitable, unconventional (–0.056 is equivalent to 7 more month of upper secondary schooling)

Conformist, trustful, dutiful or undemanding

Altruistic. tender-minded

Anxiety, depression, impulsiveness,

Education bias,
favoring higher education disproportionately

Women more concentrated in industries with lower average digitalization prob's

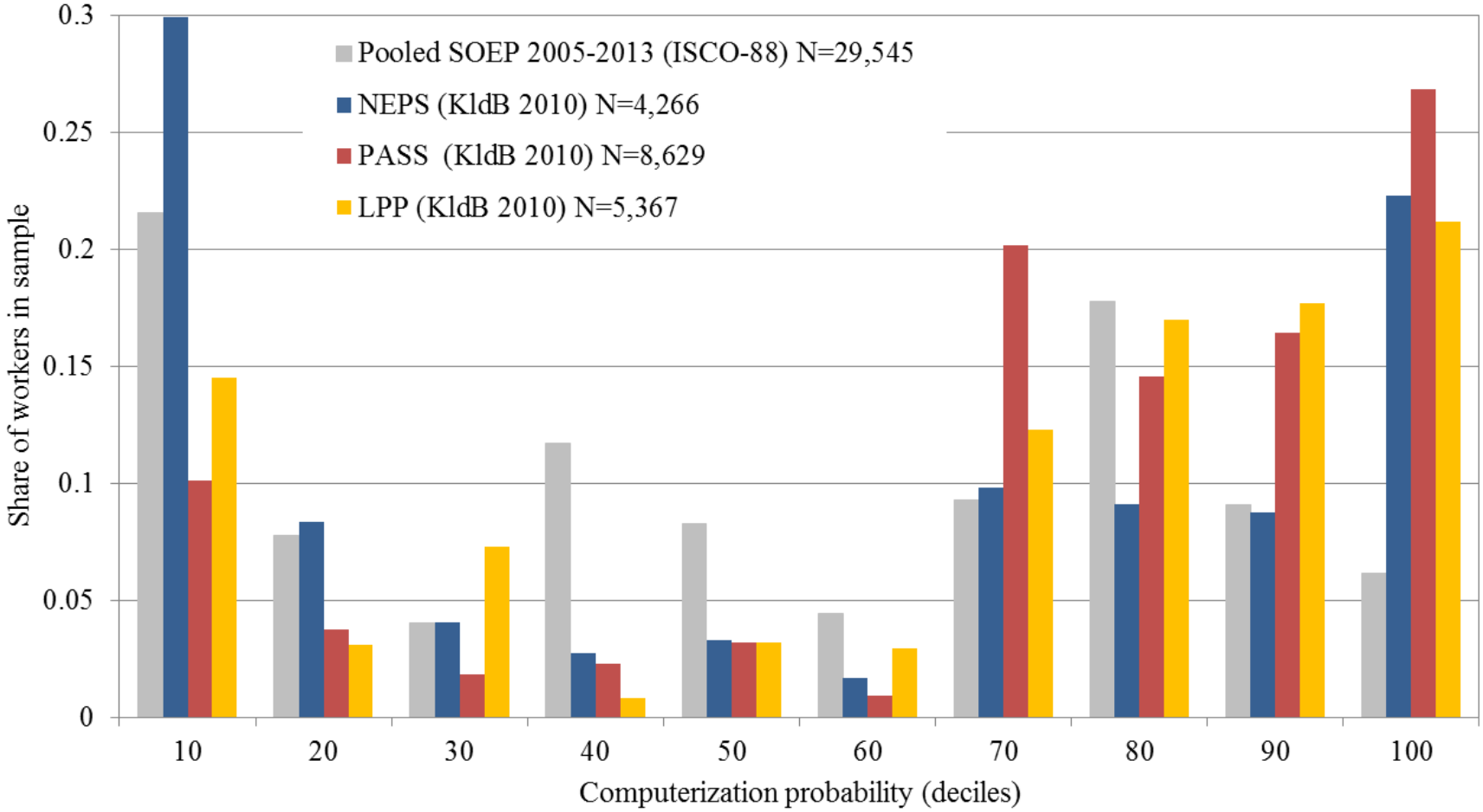
Fractional response regression;
dependent variable: digitalization probability of workers' occupations

Robustness

- NEPS: Noncognitive skills are equivalent to 3 more years of upper secondary school
- PASS & LPP: Noncognitive skills less relevant
  - PASS targets households with lower socio-economic status (SGB II)
  - LPP targets larger manufacturing firms
  - Both: Disproportionately high shares of workers in jobs with high digitalization probabilities

Robustness

Distribution of workers across deciles of digitalization probabilities



Conclusion

- Future technological change skill-biased toward
  - Higher education
  - Noncognitive skills
    - More openness to experience
    - Less agreeableness
    - More emotional stability (less neuroticism)
- Education and labor market policies ("lifelong learning") should focus more on noncognitive skills to foster workers' labor market resilience in the digital age

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THANK YOU!

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