

Is this Time Different? How Digitalization Influences Job Creation and Destruction

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Transformation Day, FHNW, Olten, September 2, 2020

Introduction

Digitisation destroys jobs

1964

Ifo-Institut in Munich: 1,5 millions of Germans loose their jobs. (Zeitschrift „Der Spiegel“)

1978

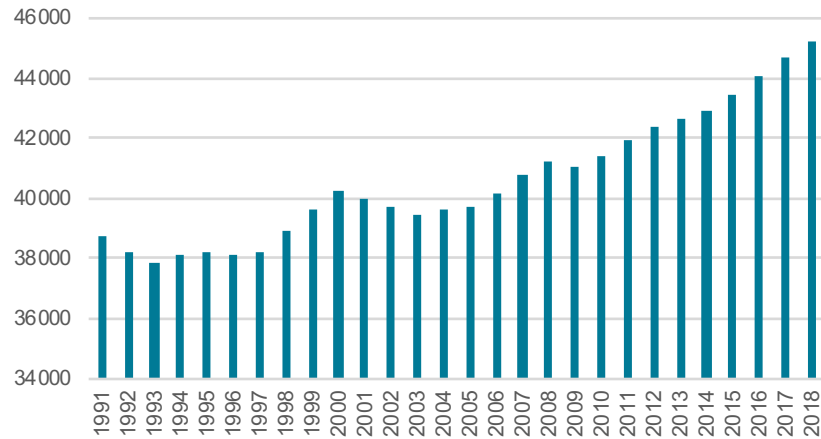
In 20 years, 80 percent of jobs will be destroyed. (Zeitschrift „Der Spiegel“)

2016

In Germany, 12% of jobs are lost, that would be five million people. (Zeitschrift „Der Spiegel“)

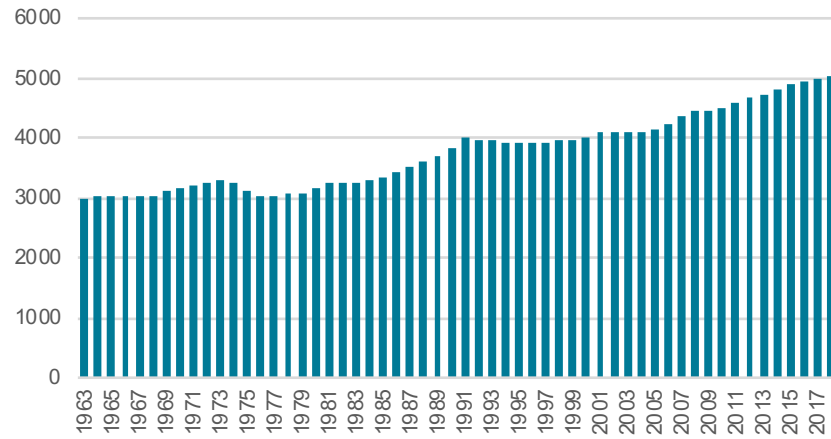
In fact employment increased

Employment (in 1000) Germany



Source: Statistical Office Germany

Employment (in 1000) in Switzerland



Source: Swiss Federal Statistical Office

IS THIS TIME DIFFERENT?

Anything is Possible

- Studies emphasizing ...
 - ...the risks for labor markets, where technological adoption might result in mass unemployment (Ford 2015, Frey and Osborn 2017, Leontief 1952).
 - ...the new job opportunities related to the development of new technologies (Chandler 1977, Mokyr 1999).
- Both forces are at work, however, consistent with Schumpeter's concept of creative destruction, the **net impact** on jobs seems to be **positive** (Mastrostefano and Pianta, 2009, Kogan et al. 2017).

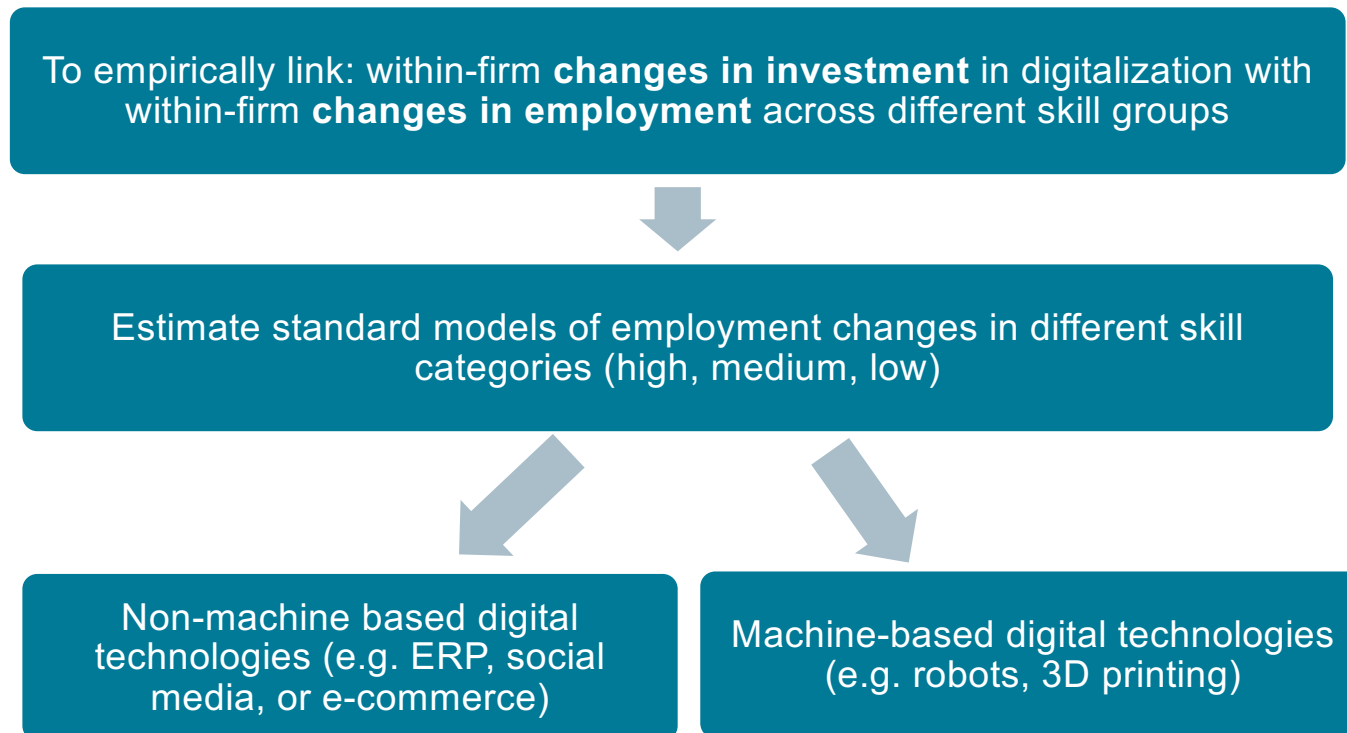
Jobs in the era of digitalization

- **Theoretical** potentials of Job losses ..
 - ... 47% for the US (Frey and Osborne 2017)
 - ... 57% if all Western economies are taken into account (Schwab 2016)
- These numbers will **hardly come true** (e.g. Arntz et al. 2017; Autor 2015; Dengler and Matthes, 2015)
 - Plenty of new task (programming, data analysis) have been created (Acemoglu and Restrepo 2017)
 - New industries evolved with many employees (e.g. Amazon, Facebook ...)

Job Polarization

- **Tasks** that become **obsolete** are **different** from the task **created** – heterogeneous effects on skill requirements.
 - E.g. Robots compete directly with manual labor (low to medium skill level) and might require high skilled labor for complementary tasks or their development.
- Job polarization: digitalization ...
 - ...**increases** the demand for high-skilled and low-skilled workers;
 - ...**decreases** the demand for medium-skilled workers (e.g. Autor et al. 2003; Goos and Manning 2007; Goos et al. 2009; Michaels et al. 2014)
- It is unclear **which type** of technologies cause this effect or if all digital technologies lead to similar effects

Detailed investigation of the relationships:



EMPIRICAL INVESTIGATION

Data

- Data from two surveys
 - Unique business survey on the digitalization activities of Swiss firms (2016)*;
 - overview about the adoption of machine-based and non-machine-based digital technologies.
 - Swiss Innovation Survey (2015), which is equivalent to the Community Innovation Survey in the EU.
- Both surveys are based on the KOF enterprise panel (ca. 5700 companies)
 - Stratified random sample (stratification criteria: 34 industries; 3 firm-size classes)
- Response rate ca. 30% in both surveys
 - We restricted the sample to firms with more than 20 employees (full-time equivalent)

*) The digitalization survey was conducted by the ETH Zurich, KOF Swiss Economic Institute, the Chair of Work and Organizational Psychology at the Department of Management, Technology, and Economics at the ETH Zurich, and the University of Applied Sciences and Arts Northwestern Switzerland (FHNW), School of Applied Psychology (APS).

Measurement of formal educational attainment

- **High-skilled:** contains workers with professional tertiary education including graduates from universities of applied sciences and conventional universities.
- **Mid-skilled:** workers with **completed upper secondary** education and workers who have finished **vocational education and training** rather than a general upper secondary education
- **Low-skilled:** comprises untrained workers and dual VET students

Measurement of digitalization

- Investments in **Hard- and Software**
- **Machine-based technologies:** computerized automated control systems, programmable logistic controllers, rapid prototyping, computerized numerical control (CNC) and direct numerical control (DNC) machines, robots, autonomous vehicles, 3D printing, Internet of Things.
- **Non-machine-based technologies:** e.g. ERP, e-purchasing, CRM, SCM, Business analytics, social media, cloud computing, telework.

DESCRIPTIVE INFORMATION

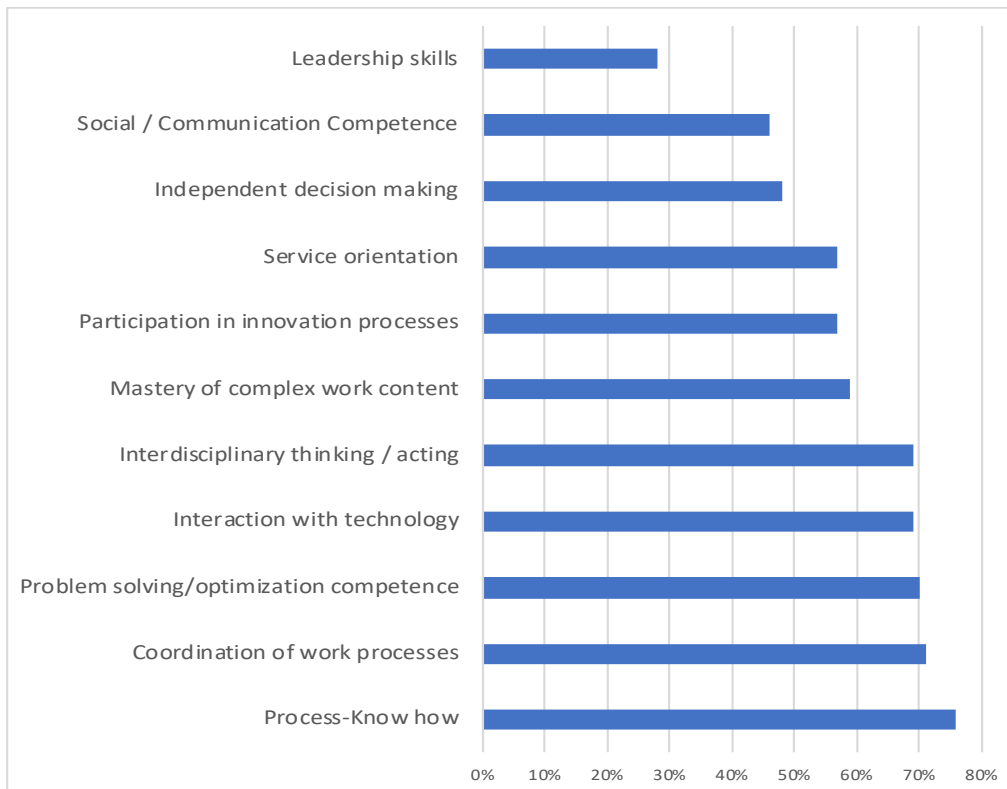
Switzerland: Digitization and the demand for education

	Small	Medium-sized	Large
Universities			
Unchanged	94	88	79
Decrease	1	0	1
Increase	4	12	20
Universities of Applied Sciences			
Unchanged	85	77	68
Decrease	1	2	1
Increase	13	21	31
Colleges			
Unchanged	85	79	64
Decrease	1	3	7
Increase	14	18	29

	Small	Medium-sized	Large
Vocational Education			
Unchanged	72	85	80
Decrease	6	6	12
Increase	22	8	8
Trained/untrained			
Unchanged	79	82	73
Decrease	14	15	25
Increase	7	2	2
Apprentices			
Unchanged	87	95	89
Decrease	3	1	3
Increase	11	4	8

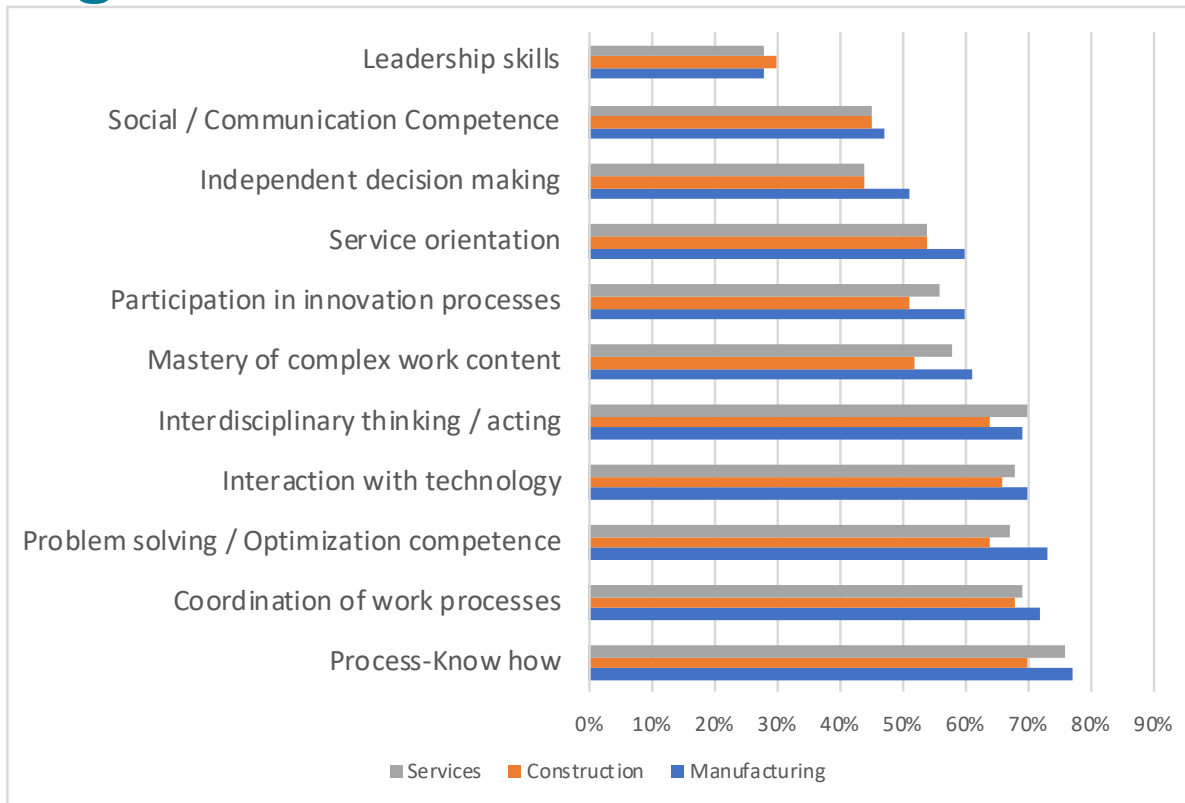
Source: Arvanitis S., Grote, G., Spescha, A., Wäfler T., Woerter M. (2017). Digitalisierung in der Schweizer Wirtschaft: Ergebnisse der Umfrage 2016 - eine Teilauswertung im Auftrag des SBFI, KOF Studien Nr. 93, Juni.

Digitalization: Demand for Skills



Source: Bienefeld N., Grote G., Stoller I., Wäfler, T., Wörter, M., Arvanitis S. (2018). Digitalisierung in der Schweizer Wirtschaft: Ergebnisse der Umfrage 2016 - Teil 2: Ziele, berufliche Kompetenzen und Arbeitsorganisation, KOF Studie No. 99, Zürich.

Digitalization: Demand for Skills - Sectors



Source: Bienefeld N., Grote G., Stoller I., Wäfler, T., Wörter, M., Arvanitis S. (2018). Digitalisierung in der Schweizer Wirtschaft: Ergebnisse der Umfrage 2016 - Teil 2: Ziele, berufliche Kompetenzen und Arbeitsorganisation, KOF Studie No. 99, Zürich.

ECONOMETRIC ANALYSIS

Estimation methods

- We estimate the relationships in first-differences ...
 - ... since we have a very short panel (two survey waves)
 - ... since we need to control for unobserved time-invariant heterogeneity.

$$\Delta Skill_i = \alpha_0 + \alpha_1 \Delta diginvest_chf_i + \alpha_2 \Delta rnd_i + \alpha_3 \Delta emp_i + \varepsilon_i$$

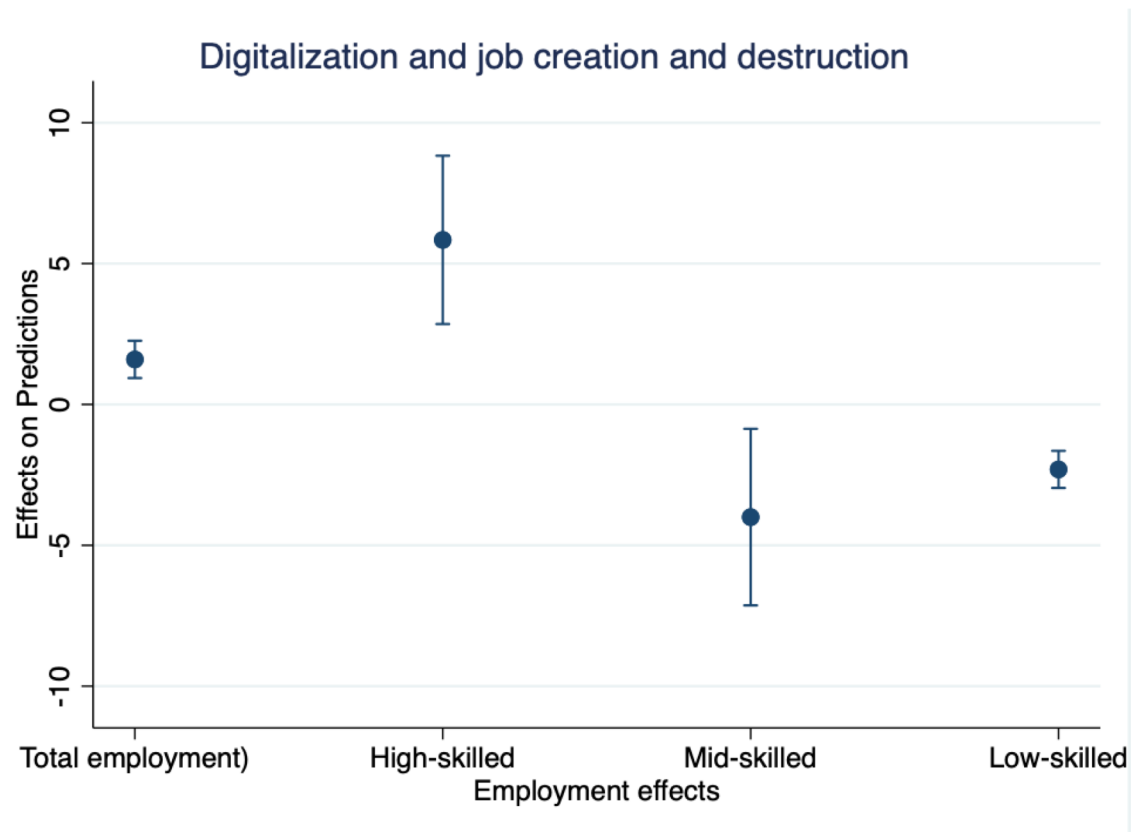
where,

$$\Delta Skill \in \{\Delta highskill, \Delta midskill, \Delta lowskill\}$$

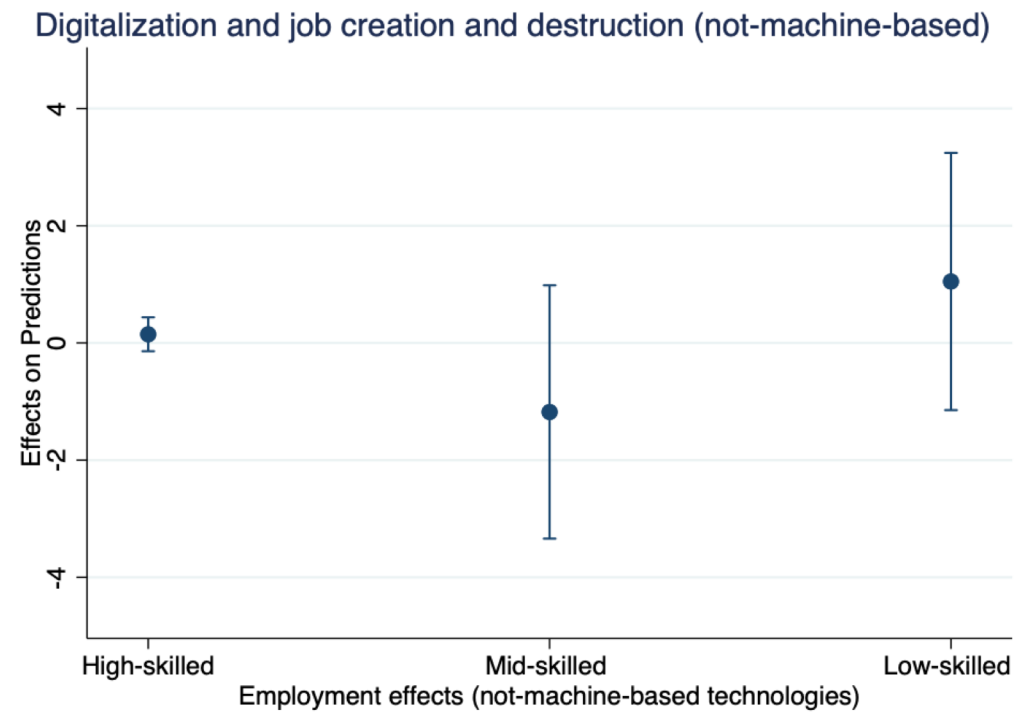
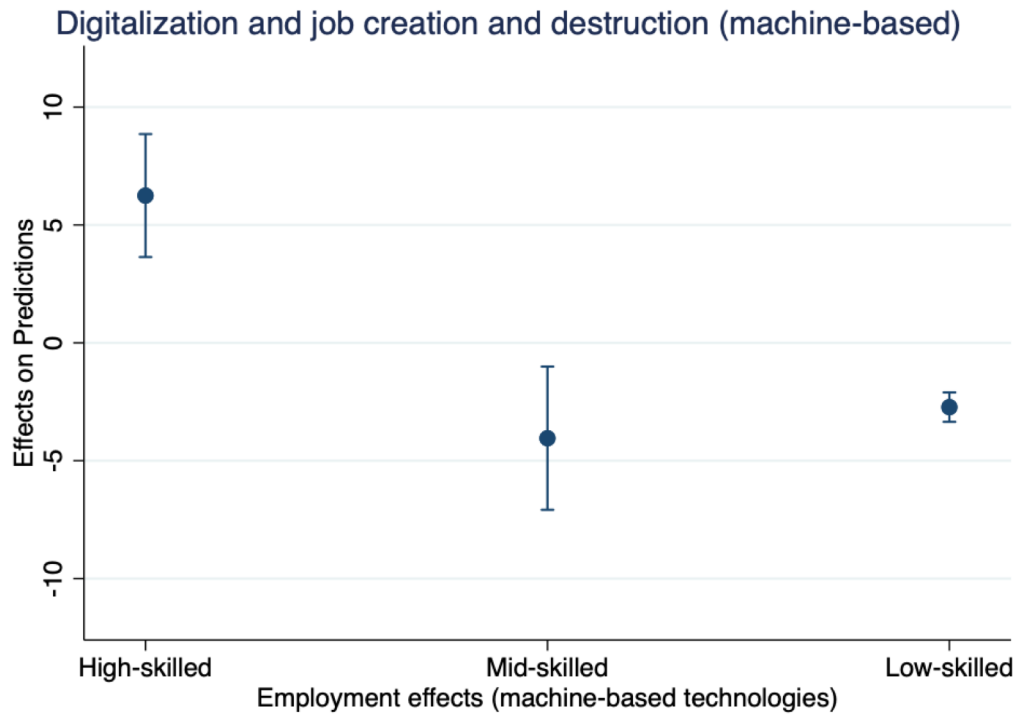
- Controls:
 - Change in R&D expenditures: since they can have similar effects on employment.
 - Change in employment: our coefficient of interest should not capture general firm size changes.

RESULTS

Results: digitalization and job creation and destruction

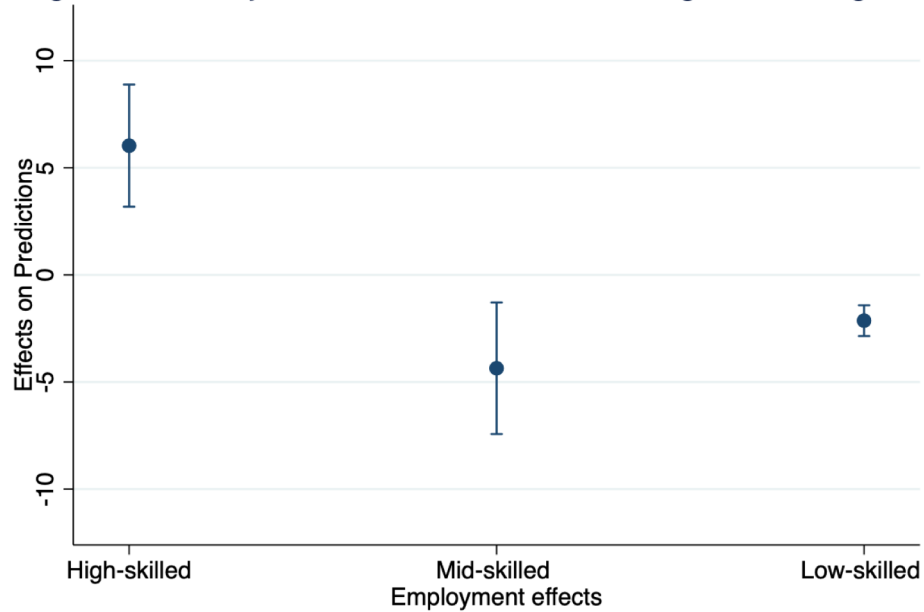


Results: machine-based vs. not-machine based

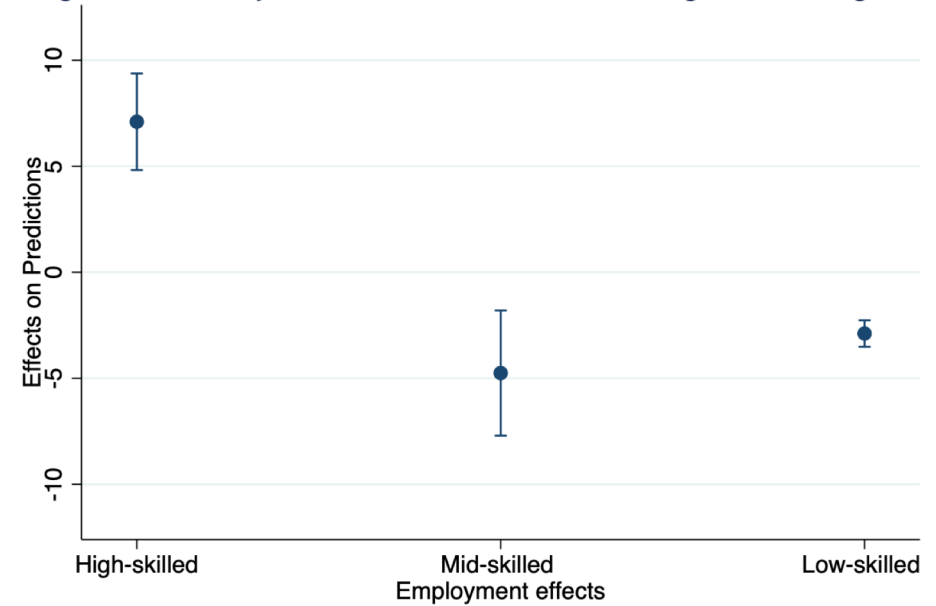


Employment effects: 3-7 digital technologies used for more than 2 years

Digitalization and job creation and destruction - 3 digital technologies



Digitalization and job creation and destruction - 7 digital technologies



Conclusions (1)

- Digital Investments are ...
 - ... positively associated with employment of high-skilled workers
 - ... negative associated with employment of low-skilled workers
- These effects are entirely driven by machine-based digital technologies
- Economic implications
 - The breakthrough of machine-based technologies require **better technological infrastructure**
 - **Skilled labor is necessary** to develop such technologies and skills to use them effectively.
 - **Global competition for talents** is likely to intensify. Well-situated companies might face stronger competition for their most talented employees.

Conclusions (2)

- Challenges for policy
 - **Inequality** may rise
 - Skilled labor must be efficiently allocated to growing, productive sectors – this requires **flexible labor markets** and workable product market competition.
 - **Training and continuing professional development** is necessary to improve the match between skills and job requirement.
 - Since the ability to learn and retrain skills is positively related with educational attainment, **attractiveness of tertiary education** should be increased.
 - **Innovative social measure** to address those parts of the society that does not manage the transition (e.g. basic income).

Thank you very much for your attention!