# DIGITIZATION AND THE FUTURE OF WORK

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**Centre for European Economic Research (ZEW)**

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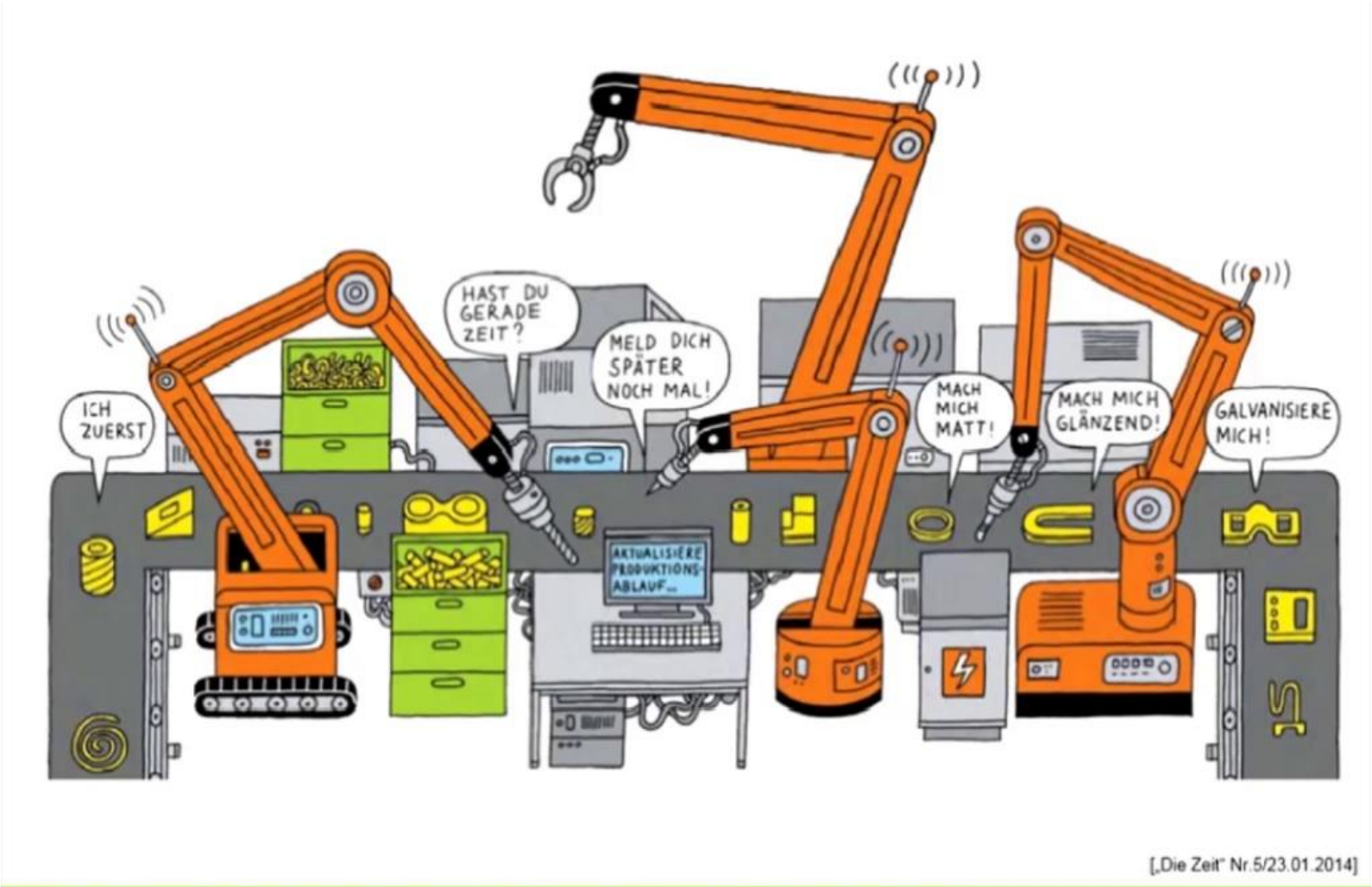
Seminar on “L’avenir du travail: saisir les opportunités et accompagner les risques” on behalf of the Luxembourg Ministry for Labour, Employment and the Social and Solidarity Economy

Leibniz Gemeinschaft ZEW

# Robotics, AI and Industry 4.0




[„Die Zeit" Nr.5/23.01.2014]

# End of work?


Der Spiegel,3.9.2016

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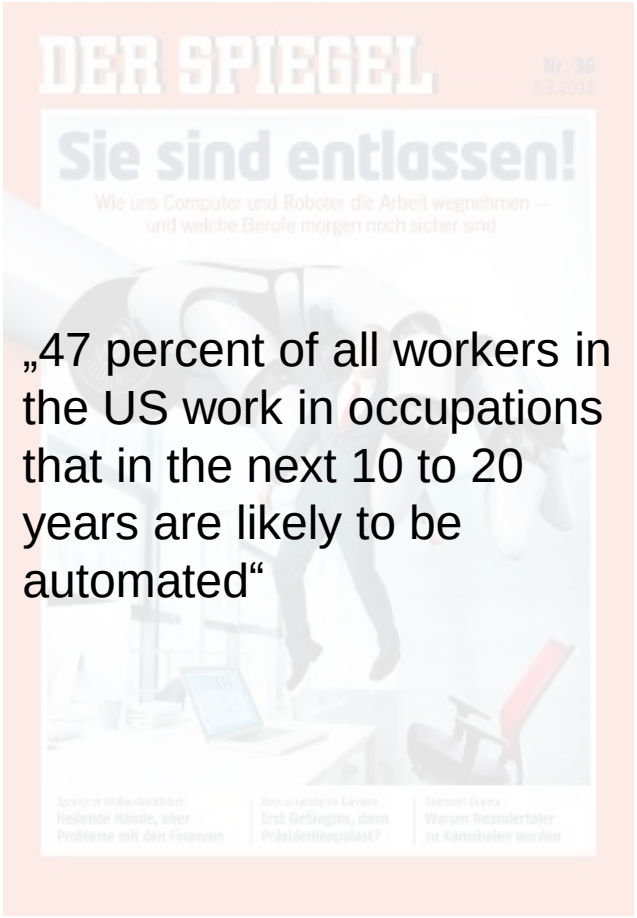


„47 percent of all workers in the US work in occupations that in the next 10 to 20 years are likely to be automated“

Der Spiegel,3.9.2016

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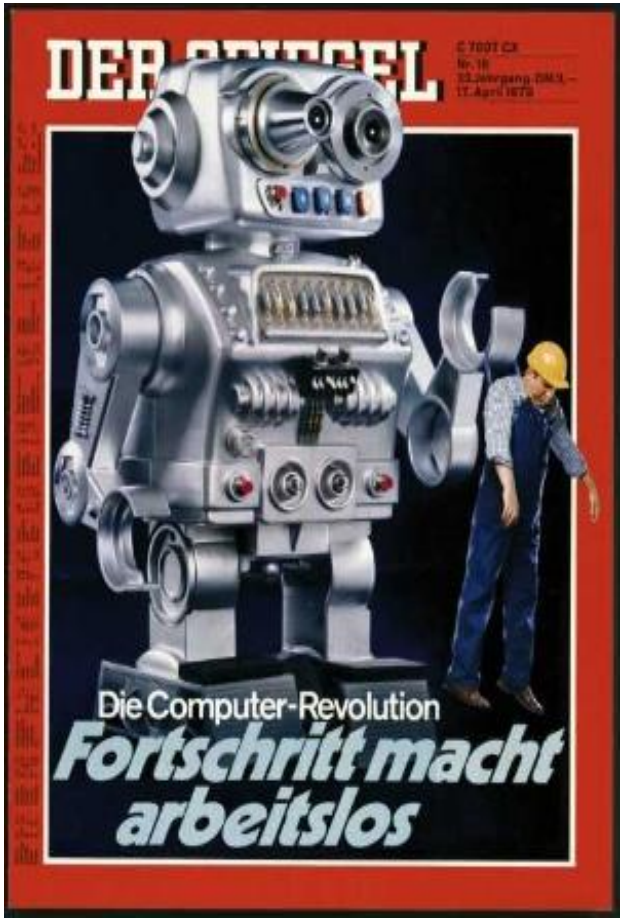


Der Spiegel,17.4.1979

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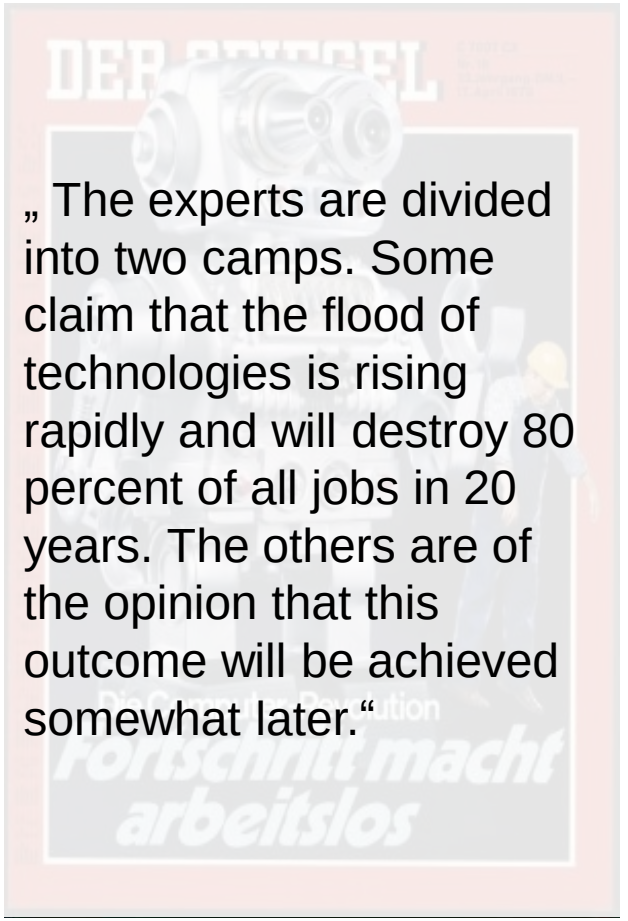


„ The experts are divided into two camps. Some claim that the flood of technologies is rising rapidly and will destroy 80 percent of all jobs in 20 years. The others are of the opinion that this outcome will be achieved somewhat later.“

Der Spiegel,17.4.1979

# Agenda

1. The risk of automation

2. The diffusion of technology

3. The impact of the digital revolution on labor markets
   - Transmission channels of new technologies
   - Total employment effects
   - Structural effects and inequality

4. Policy challenges

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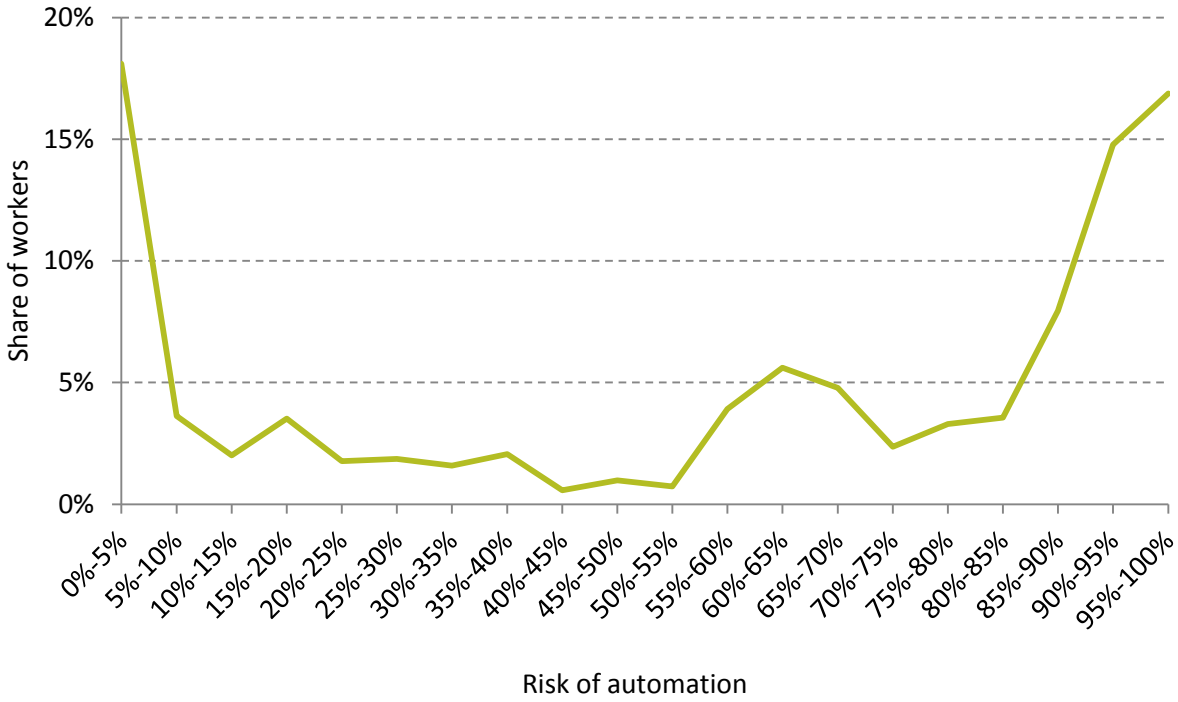
# Study by Frey/Osborne (2017)

## 47% of US jobs are at risk of automation




**Source:** Frey/Osborne (2017). The future of employment: how susceptible are jobs to computerisation?. Technological Forecasting and Social Change, 114, 254-280.

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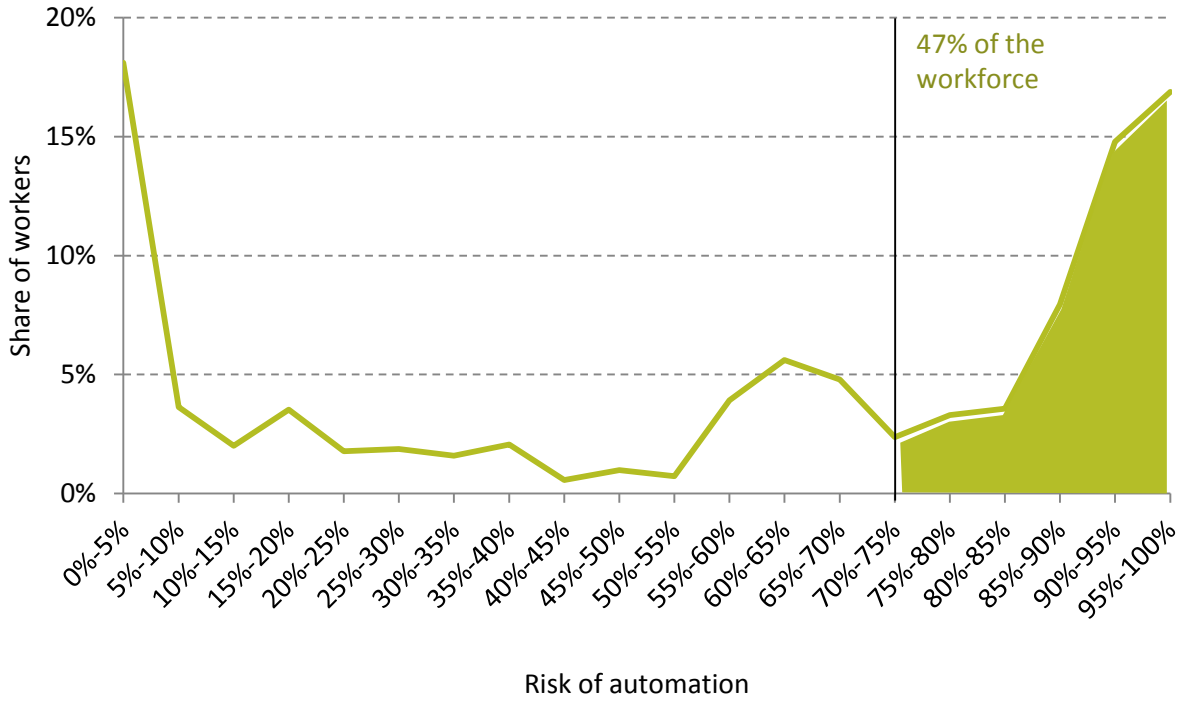



**Source:** Frey/Osborne (2017). The future of employment: how susceptible are jobs to computerisation?. Technological Forecasting and Social Change, 114, 254-280.

# It all depends on the specific job

Occupation-level approach (Frey/Osborne)

- New technologies replace entire professions
- All employees in the same occupational group have the same risk

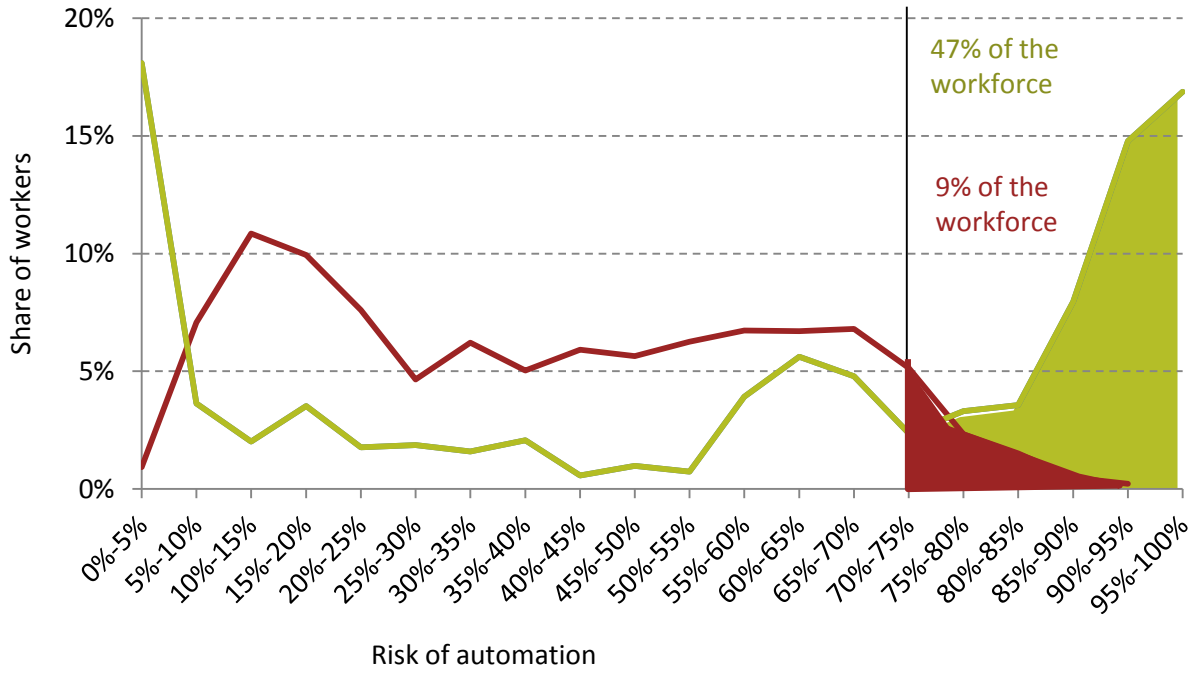
Job-level approach (Arntz/Gregory/Zierahn)

- Bundles of tasks vary not only between but also within professions
- Even employees in professions “at high risk” often perform tasks that are difficult to automate

=> Analyze automation risks on the level of jobs

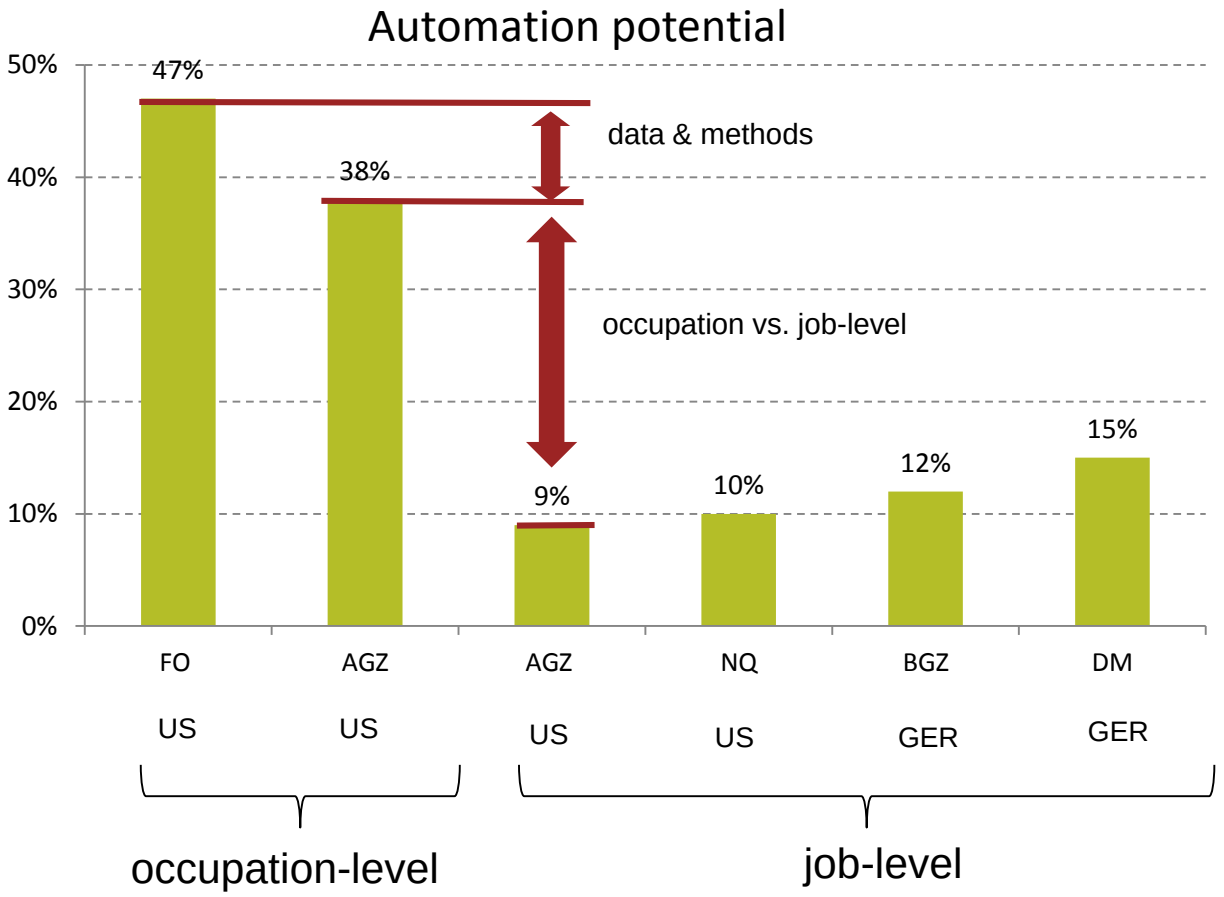
# Automation risks based on job-level approach

## Only 9% of US jobs at risk of automation




**Source:** Arntz/Gregory/Zierahn (2017): Revisiting the Risk of Automation, Economics Letters 159: 157-160.

# Understanding the numbers




FO – Frey/Osborne

AGZ – Arntz/Gregory/Zierahn

BGZ– Bonin/Gregory/Zierahn

NQ – Nedelkoska/Quintini

DM – Dengler/Matthes

**Source:** Arntz/Gregory/Zierahn (2017): Revisiting the Risk of Automation, Economics Letters 159: 157-160.

# How threatened are those jobs?

Automation risks must not be equated with employment effects:

1. Slow diffusion of technologies
2. Adaptability of employees
3. Creation of new jobs

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# Representative IAB-ZEW Labor Market 4.0 establishment survey

Survey conducted in May 2016

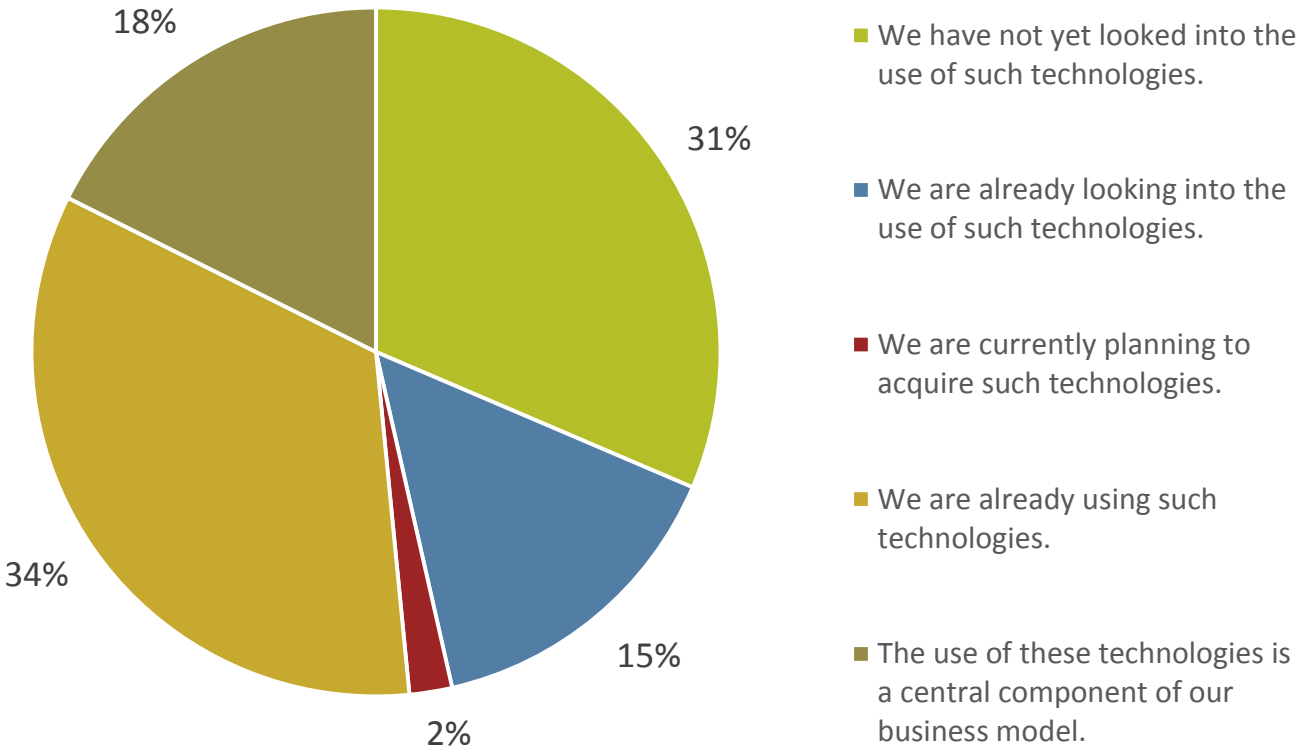
- 2032 CATI interviews with establishments (production managers/ firm owners)
- Service providers (67%) and producers (33%)

Content of questionnaire

- Relevance of new digital technologies (including 4.0 technologies)
- Degree of automation of work equipment
- Changes in labor demand (skills, tasks, competencies)
- Background characteristics (sales, profits, etc.)
- Information gathered for the presence (2016), past (before 5 year) and future (in 5 years)

# Slow diffusion of 4.0 technologies

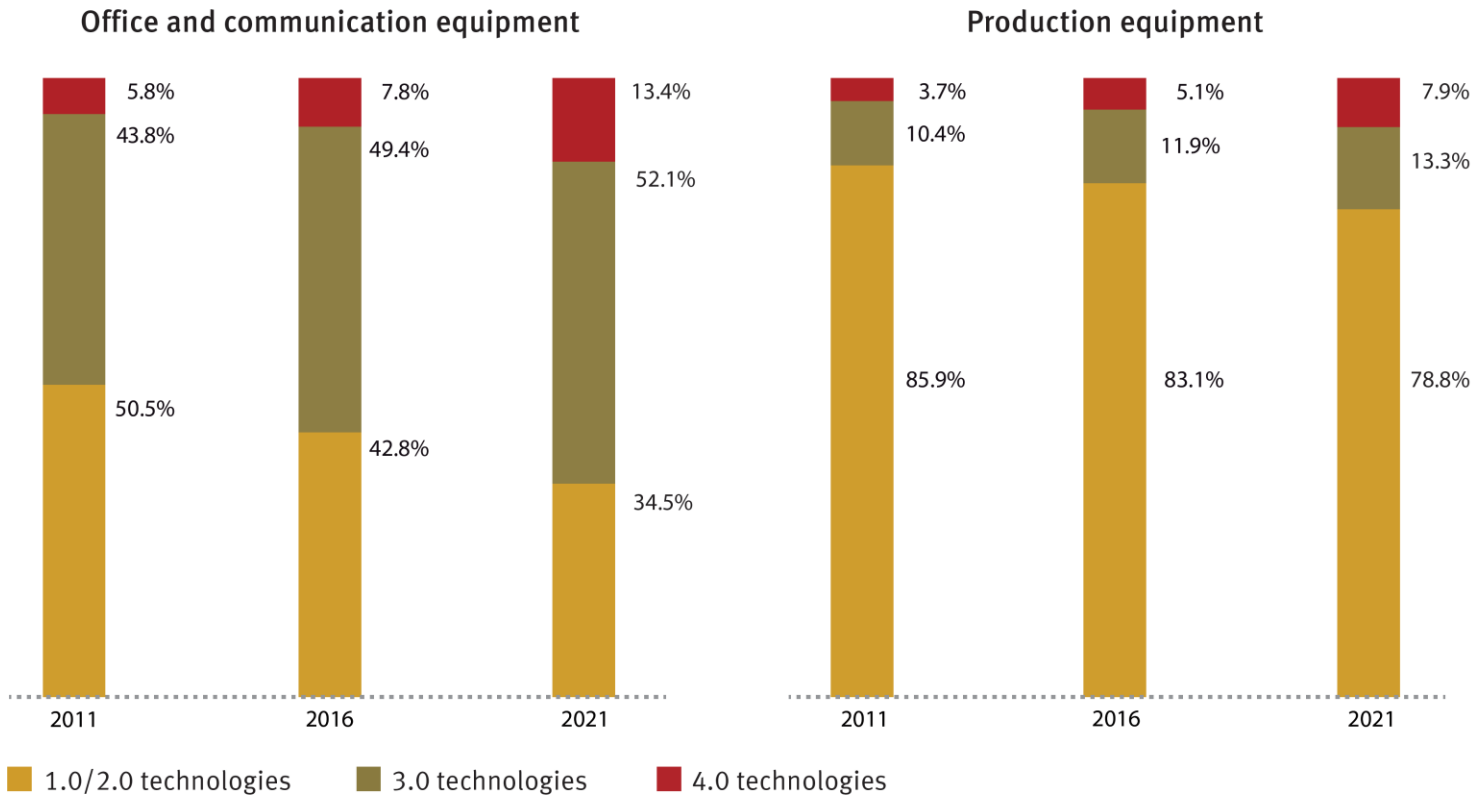
## About half of German establishments use 4.0 technologies




**Source:** Arntz/Genz/Gregory/Janser/Lehmer/Matthes/Zierahn (2018), Technology and Jobs in the Fourth Industrial Revolution - Firm-Level Evidence, unpublished manuscript.

# Slow diffusion of 4.0 technologies

## Low but increasing share of 4.0 technologies

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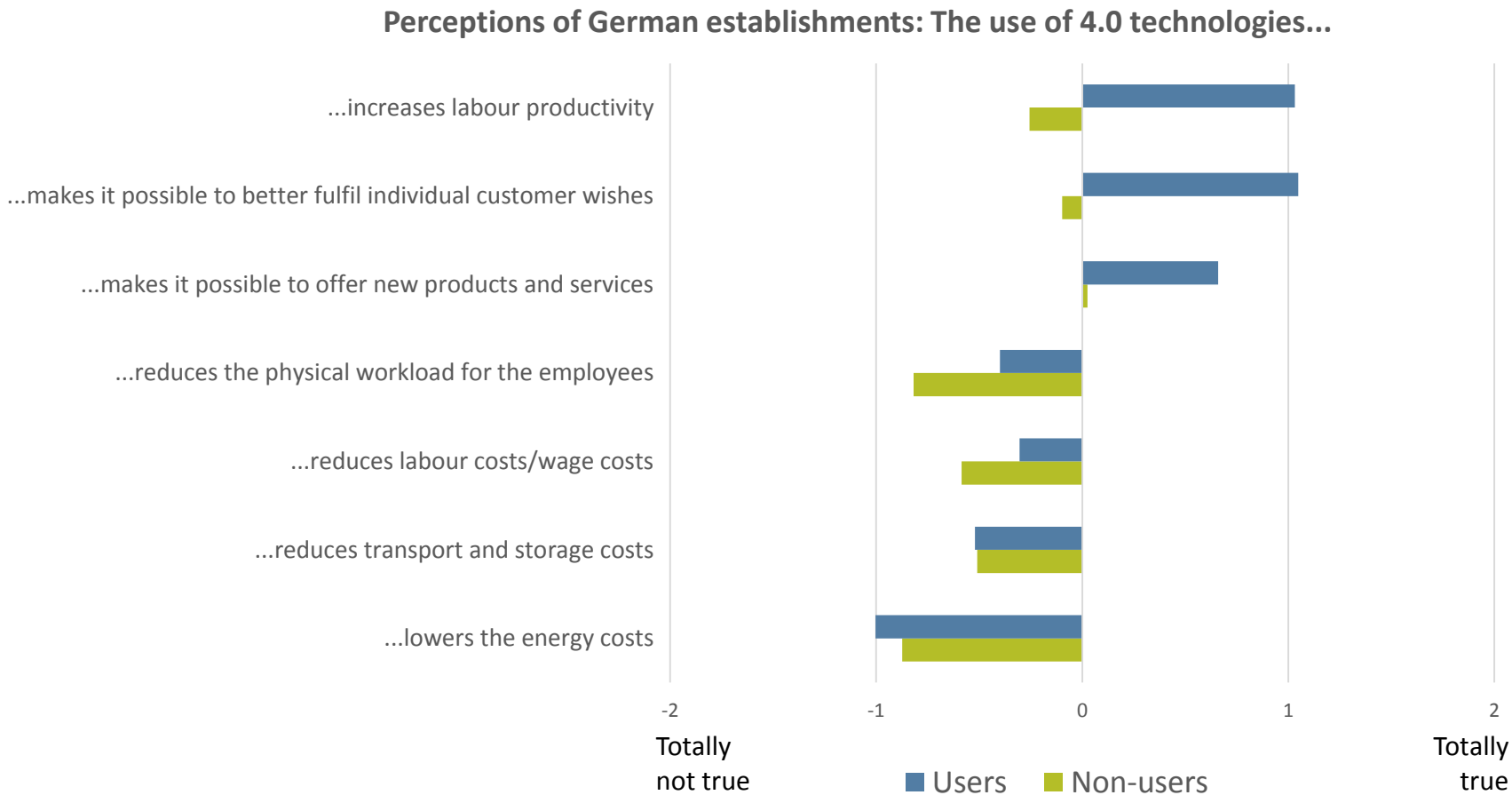
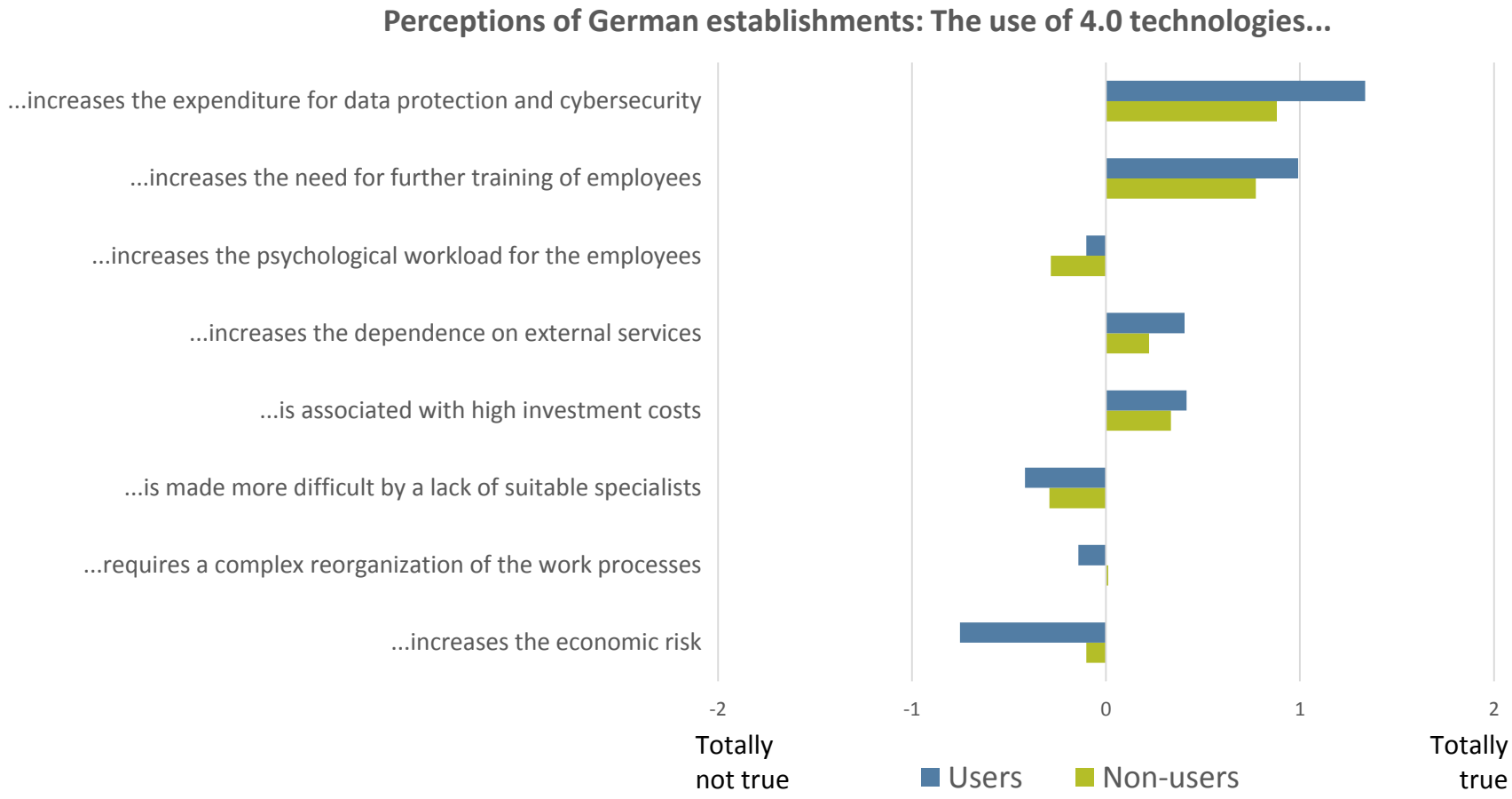
# Opportunities of 4.0 technologies




**Source:** Arntz/Genz/Gregory/Janser/Lehmer/Matthes/Zierahn (2018), Technology and Jobs in the Fourth Industrial Revolution - Firm-Level Evidence, unpublished manuscript.

# Challenges of 4.0 technologies




**Source:** Arntz/Genz/Gregory/Janser/Lehmer/Matthes/Zierahn (2018), Technology and Jobs in the Fourth Industrial Revolution - Firm-Level Evidence, unpublished manuscript.

# Digital divide between firms and workers

## Leaders are larger, capital-intensive and more successful

| Average values accross 2032 establishments | Technology Leaders | Technology Followers | Difference |
|---|---|---|---|
| Number of employees | 18.3 | 8.5 | 9.8 |
| Profits (in mil. Euros) | 4.48 | 0.2 | 4.3 |
| Revenues (in mil. Euros) | 49.7 | 5.9 | 43.8 |
| Value added (in mil. Euros) | 38.1 | 4.1 | 34 |
| Service provider (in %) | 88.7 | 83.2 | 5.5 |
| Supplier of new technologies (in %) | 11.5 | 3.5 | 8 |
| Capital stock (in mil. Euros) | 2.91 | 1.85 | 1.1 |
| Share of entire work equipment | | | |
| 1.0/2.0 technologies | 50.6 | 58.8 | -8.2 |
| Share of 3.0 technologies | 41.2 | 36.5 | 4.7 |
| Share of 4.0 technologies | 8.2 | 4.7 | 3.5 |
| Number of firms | 711 | 1321 | |

Invested in 4.0 technologies between 2011 and 2016?

- Yes: Leaders
- No: Followers

**Source:** Arntz/Genz/Gregory/Janser/Lehmer/Matthes/Zierahn (2018), Technology and Jobs in the Fourth Industrial Revolution - Firm-Level Evidence, unpublished manuscript.

# Preliminary conclusion

- Slow but accelerating adoption of 4.0 technologies
- Different perceptions of opportunities and challenges
- Growing digital divide between establishments

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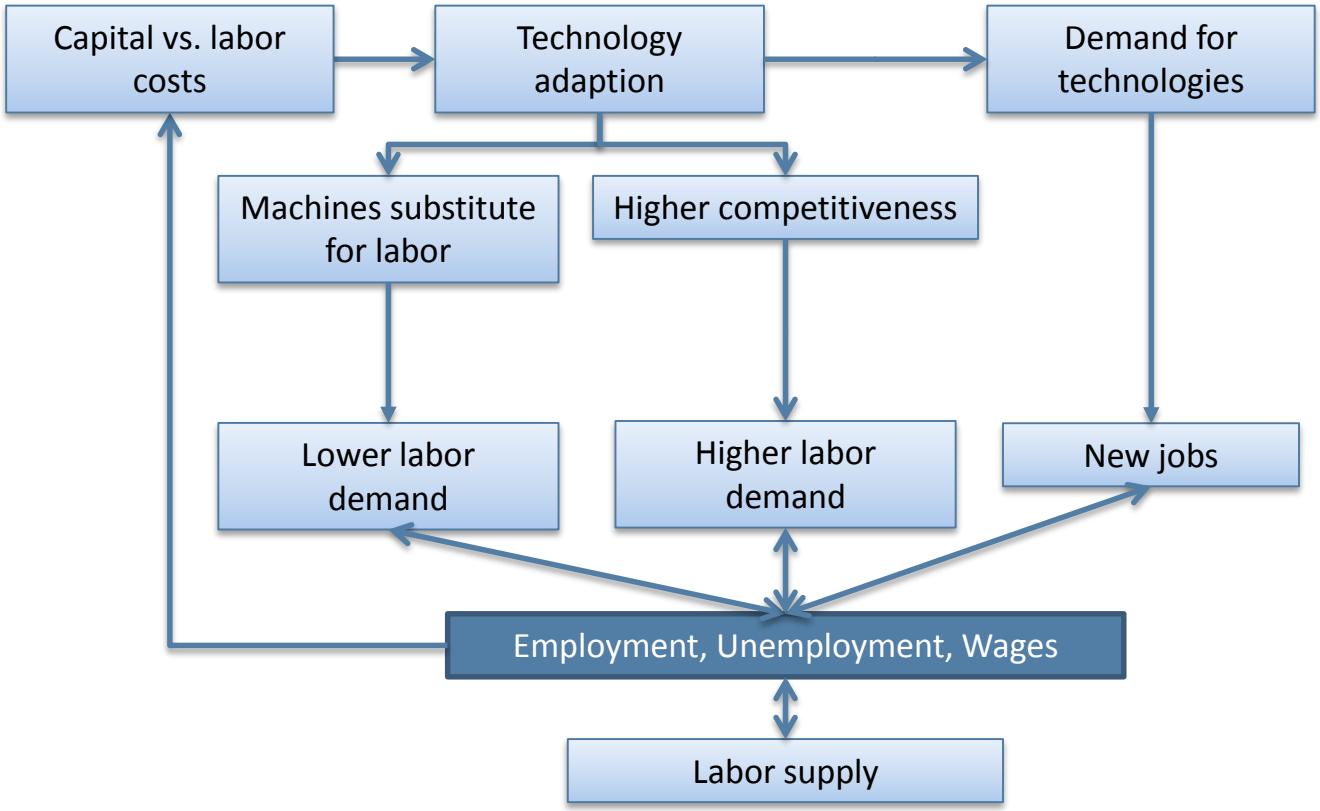
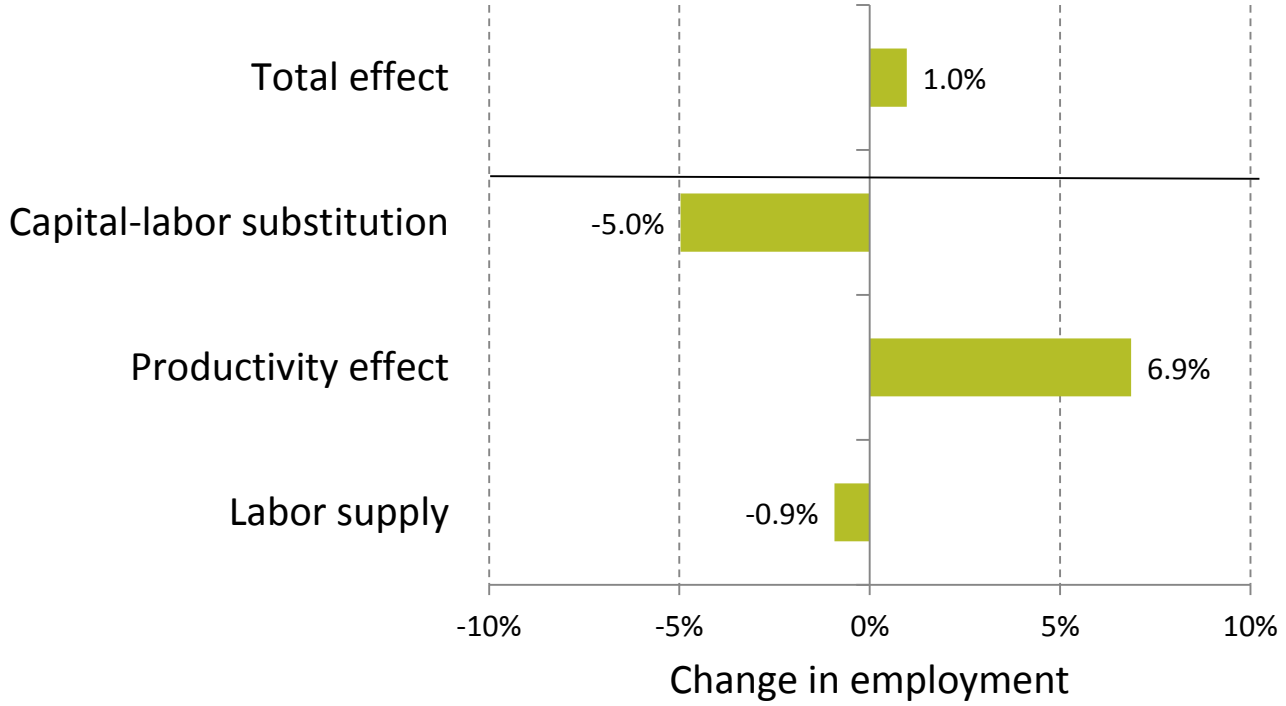
# Transmission channels of new technologies

New technologies both destroy and create work



# Positive net effect of digitization in Germany

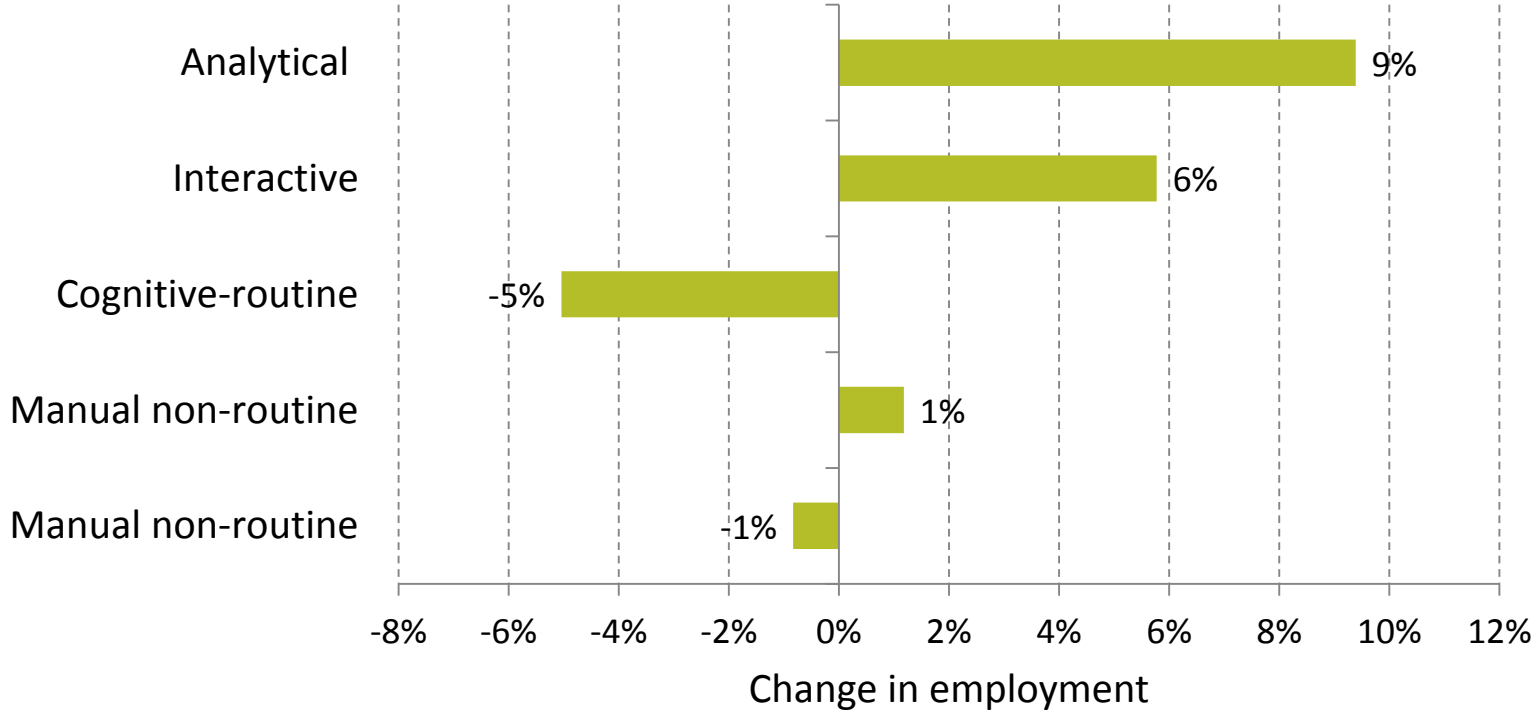
## Change in employment between 2011-2016 (in percent)




**Source:** Arntz/Gregory/Zierahn (2018), Technology and the Future of Work: Aggregate Employment Effects of Digitization, unpublished manuscript.

# Structural effects between occupational groups

Change in employment between 2011-2016 (in percent)



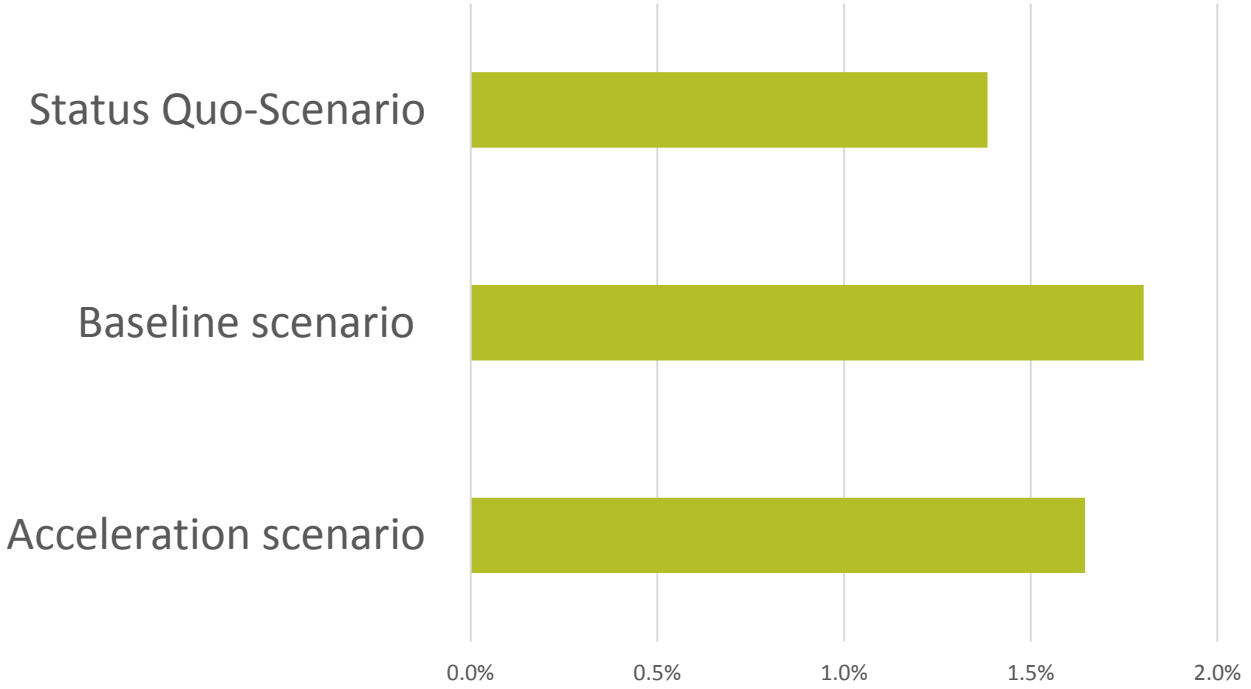

**Source:** Arntz/Gregory/Zierahn (2018), Technology and the Future of Work: Aggregate Employment Effects of Digitization, unpublished manuscript.

# Similar findings by other studies

- Wolter et al. (2015) - D
  - Restructuring of 60 thousand jobs by 2030 in favor of service and technical occupations
- Dorn et al. (2015) - US
  - No employment losses in local labor markets with routine intensive jobs
- Gregory, Salomons, Zierahn (2016) - EU
  - Technological progress between 1999 and 2010 led to an increase in labor demand
- Acemoglu und Restrepo (2017) - US
  - Employment losses in regions with a strong use of industrial robots
- Dauth et al. (2017) - D
  - No evidence that robots cause total job losses; Rather restructuring from manufacturing to service sector

# Scenarios for the next 5 years

## Small positive employment effects expected for 2016-2021



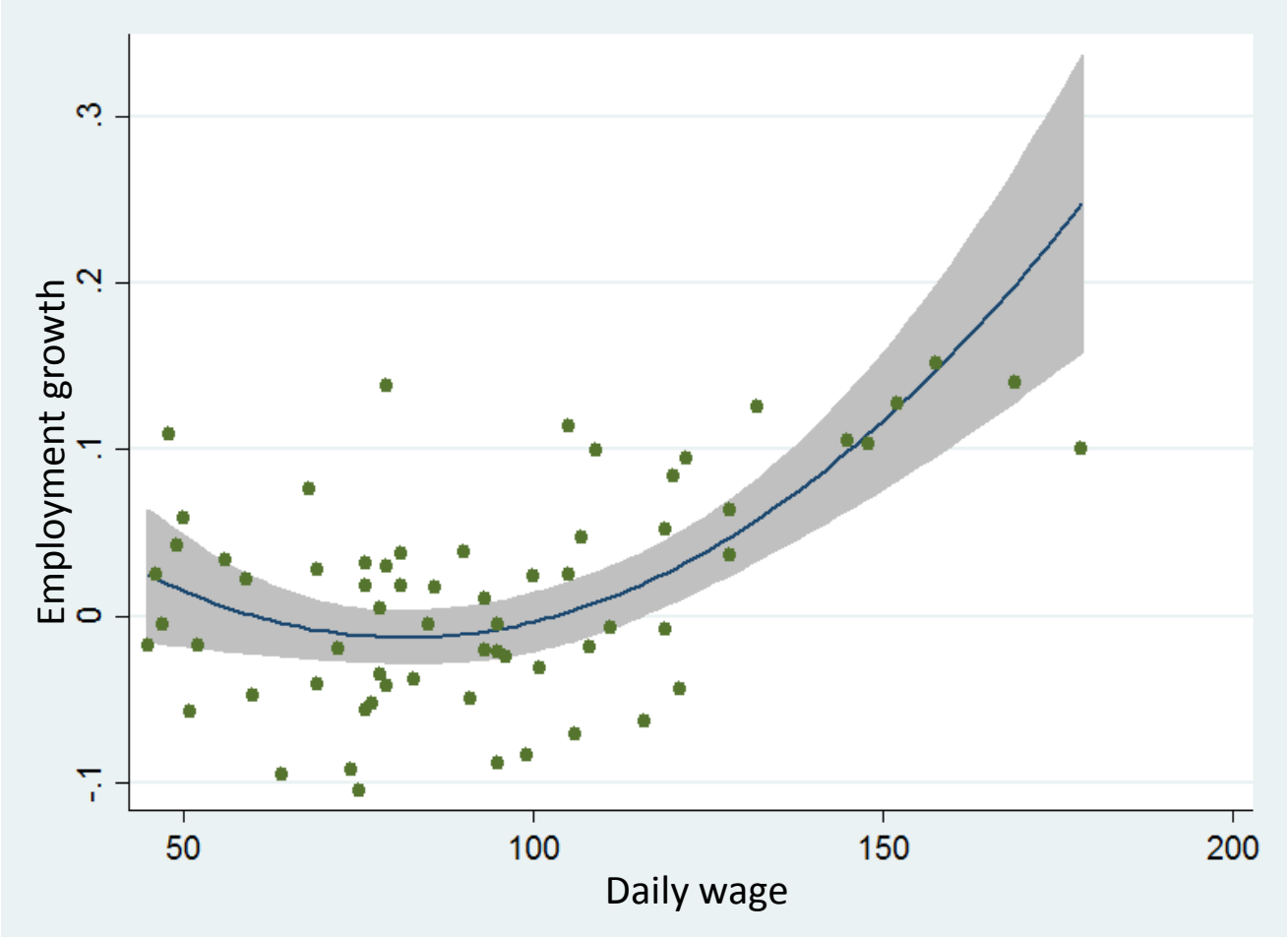

…as in the last 5 years

…according to the investment plans of the surveyed establishments

…20% faster then in baseline scenario

**Source:** Arntz/Gregory/Zierahn (2018), Technology and the Future of Work: Aggregate Employment Effects of Digitization, unpublished manuscript.

# Growing wage and employment polarization




**Source:** Arntz/Gregory/Zierahn (2018), Technology and the Future of Work: Aggregate Employment Effects of Digitization, unpublished manuscript.

# Preliminary conclusion

- New technologies both destroy and create work
- Small positive net effects of digitization
- Strong structural effects with changes in work content
- Growing wage and employment polarization

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# Policy challenges

1. Education and training policies
   - All levels of education
   - Higher education, vocational education and training
   - Lifelong Learning
2. Labour market policies
   - Public and private employment agencies
   - Non-standard work
3. Income and tax policies
   - Income policies
   - Tax policies
4. Technology regulation policies

ZEW

# Thank you for your attention

**Contact details**

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