Robots, ICT and their impact on EU labour markets

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Artificial intelligence and the next generation of competences :

How Digital – and Artificial Intelligence will impact jobs and competences profiles?

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Intellectual Capital for Communities In the Knowledge Economy

Digitalization and work

- Production processes have become increasingly automated.
- Workers can be replaced by more machines
- But, automation also brings productivity gains.
- How can we estimate the impact of digitalization?
  1. General equilibrium approach

  Estimate the equilibrium impact of automation on employment and wages based on data from the last decades.

  2. Looking at the future: The impact of machine learning and artificial intelligence

  How feasible it is to automate existing jobs given current and presumed technological advances?

Industrial robots: One automated technology

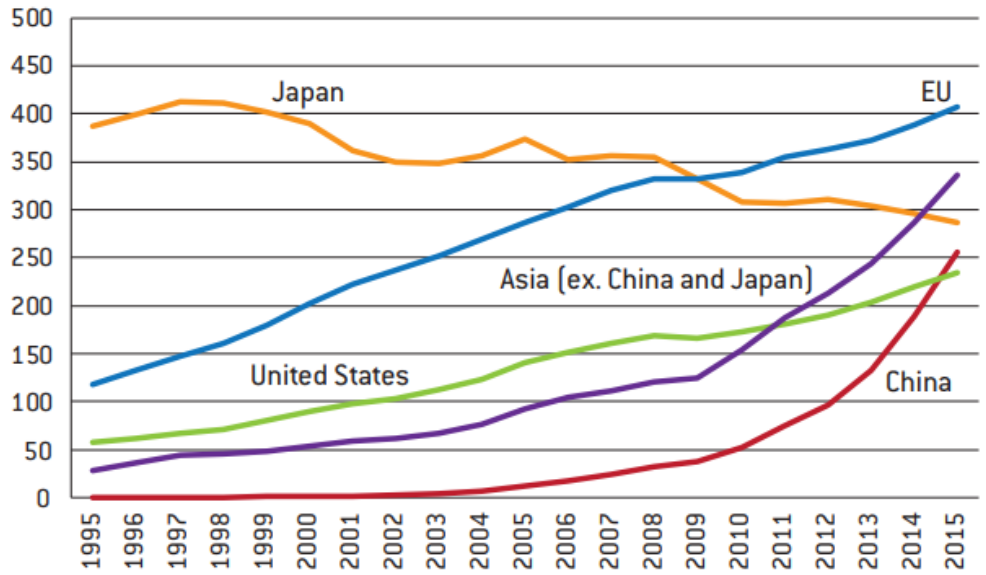
- IFR (2016):

"an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications".

- This definition excludes other types of capital that may also replace labor such as ICT and other machines.
- But, it enables an internationally and temporally comparable measurement of a class of technologies that are capable of replacing human labor in a range of tasks.

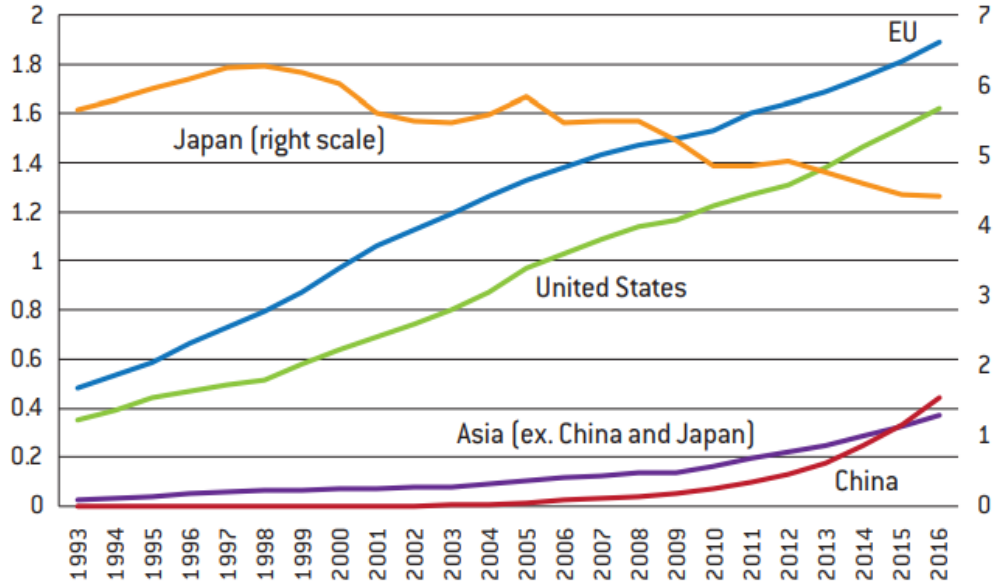
Industrial robots: robots' penetration

Figure 2.11: Industrial robots by country (in thousands)



Source: IFR.

Figure 2.12: Industrial robots per thousand workers by country



Source: IFR and ILO.

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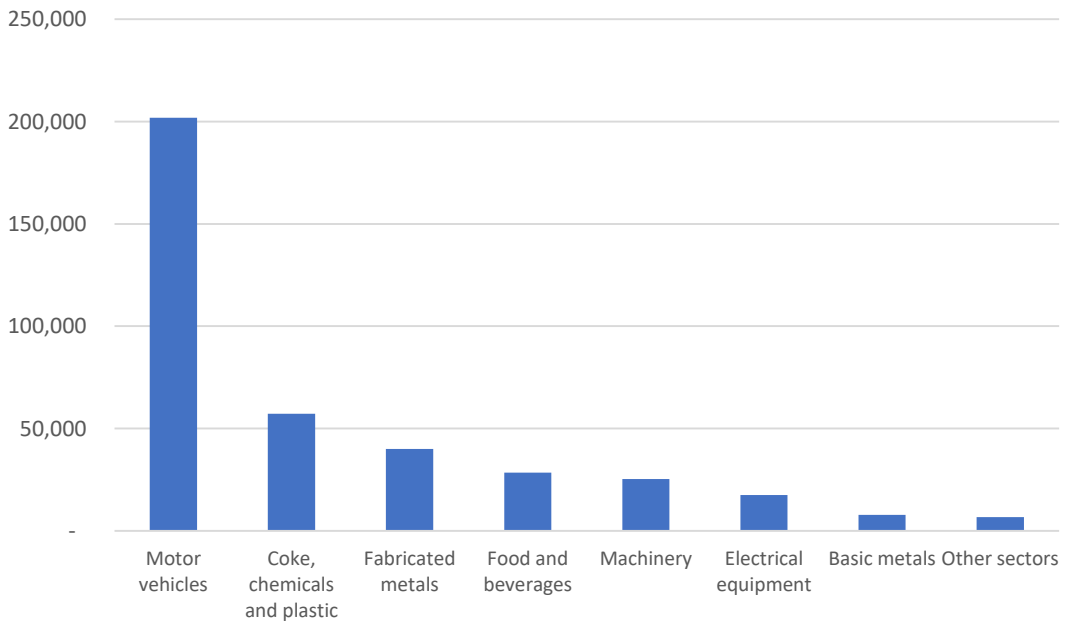
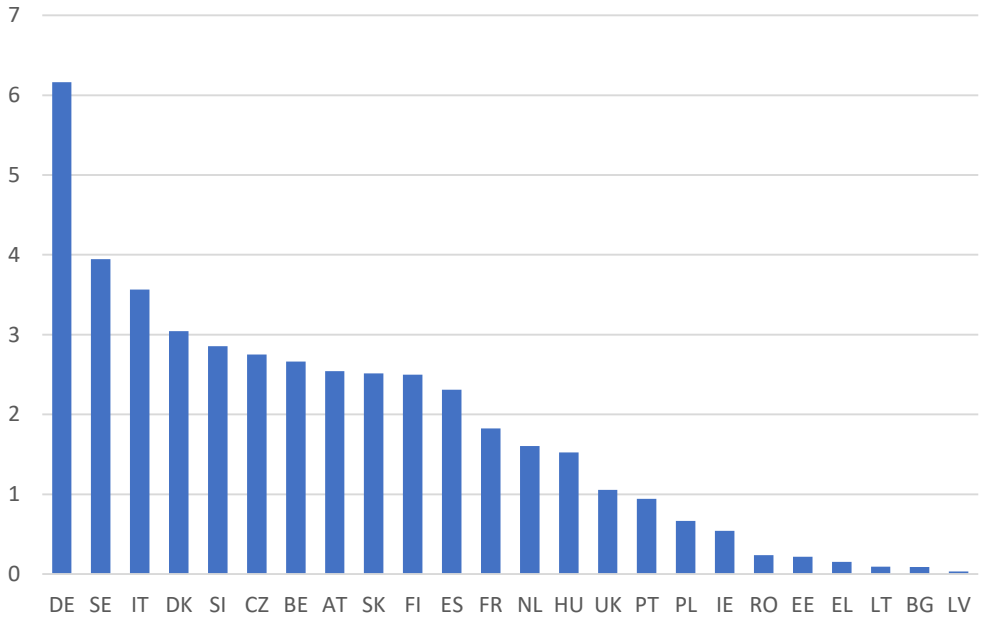
Industrial robots: robots' penetration

Industrial robots by sector in thousands, 2015

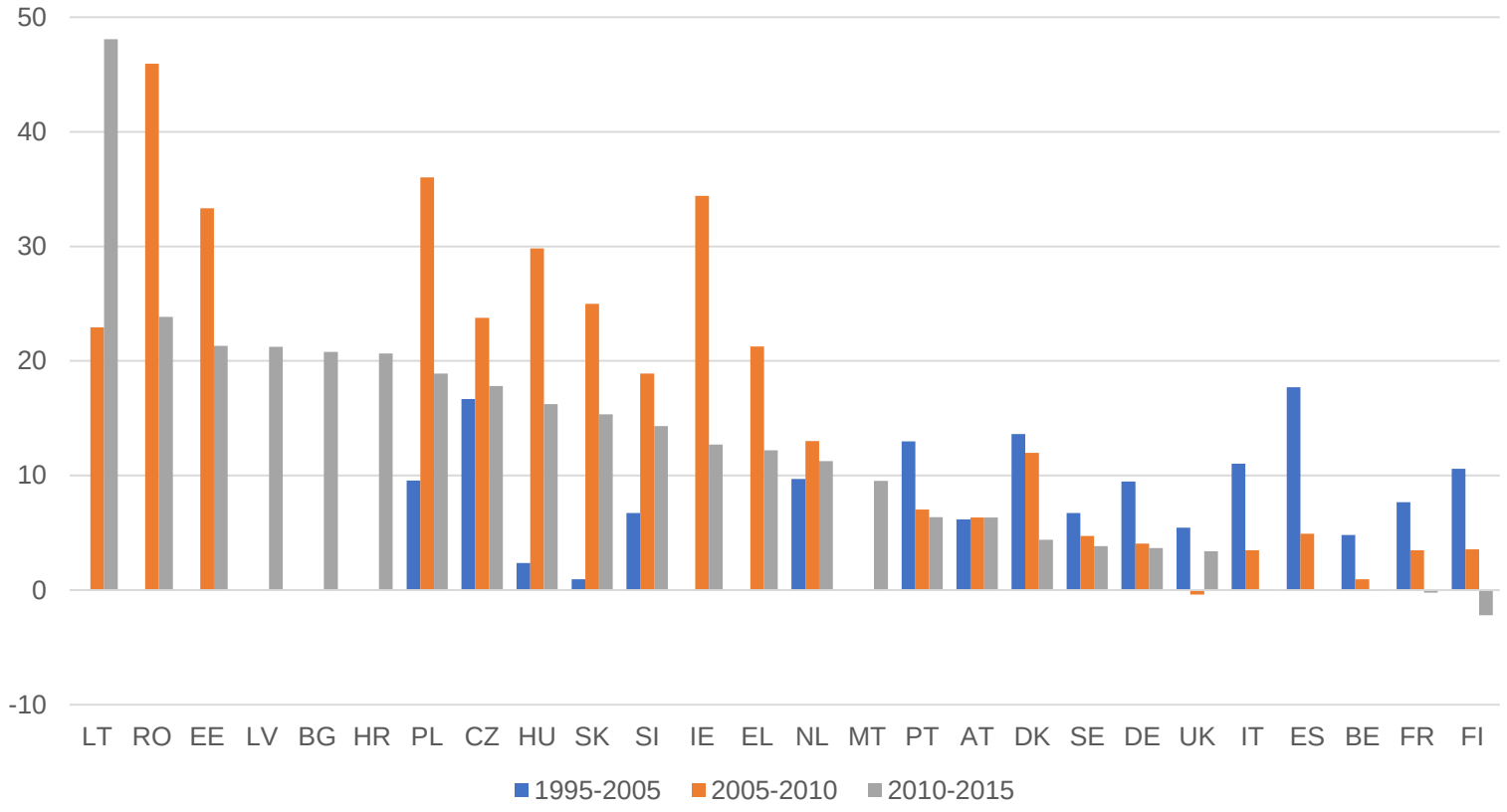


Robots per 1000 workers by country, 2015



Industrial robots: robots' penetration

Median annual growth rate (%) of operating industrial robots, by country

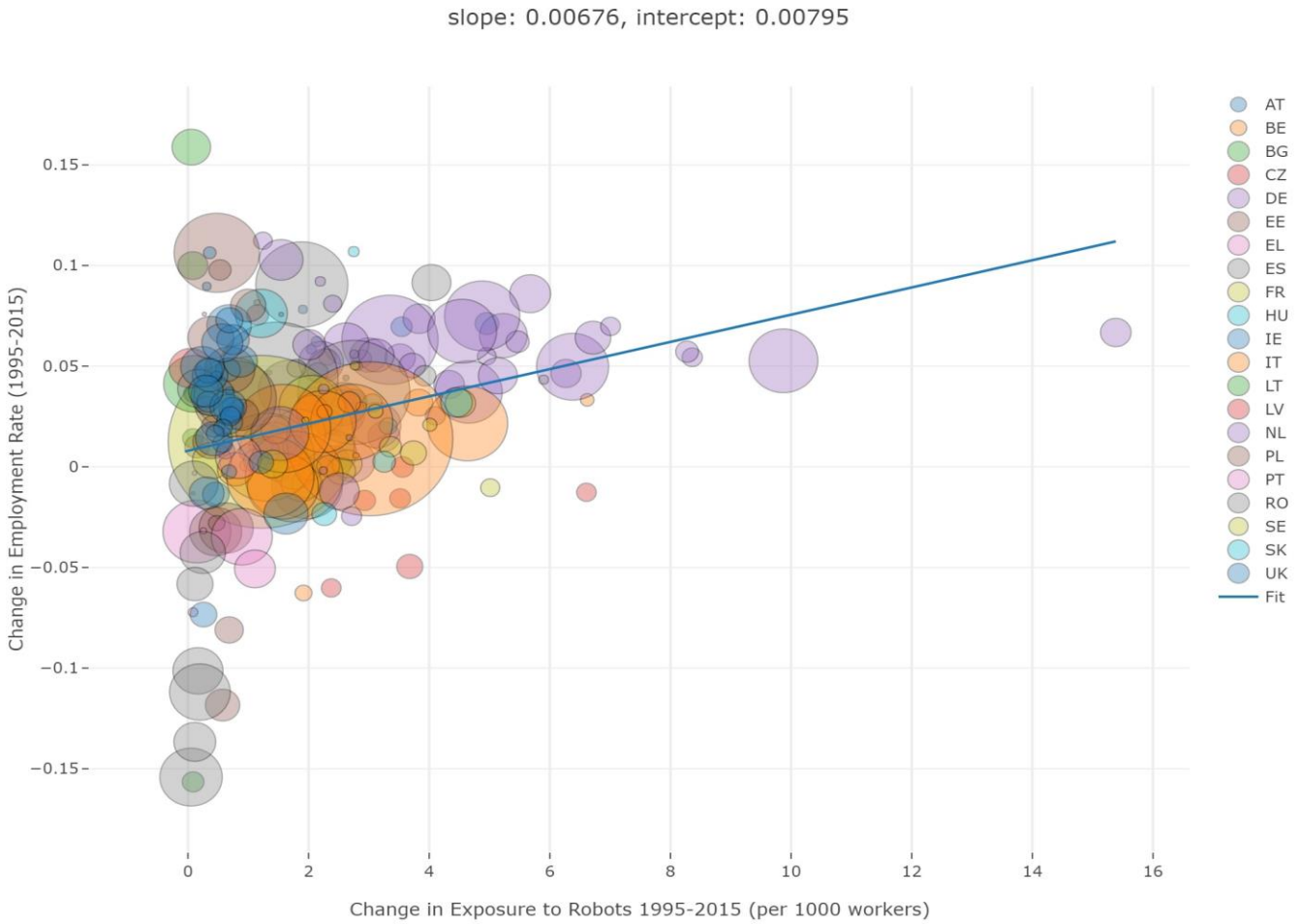


Empirical estimates on the impact of robotisation

- Acemoglu and Restrepo (2018) find negative effects of robot introduction on employment for the 1990-2007 period for the US
- The effects of robots is different from effects of overall capital expansions and ICT expansions

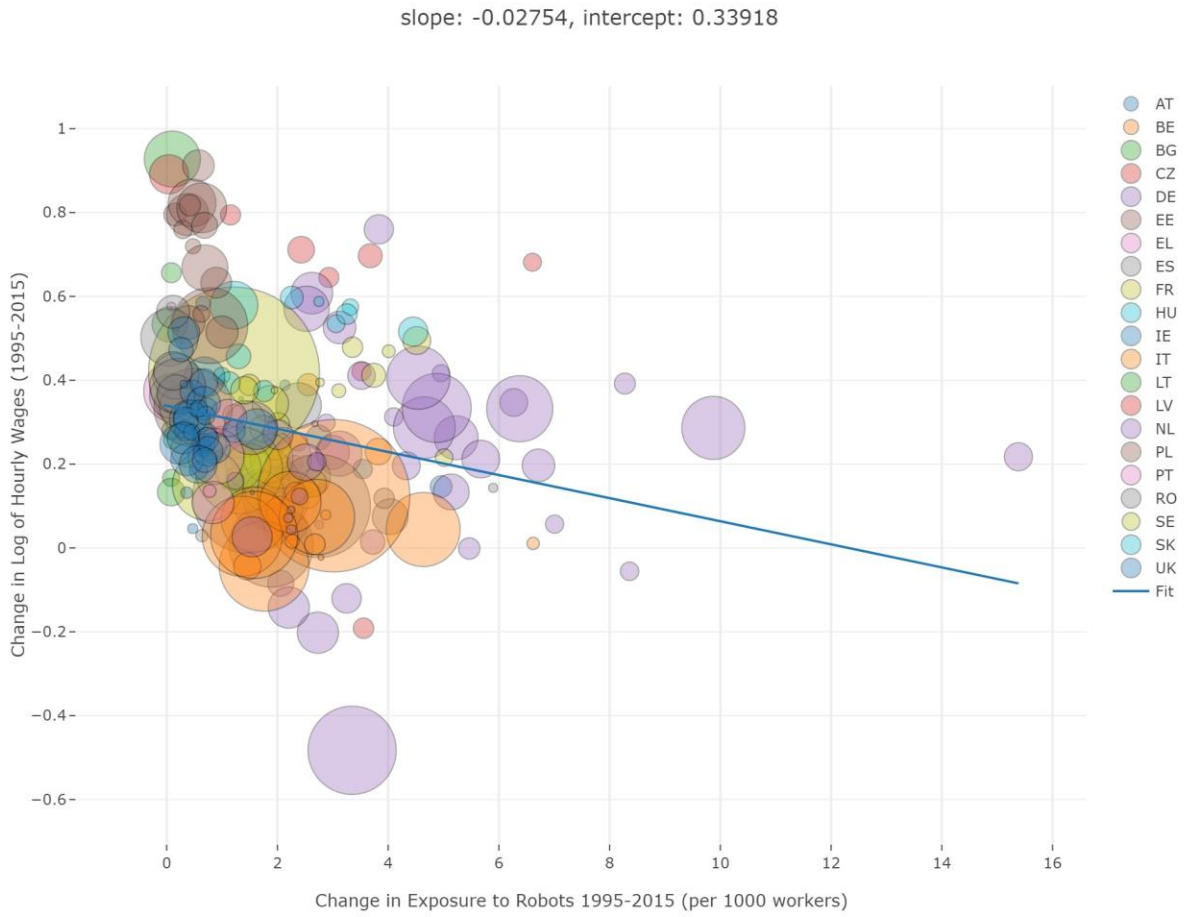
- Chiacchio et al (2018) applying the same methodology to 6 European countries reached the same conclusion if attenuated - negative effects of employment - for 1995-2007
  - One additional robot per thousand workers reduces the employment rate by 0.16-0.20 percentage points (smaller than predicted by Acemoglu and Restrepo)

Empirical estimates on the impact of robotisation



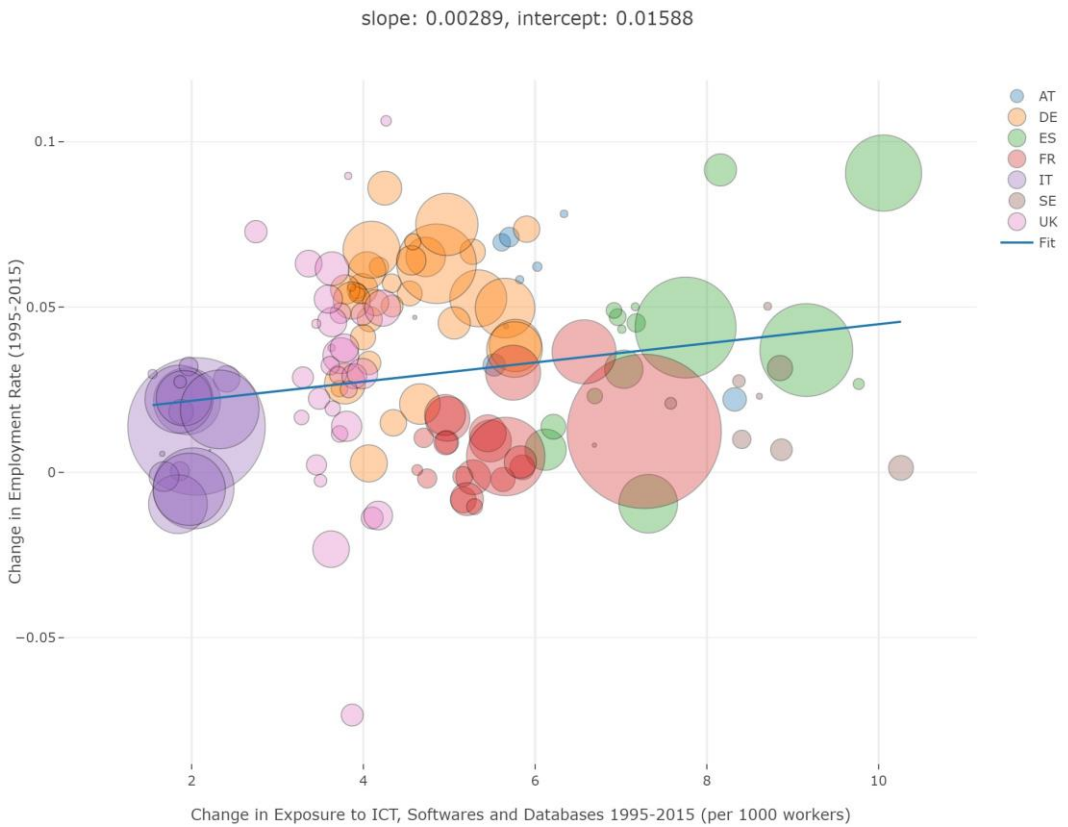
- Looking at the longer 1995-2015 period, exposure to robots appears positively correlated with increases in regional employment rate

Empirical estimates on the impact of robotisation



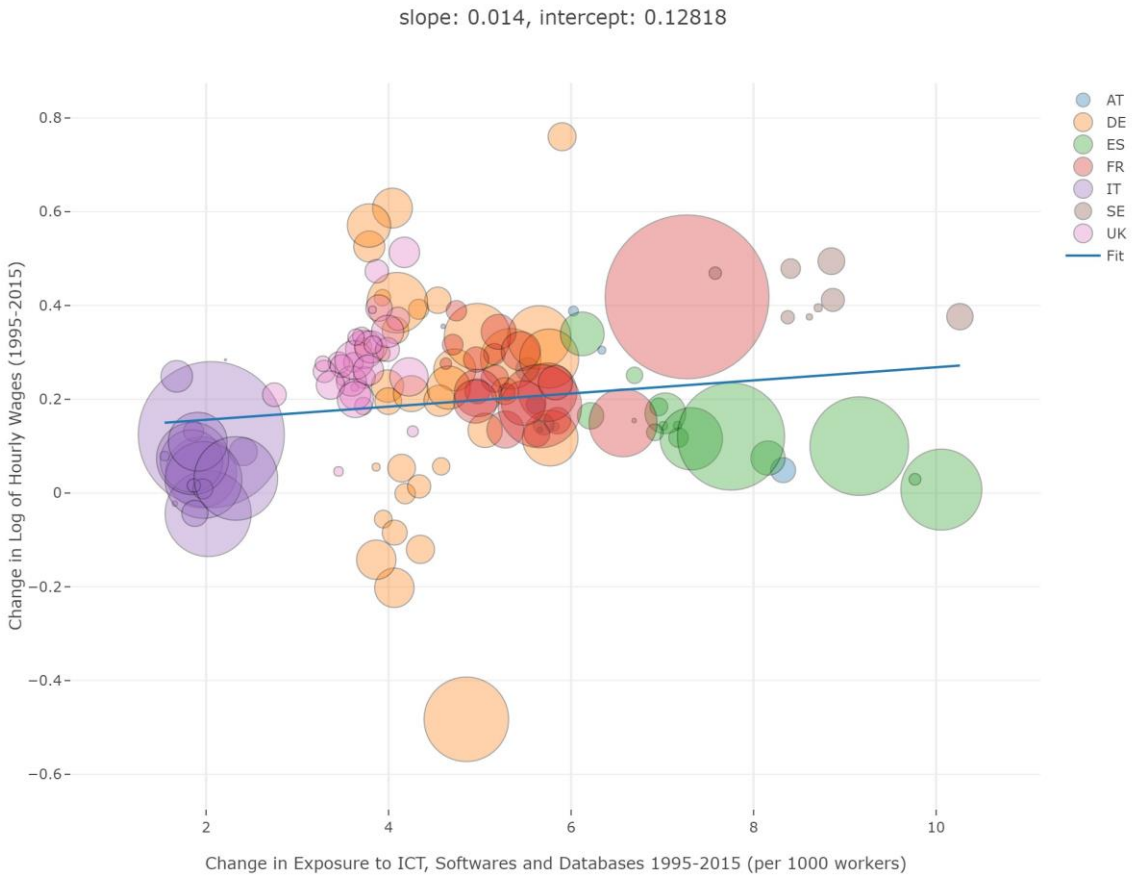
- Exposure to robots appears negative correlated with increases in wages

Empirical estimates on the impact of ICT



- Exposure to ICT likewise correlated positively with growth in employment rates

Empirical estimates on the impact of ICT



- Yet, no negative wage effect from ICT exposure transpires

Empirical estimates on the impact of robotisation

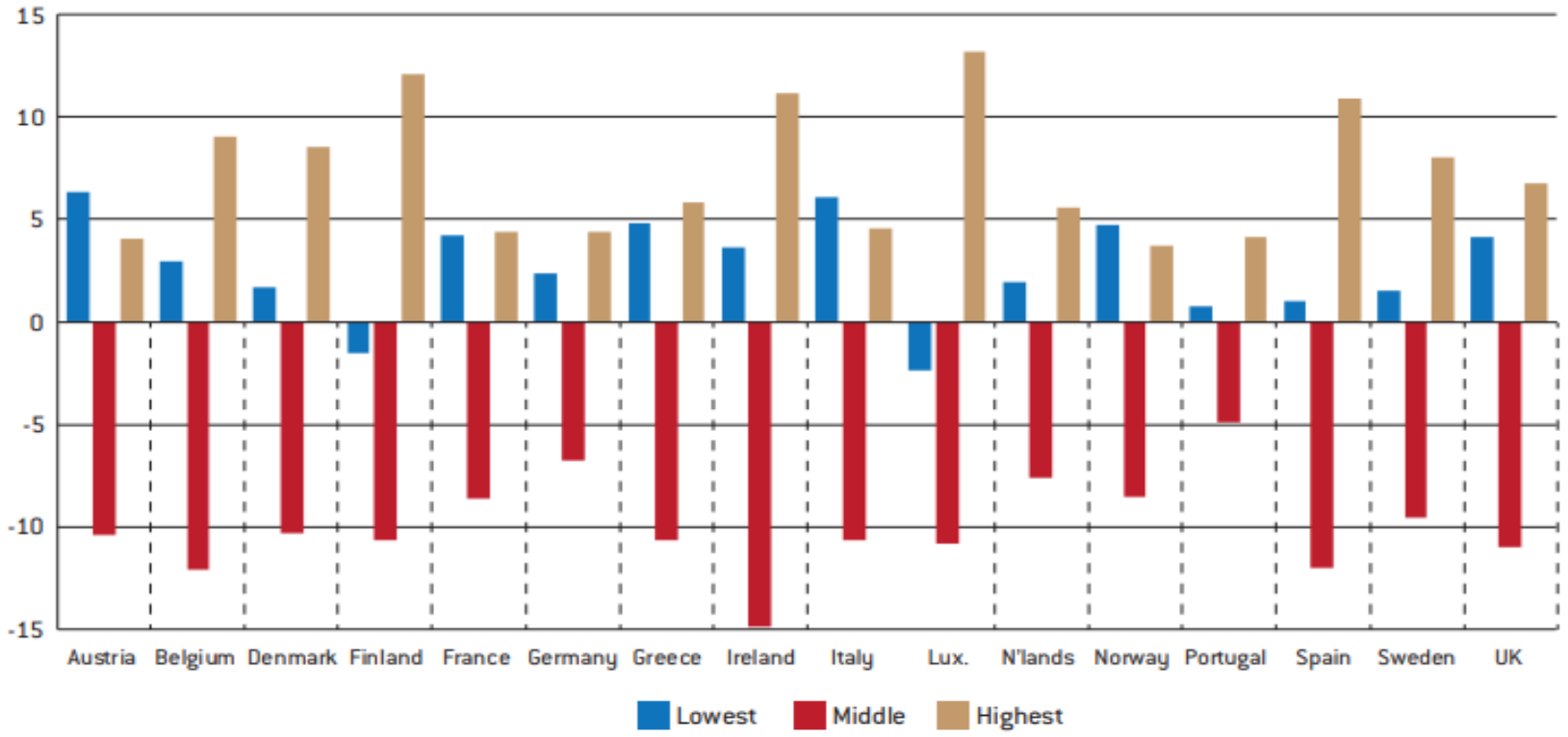
- The extension of Chiacchio et al (2018) to 1995-2015 does not show evidence of negative impacts on the employment rate
- Graetz & Michaels (2018) find no negative effects in 1993-2007 and neither does an extension of their methodology to 1995-2015

Several issues remain relevant:

- Even if negative effects on employment are temporary, policy should still attempt to **minimize them**
- (small) Negative effects on wages / Potential effects on job security
- Differential impacts on different skill groups
  - Middle-skilled individuals and low-skilled individuals most likely to be negatively affected (Chiacchio et al (2018) and Graetz & Michaels (2018))

Technology replacement potential: job polarisation

Figure 2.26: Job polarisation in Europe. % change in hours worked per occupation group, 1993-2010

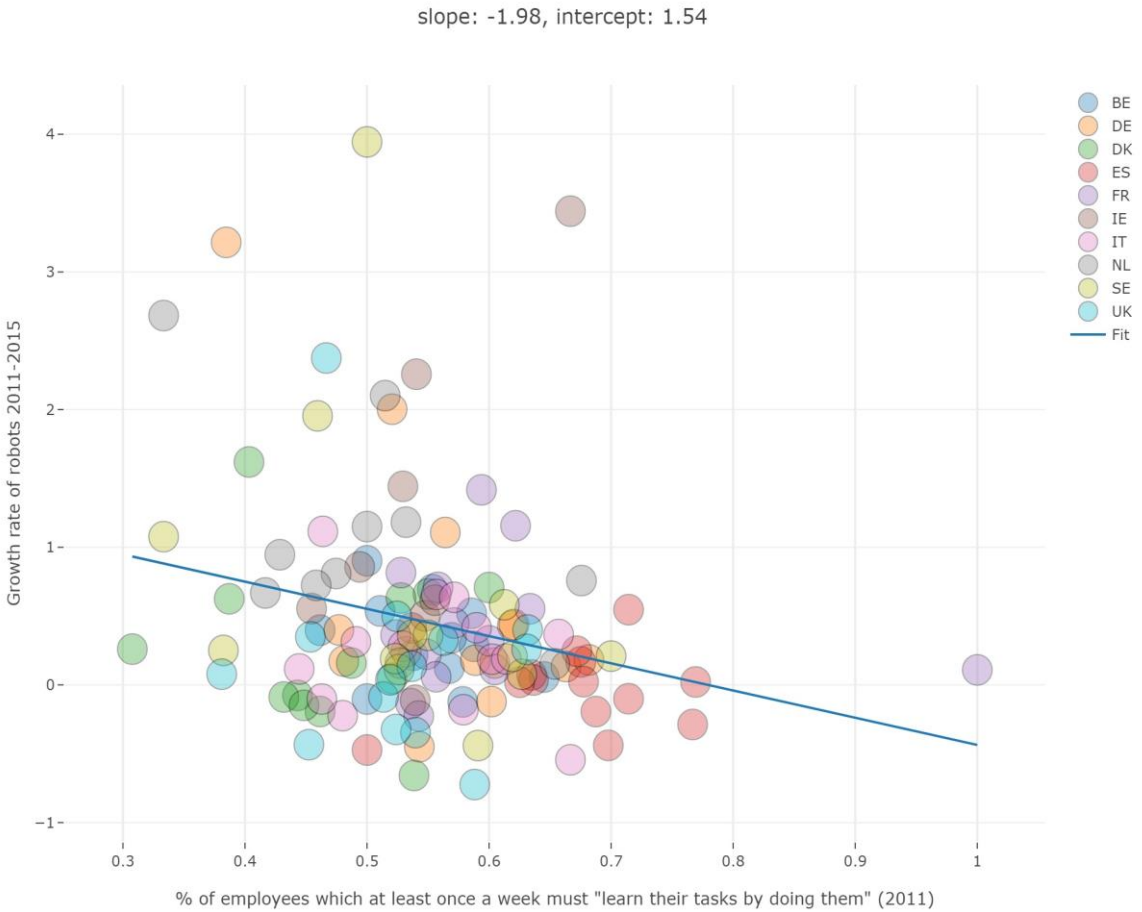


Source: Goos *et al* (2014). Note: Occupations are grouped according to how they pay: the four lowest paying, the nine middling and the eight highest paying.

Technology replacement potential: routine-based technological change

- Introduction of technology has so far often been connected to how ‘routine’ tasks are
- Such hypothesis, called ‘Routine-biased technological change’, predicts middle-skilled workers would be the most disadvantaged
- Empirical studies are supportive of the theory

Looking at the future: technology replacement potential



- Country-sectors where the employees ‘learn by doing their tasks’ (less routine) have been safer from replacement by Industrial Robots

Looking at the future: technology replacement potential

- Yet, such professions will not be ‘protected’ from other technologies
- Machine Learning (ML) can exactly target these professions: by repeating a task (on expanding sets of data) algorithms are able to improve their own performance and ‘learn by doing’
- ML, even if seen as a particular category of ICT, might thus be more similar to robots in its impacts than to ICT (task replaceability)

Looking at the future: technology replacement potential

- Other characteristics which we have found stave off robot introduction - % of individuals which almost solely do ‘non-physical’ labor – will likewise not ‘protect’ against ML

More detailed insights on how:

- Robot introduction affects different groups
- Robot introduction affects income distribution
- Labour market policies and education have ‘smoothened’ transition to other tasks

Will allow policy makers to react better to transformative technology to come

Concluding remarks

- Equilibrium effects not the most troublesome: concerns about ‘robots stealing our jobs’ arguably too alarmist
- Productivity effects might ultimately trump replacement
- Yet, even if effects are temporary, transition period will be tougher – and impacts larger - for new, broader reaching technologies, than it has been for industrial robots

Concluding remarks

- Identification of skills which shall ease transition is needed
- Education and life-long training should be prioritized
- Social protection for news jobs must be considered (sharing economy, digital platforms)
- Welfare systems must ensure fair redistribution of benefits