

THE IMPACT OF ICT AND ROBOTS ON LABOUR MARKET OUTCOMES OF DEMOGRAPHIC GROUPS IN EUROPE

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We study the age- and gender-specific labour market effects of two key modern technologies, Information and Communication Technologies (ICT) and robots, in 14 European countries between 2010 and 2018. To identify the causal effects of technology adoption, we utilise the variation in technology adoption between industries and apply the instrumental variables strategy proposed by Acemoglu and Restrepo (2020). We find that the adoption of ICT and robots increased the shares of young and prime-aged women in employment and the wage bills of particular sectors, but reduced the shares of older women and prime-aged men.

CONTRIBUTION OF THIS PAPER

- ✓ We study the effects of technology adoption on labour market outcomes of eight detailed demographic groups defined by age (20-29, 30-49, 50-59, 60+) and gender.
- ✓ Within the demographic groups, we further investigate the effects on four occupation groups (non-routine cognitive, routine cognitive, routine-manual, non-routine manual).
- ✓ We decompose the overall effects into the effects of ICT capital growth and robot adoption.

DATA

- ✓ Labour market outcomes derived from the EU Structure of Earnings Survey (EU-SES).
- ✓ The data on ICT capital obtained from Eurostat and EU-KLEMS; the data on robots come from the International Federation of Robotics.
- ✓ Unit of observation: demographic group in a country-sector cell (22 sectors per country).
- ✓ 14 European countries: Belgium, Czechia, Germany, Estonia, Greece, Spain, Finland, France, Italy, Lithuania, Latvia, the Netherlands, Norway, and Sweden.

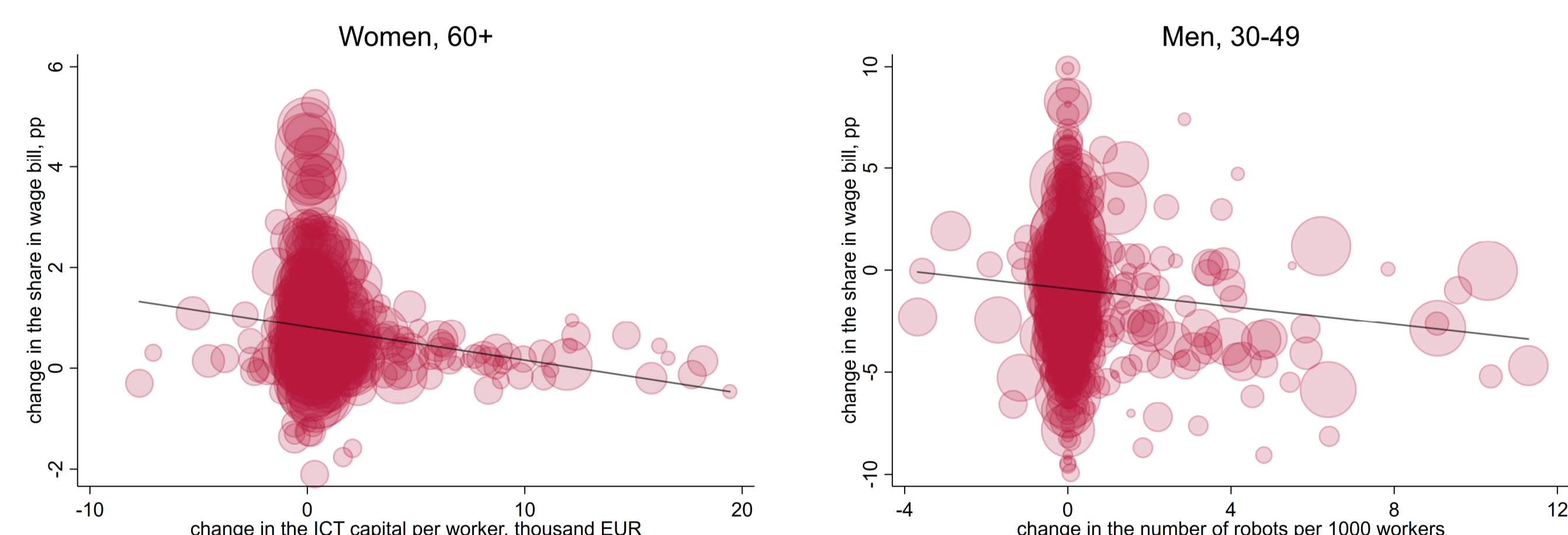
OUTCOME VARIABLES

- ✓ The share of a demographic group in total sectoral employment.
- ✓ The demographic group's average hourly wage as % of the sector's average.
- ✓ The share of a demographic group in the total sectoral wage bill.

DESCRIPTIVE RESULTS

- ✓ The adoption of ICT technology is negatively correlated with outcomes of older women and positively related to the outcomes of young and prime-aged women.
- ✓ The labour market outcomes of prime-aged men are negatively related to both types of technology.

4-year changes in technology exposure vs 4-year changes in the group's shares in total sector wage bill



IDENTIFICATION STRATEGY

- ✓ We use 4-year differences. Results are robust to using 8-year differences.
- ✓ We utilise the between-sector variation in technology adoption. Instrumented with average exposure in the same sector in other countries („technology frontier” instrument).
- ✓ Country-year fixed effects control for the changes in population structure, institutional developments, etc.
- ✓ We also control for the changes in the sector's GVCs participation and for a lagged share of tertiary-educated persons in a demographic group in a given sector.

ECONOMETRIC RESULTS

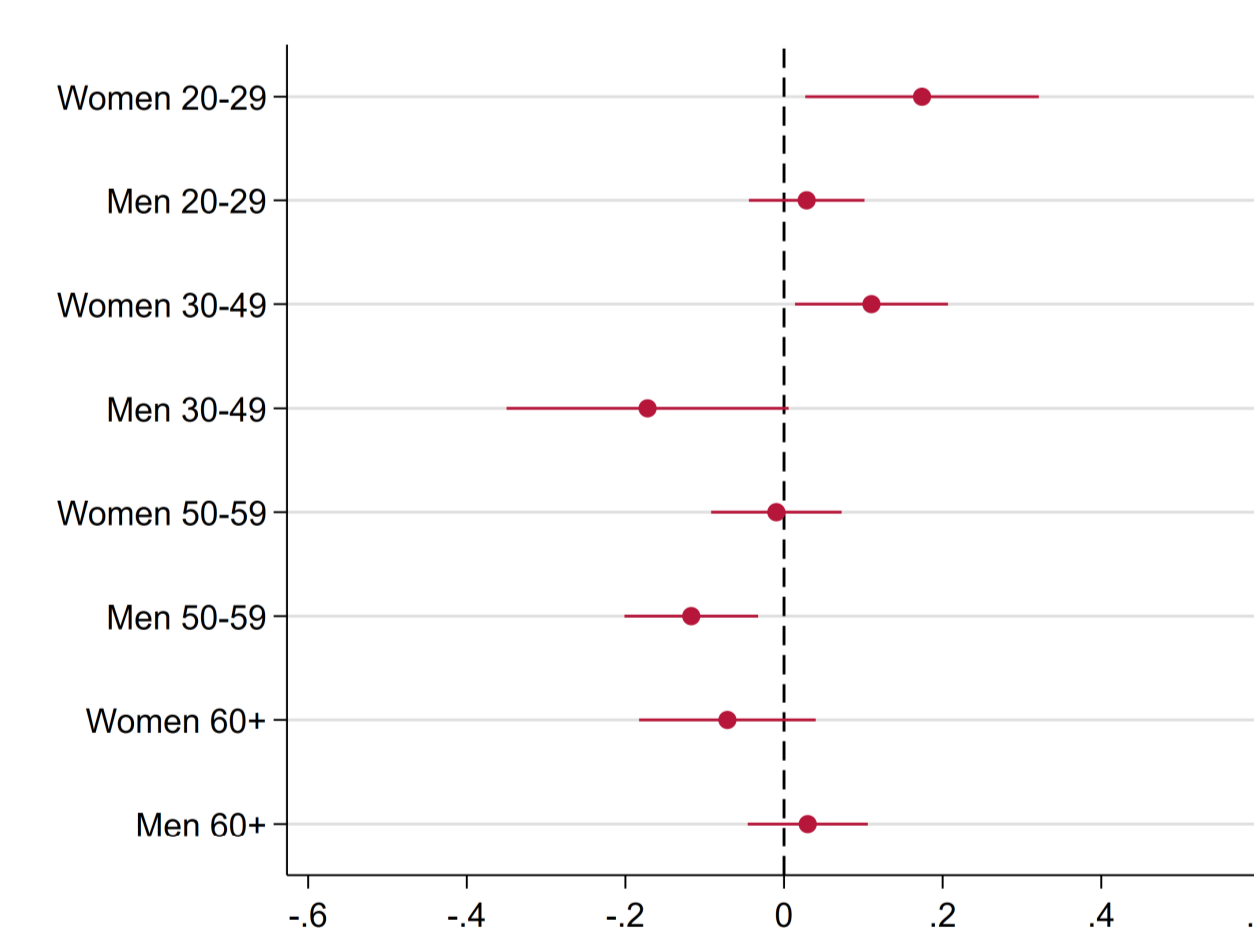
- ✓ Growth in ICT capital of 1,000 EUR per worker: the employment share of older women ↓ by 0.21 pp; the share of young women ↑ by 0.13 pp (p-value = 0.051).
- ✓ Additional robot per 1,000 workers: the employment share of young women ↑ by 0.25 pp the employment shares of prime-aged men and older women ↓ by 0.31 and 0.17 pp.
- ✓ No significant effects on relative hourly wages.

Baseline 2SLS estimates of employment effects

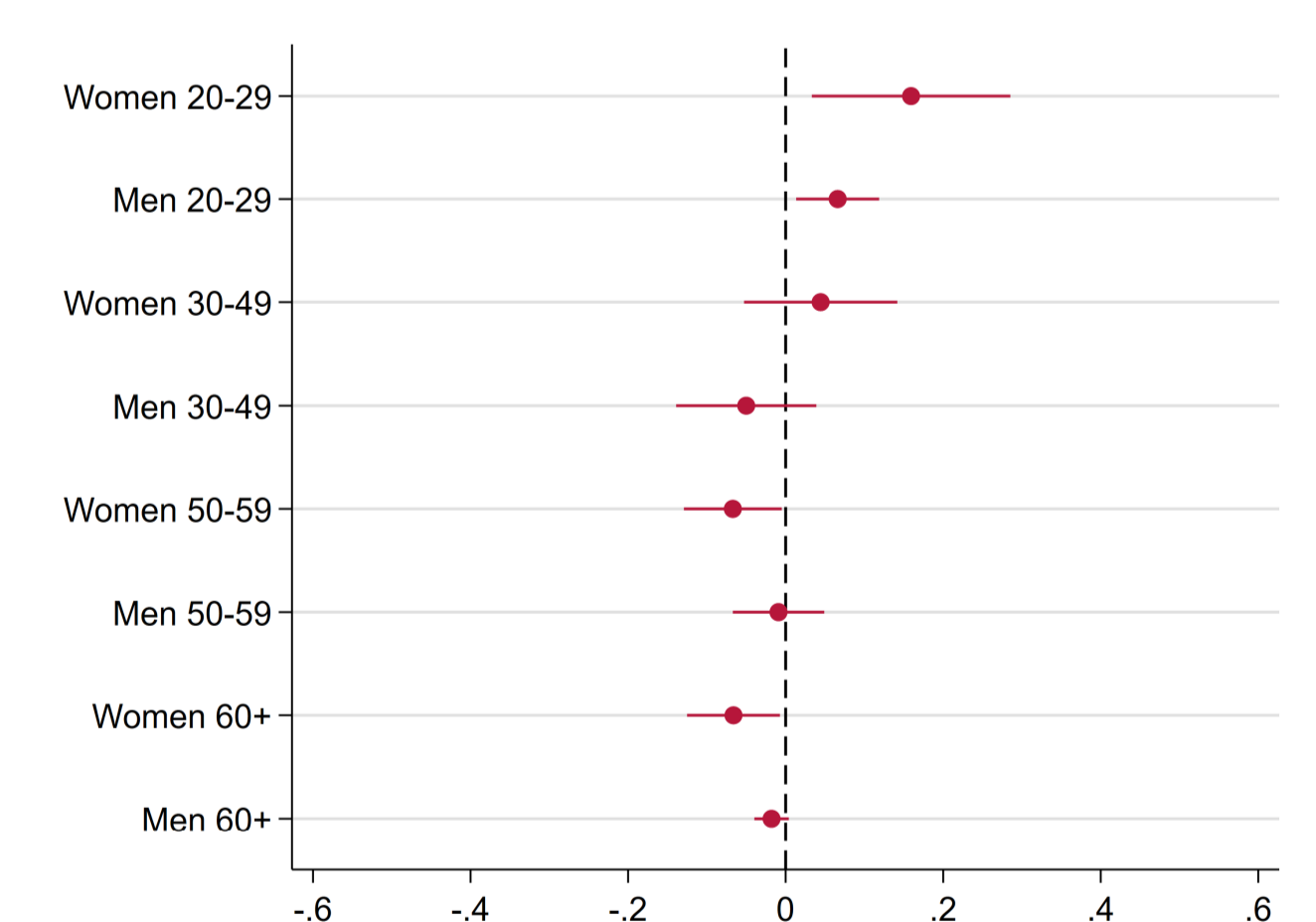
	Age 20-29	Age 30-49	Age 50-59	Age 60+
Women				
Δ ICT capital	0.130*	0.196*	-0.004	-0.208***
Δ Robots	0.250***	0.095	-0.036	-0.168**
K-P Wald F/ obs.	11.4 / 584	12.0 / 616	11.3 / 606	9.5 / 520
Men				
Δ ICT capital	0.007	-0.116	-0.105	0.074
Δ Robots	-0.113	-0.310**	0.148	0.042
K-P Wald F/ obs.	10.7 / 608	12.1 / 622	11.4 / 618	11.2 / 586

- ✓ Age- and gender-specific effects within particular occupation types. ➡ The differences between demographic groups can be largely attributed to their skills.
- ✓ Consistent with the literature: new technologies reduce returns to old skills (Fillmore and Hall 2021; Barth et al. 2022) and increase returns to social skills, in which women have an advantage (Deming 2017).

Employment effects of the ICT capital growth among workers in non-routine manual occupations



Employment effects of robot adoption among workers in routine cognitive occupations



- ✓ Employment shares of women 60+ in 2018 were lower by 0.41 pp than in the counterfactual scenario of no technology adoption in the period 2010-2018.
- ✓ For prime-aged women and prime-aged men, the effects of technology adoption were relatively small in relation to their overall employment shares.

The effects of technology adoption on employment shares, 2010 - 2018

