Automation, long-term structural change in the labour market and fertility

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Labour market and fertility

- Labour market: source of income (also social status, prestige)
- Employment uncertainty
  - Individual LM situation
  - LM conditions (country / region) / Economic recession
  - Feeling of economic uncertainty
- Work – family conflict
- Institutional context: welfare policies, social norms

Here-and-now measures cyclical

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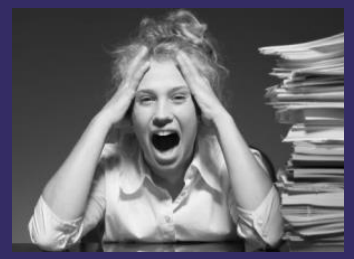
Structural change in the labour market

GLOBALIZATION

TECHNOLOGICAL CHANGE

New opportunities

New risks



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Labour market effects of automation

Job destruction

- Arntz et al. (2017): around 10 – 14% of jobs will be fully replaced by robots and for 25% - 32% around 50-70% of tasks will be automated in the next two decades
- US: 1 robot / 1000 workers reduces the employment rate by 0.2 pp. and wages by about 0.42% (Acemoglu and Restrepo 2020)
- Europe: negative effects on employment of low and middle educated workers (Graetz and Michaels 2018)
- Job loss mainly in manufacturing and among low and middle educated workers (Jung and Lim 2020, de Vries et al. 2020)

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Labour market effects of automation

Job creation

New jobs and job tasks

Growing demand for services (Kariel 2021)

Productivity effect: investment in product development, sales and marketing

Growing demand for highly skilled workers

Boost for growth in companies and regions which are technologically advanced and able to embrace the change (Crowley et al. 2021, Acemoglu et al. 2022)

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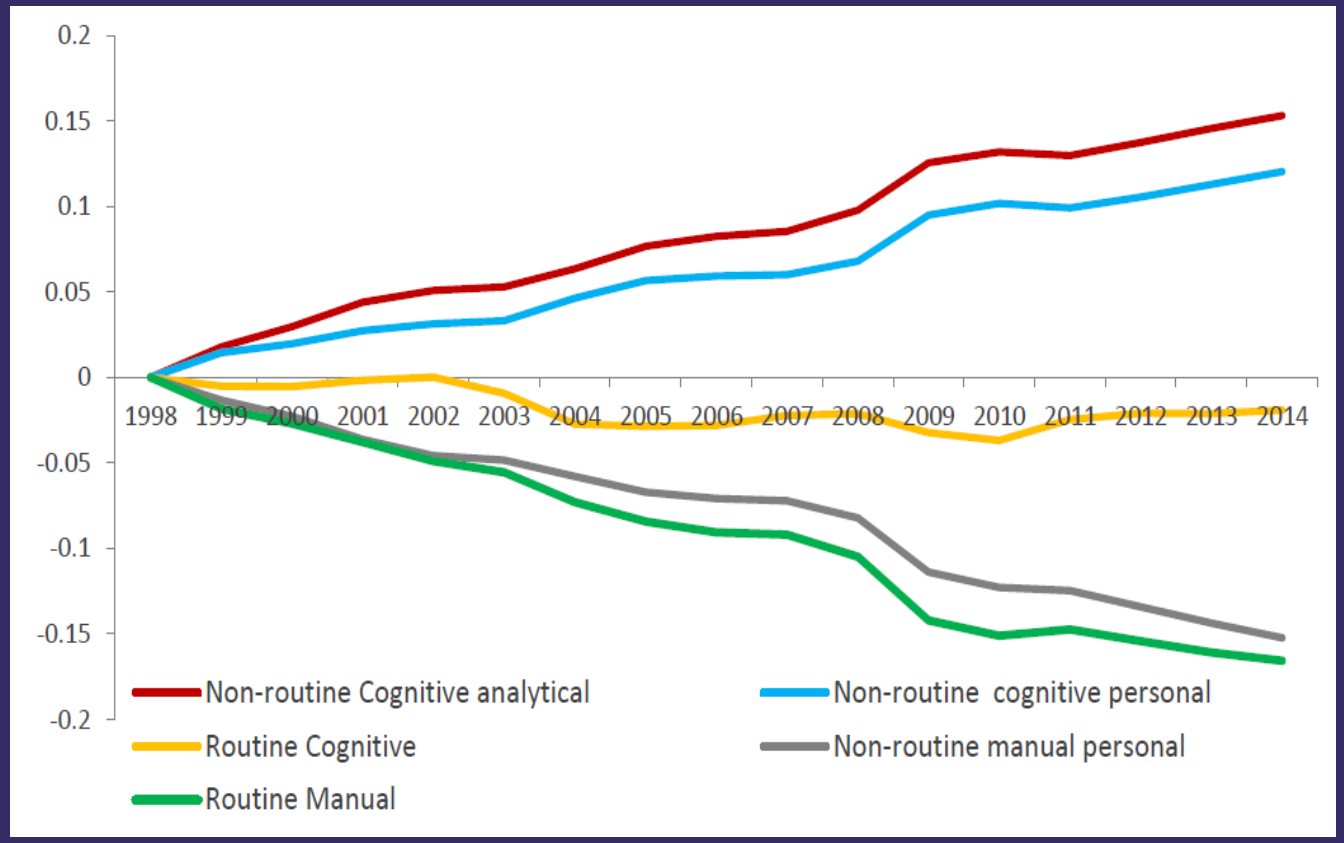
Labour market effects of automation

Changing task content of jobs, EU 1998-2014



Source: Górka et al. (2017)

- Changing demand for skills
- Growing disparities between high and low-to-middle skilled
- Larger turnover in the labour market
- Larger uncertainty (Dekker et al. 2017, Schwabe and Castellacci 2020)
- negative effects on mental health (Abeliansky et al. 2019)
- even higher mortality (Gihleb et al. 2021, O'Brien et al. 2022)

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Labour market effects of automation

- Unclear gender effects
- Women more present in routine jobs (Brussevich et al. 2019)
- But also leaving these jobs more quickly (Black and Spitz-Oener 2010, Cortes et al. 2021)

- No / slightly positive effects on overall employment of women relative to men (Cortes et al. 2021) but women seem to be losing in terms of pay (Aksoy et al. 2019)

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Innocenti et al. (2021): economic complexity (capacity to innovate, develop and create job opportunities) leads to higher fertility (IT)

Anelli et al. (2021): adoption of industrial robots → more cohabitation and divorce, decline in marital fertility, increase in non-marital fertility (US)

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Fertility effects of automation less pronounced in regions with:

- **H1:** initially low levels of manufacturing
- **H2:** low representation of men in manufacturing (relative to women)
- **H3:** better educated populations
- **H4:** more technologically advanced

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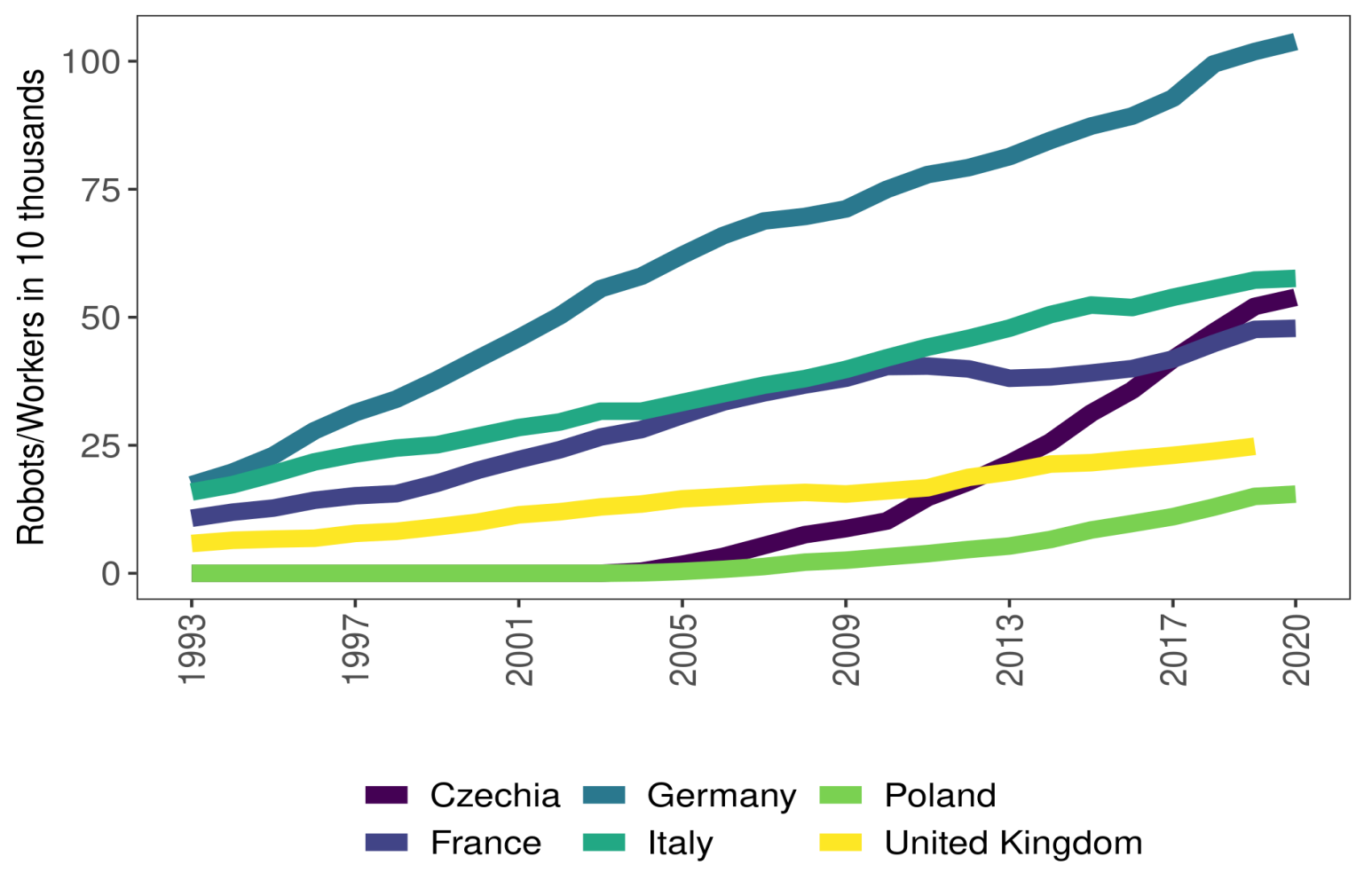
Country coverage



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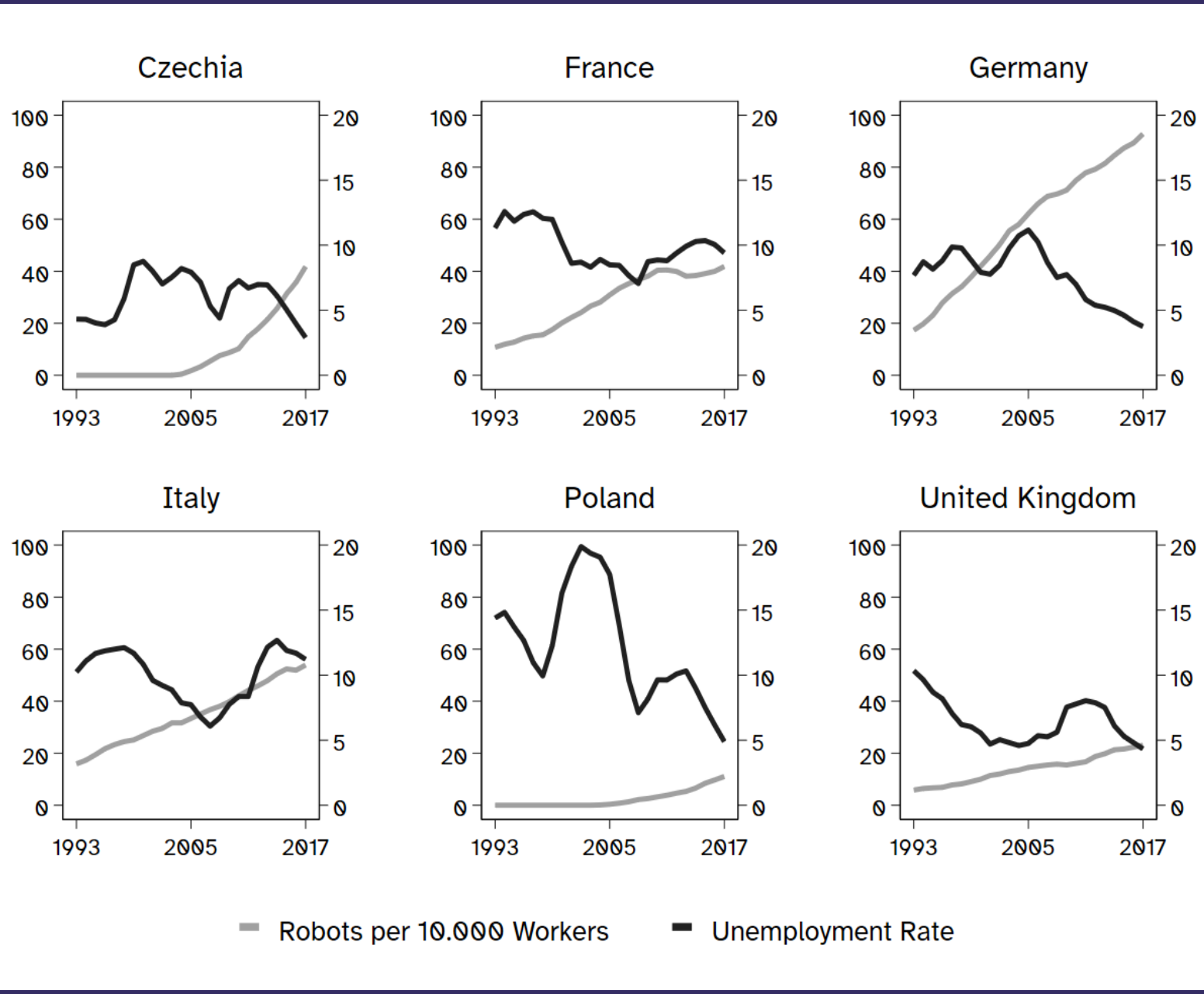
Czechia
France
Germany
Italy
Poland
United Kingdom
100
80
60
40
20
0
20
15
10
5
0
1993
2005
2017
Robots per 10.000 Workers
Unemployment Rate

Data (1993-2017)

EUROSTAT:

- Regional NUTS-2 fertility rates (total and age-specific)
- Regional employment structures by industry (NACE 2-digit)

INTERNATIONAL FEDERATION OF ROBOTICS (IFR)

- Robot stocks (country and industry-specific) at 3-digit since 1993

fully autonomous machines that do not require a human operator

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Measurement

$$Exposure\ to\ robots_{r,t} = \sum_{i=1}^{N} \frac{empl_{r,i,t_0}}{empl_{r,t_0}} \left(\frac{robots_{i,t}}{empl_{i,t_0}}\right)$$

distribution of intitial employment at t0 across regions

replacement of initial employment (at t0) in industry i by robots

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Source: Acemoglu and Restrepo (2020)

Modelling

$$fertility_{r,t} = \alpha \cdot Exposure\ to\ robots_{r,t-2} +$$

$$+ \beta \cdot Controls_{r,t-1} + \eta_r + \upsilon_t + \varepsilon_{r,t}$$

Controls:

- population age structure
- % highly educated
- ratio highly educated women to men
- women's economic activity rate

Regional fixed effects

Year fixed effects

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Modelling: IV

$$fertility_{r,t} = \alpha \cdot Exposure\ to\ robots_{r,t-2} +$$

$$+ \beta \cdot Controls_{r,t-1} + \eta_r + \upsilon_t + \varepsilon_{r,t}$$

$$\sum_{i=1}^{N} \cdots \frac{empl_{r,i,t_0}}{empl_{r,t_0}} \left(\frac{robots^{c}_{i,t}}{empl_{i,t_0}}\right)$$

Overidentified IV model:

- Robot stocks instrumented with robots in {Germany, France, UK, Italy, Spain, Sweden, Norway and Finland} excluding the studied country
- In models for Czechia and Poland we additionally use US as an intstrument

Modelling: IV

$$fertility_{r,t} = \alpha \cdot Exposure\ to\ robots_{r,t-2} + x\ Moderator_{r,t-1}$$

$$+ \beta \cdot Controls_{r,t-1} + \eta_r + \nu_t + \varepsilon_{r,t}$$

Fertility effects less pronounced if:

- **H1:** initially low levels of manufacturing
- **H2:** higher initial representation of women in manufacturing (relative to men)
- **H3:** better educated populations
- **H4:** region more technologically advanced

Moderators:

- % empl out of manufacturing in 1993
- % women vs men in manufacturing in 1993
- % highly educated
- % empl in techn and knowledge sector

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Fertility effects of automation

Country	TFR	FR 20-24	FR 25-29	FR 30-34	FR 35-39	FR 40-44	FR 45+
Germany	**ns**	ns	ns	ns	-0.00011***	-0.00005***	ns
France	**ns**	ns	ns	ns	ns	ns	ns
Italy	**-0.00118***	ns	-0.00090***	ns	ns	ns	ns
UK	**ns**	ns	ns	ns	ns	0.00039*	ns
Czechia & Poland	**ns**	ns	ns	ns	0.00025*	ns	ns

*** 1% ** 5% * 10%. Sample sizes: 680 observations for Germany, 440 for France, 400 for Italy, 700 for the UK, and 240 for Poland and Czechia jointly.

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Fertility effects of automation
employment out of manufacturing

Country	TFR *main effect*	TFR *interaction effect*
Germany	-0.0022*	0.00003**
France	ns	ns
Italy	ns	ns
UK	-0.0223*	0.00031**
Czechia & Poland	0.0063	-0.00009*

*** 1% ** 5% * 10%. Sample sizes: 680 observations for Germany, 440 for France, 400 for Italy, 700 for the UK, and 240 for Poland and Czechia jointly.

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Fertility effects of automation
employment out of manufacturing (int 1)
empl of women versus men in manufacturing (int 2)

Country	**TFR** ***main effect***	**TFR** ***Int1***	***TFR*** ***Int 2***
Germany	0.00079	0.00001	-0.0035***
France	0.0049	-0.00002	-0.0068**
Italy	0.0144***	-0.00011**	-0.0137***
UK	-0.0378***	0.00042***	0.0187*
Czechia & Poland	ns	ns	ns

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Fertility effects of automation
% highly educated

Country	TFR *main effect*	TFR *interaction effect*
Germany	-0.0016***	0.00005***
France	0.0015**	-0.00058**
Italy	-0.00292*	0.0001
UK	ns	ns
Czechia & Poland	ns	ns

*** 1% ** 5% * 10%. Sample sizes: 680 observations for Germany, 440 for France, 400 for Italy, 700 for the UK, and 240 for Poland and Czechia jointly.

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Fertility effects of automation
empl in technology and knowledge sectors

Country	TFR *main effect*	TFR *interaction effect*
Germany	ns	ns
France	ns	ns
Italy	-0.00116*	0.000005
UK	ns	ns
Czechia & Poland	ns	ns

*** 1% ** 5% * 10%. Sample sizes: 680 observations for Germany, 440 for France, 400 for Italy, 700 for the UK, and 240 for Poland and Czechia jointly.

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Conclusions

- Rather small effects of the long-term structural LM change driven by adoption of industrial robots
- Negative effects in regions with initial high level of manufacturing and low educated populations
- More negative effects in regions with initially high % women employed in manufacturing (!)

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Outlook

- Explore the cross-country variation and role of country-specific factors
- Industrial robots only part of labour replacing technologies
- Deeper insight into fertility effects of other labour replacing vs augmenting technologies / changing demand for skills

Horizon 2020
European Union funding
for Research & Innovation

University of Warsaw
Faculty of Economic Sciences

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