The Impact of Robots on Labour Market Transitions in Europe

Ronald Bachmann, RWI – Leibniz Institute for Economic Research and Heinrich-Heine-Universität Düsseldorf

Myrielle Gonschor, RWI

Piotr Lewandowski, IBS – Institute for Structural Research

Karol Madon, IBS

Motivation

- Strong growth of robot exposure across industrialised countries
- Literature shows negative employment and wage effects for some countries (US: Acemoglu/Restrepo 2020), no effects for others (Germany: Dauth et al. 2021)
- Firm level evidence shows that robot adoption leads to expansion and increased labour demand (France: Domini et al. 2020 & Acemoglu et al. 2020; Spain: Koch et al. 2019)
- Little cross-country evidence, particularly at the worker level

Motivation

Focus on worker transitions as

- Reveal underlying mechanisms
- More sensitive than employment stocks
- Very important for individual welfare

Focus on two key labour market flows:

1) Job separation → employment to unemployment
2) Job finding → unemployment to employment

Research Question

1. What is the effect of increased robot exposure on **job separation** and **job finding** rates in Europe?
2. Which factors can explain the cross-country variation in the effects of robots?
   - labour costs
   - institutions
3. Which worker groups are particularly affected?
   - task groups

Data

- European Labour Force Survey (EU-LFS)
  - Repeated cross-section
  - Labour market status in the current and previous year
  - 16 European countries
  - Time period 1998-2017
  - Final sample: E->U 11.8 million; U->E 1.5 million
- Data from the International Federation of Robotics (IFR)
  - country-industry level
- Occupational information: O*NET Database
- Industry Data: EU KLEMS, RIGVC, Comtrade

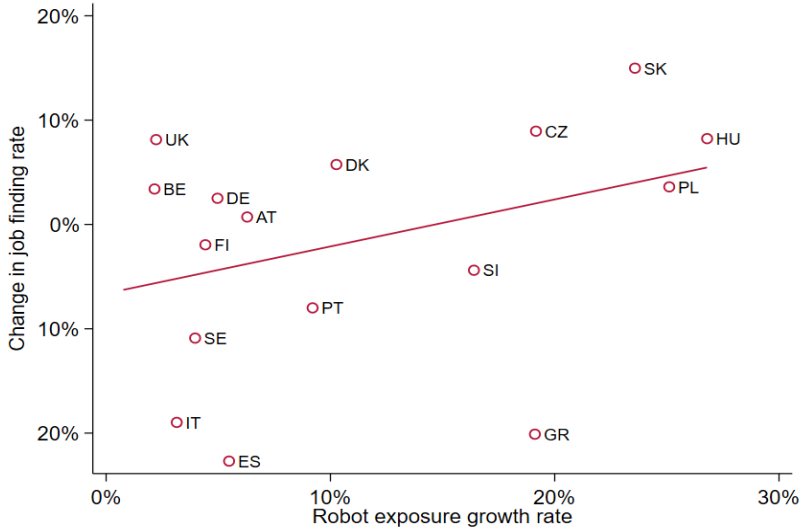
Theoretical expectations on labour-market effects of robots (Acemoglu/Restrepo 2020)

− Displacement effect: Robots take over tasks previously performed by workers

\+ Productivity effect: industries increase their demand for labour/certain tasks

- Labour-market effect of robots can be positive or negative
- Displacement effect likely to depend on labour costs

Robot exposure growth and change in job flows



Notes: Growth/change early 2000s-2017. Robot exposure is measured as number of robots per 1000 workers.

Source: EU-LFS and International Federation of Robotics, own computation.

Econometric specification: Binary Choice Model

Probit Regression for E->U and U->E flow:

$$Prob(flow = 1|X)$$
$$= \beta_1 R_{oct} + \beta_2 L_c + \beta_3 G_{ct} + \beta_4 W_{oct} + \beta_5 B_{rt} + \beta_6 X_i + p_s + \delta_t + \epsilon_{ioscrt}$$

R_{oct} Robot Exposure (stock of robots/employment)

L_c Labour Costs in 2004

G_{ct} GDP growth

W_{oct} industry control variables

B_{rt} Changes in labour demand at regional level

X_i Controls for individual characteristics

i = individual, o = occupation, s = sector, c = country,
r = region, t = time

Econometric specification: Control-function (CF) approach

- Robots might be endogenous to economic conditions in a sector/country
- Use CF approach (similar to IV approach)

- Instrument: Robot adoption in other high income countries
  - Average robot exposure in the same industries in other Western European countries in our sample

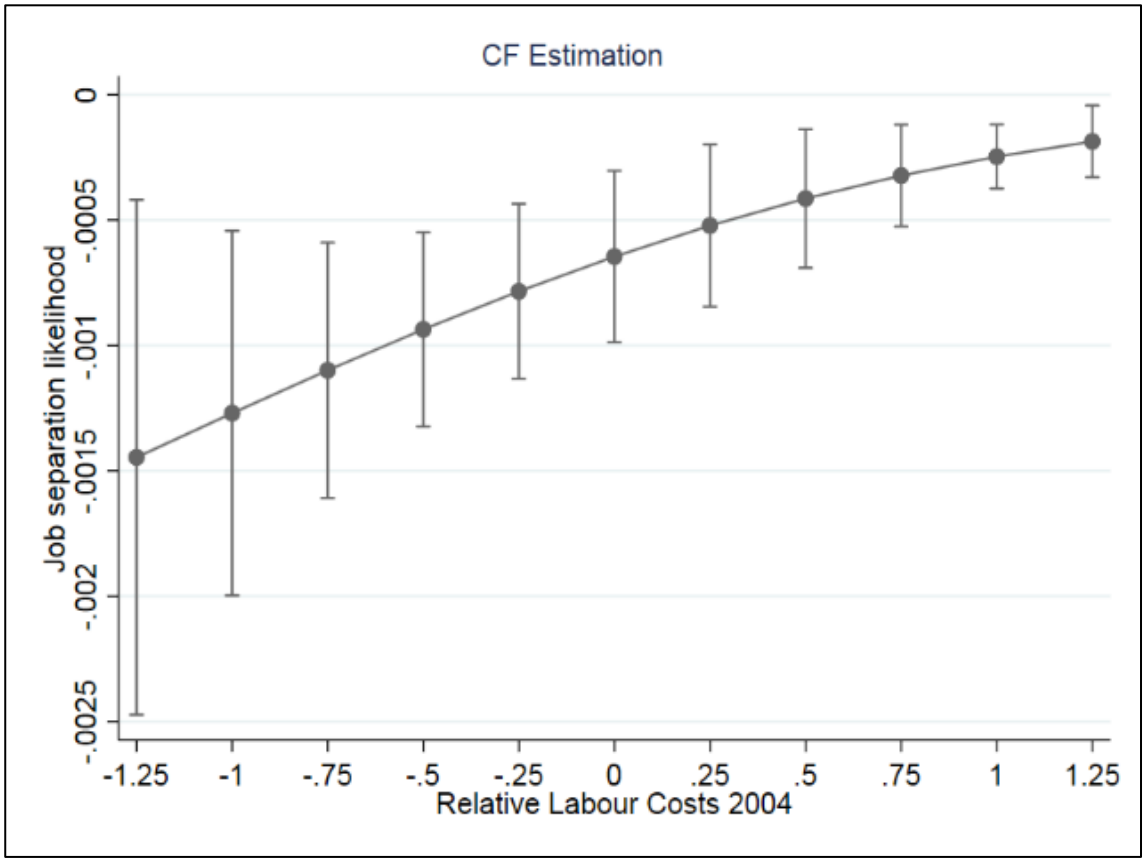
    (except for the country the instrument is applied to)
  - Standardize by employment counts in 1995

Results Job Separation Flow

	Probit	CF (2nd Stage)	Probit	CF (2nd Stage)
Robot Exposure	-0.001	-0.007***	0.002	-0.008***
	[0.001]	[0.001]	[0.002]	[0.002]
Robot Exposure X Labour Costs 2004			0.009***	0.005*
			[0.002]	[0.002]
Robot Exposure X Squared Labour Costs 2004			-0.011***	-0.001
			[0.003]	[0.003]
Labour Costs 2004	-0.104***	-0.097***	-0.114***	-0.103***
	[0.009]	[0.009]	[0.009]	[0.010]
Squared Labour Costs 2004	-0.033**	-0.031**	-0.019	-0.035**
	[0.011]	[0.011]	[0.011]	[0.012]
No. Observations	11.8 Mio	11.8 Mio	11.8 Mio	11.8 Mio

Job Separation Flow

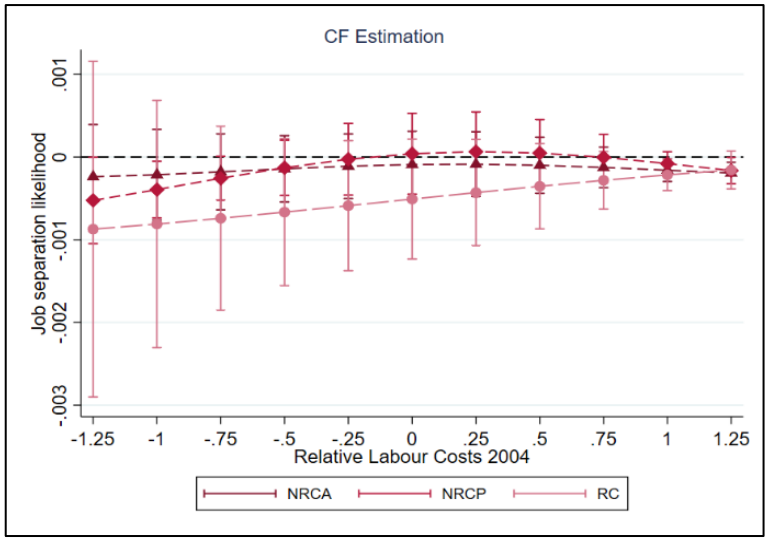
Marginal effects of robots wrt. labour costs



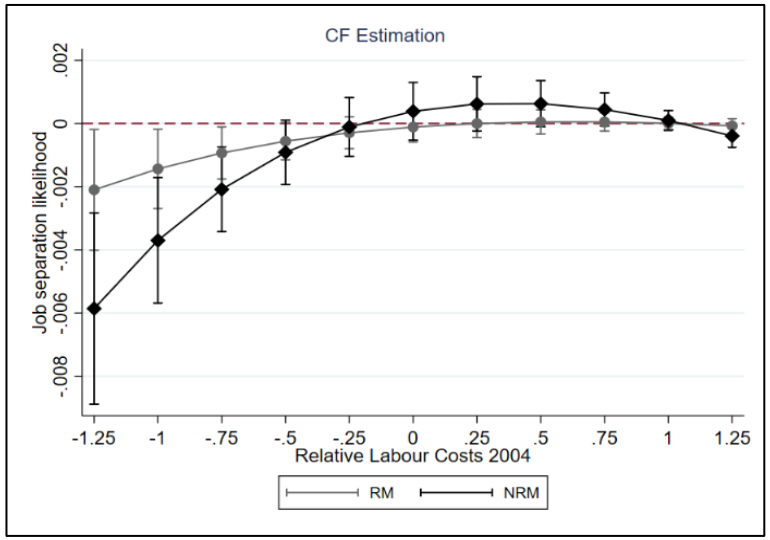
Job Separation Flow

Marginal effects of robots wrt. labour costs

Cognitive task group



Manual task group

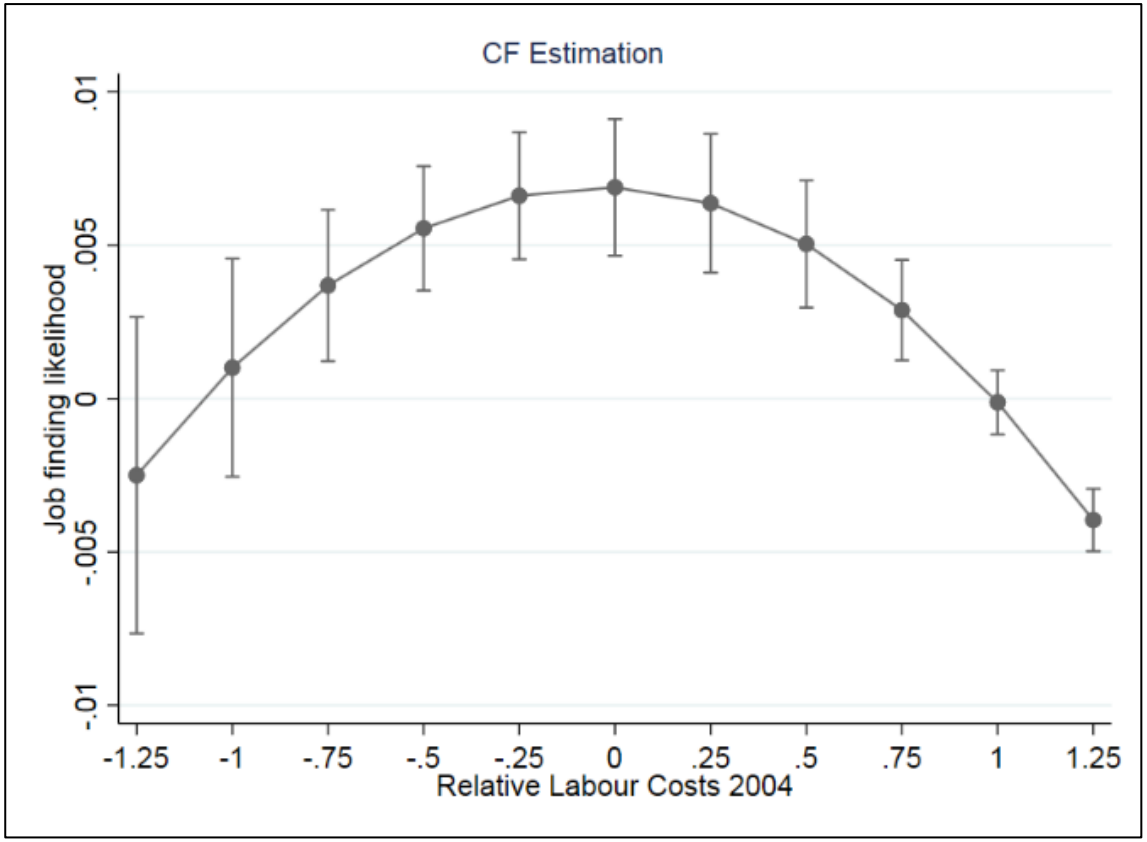


Results: Job Finding Flow

	All Sectors		All Sectors	
	Probit	CF (2nd Stage)	Probit	CF (2nd Stage)
Robot Exposure	-0.001 [0.001]	0.003* [0.002]	0.013*** [0.002]	0.019*** [0.003]
Robot Exposure X Labour Costs 2004			-0.006*** [0.002]	-0.002 [0.003]
Robot Exposure X Squared Labour Costs 2004			-0.008*** [0.002]	-0.018*** [0.004]
Labour Costs 2004	0.061** [0.019]	0.054** [0.019]	0.063** [0.020]	0.057** [0.020]
Squared Labour Costs 2004	0.081*** [0.022]	0.078*** [0.023]	0.013*** [0.002]	0.019*** [0.003]
No. Observations	1.54 M	1.54 M	1.54 M	1.54 M

Job Finding Flow

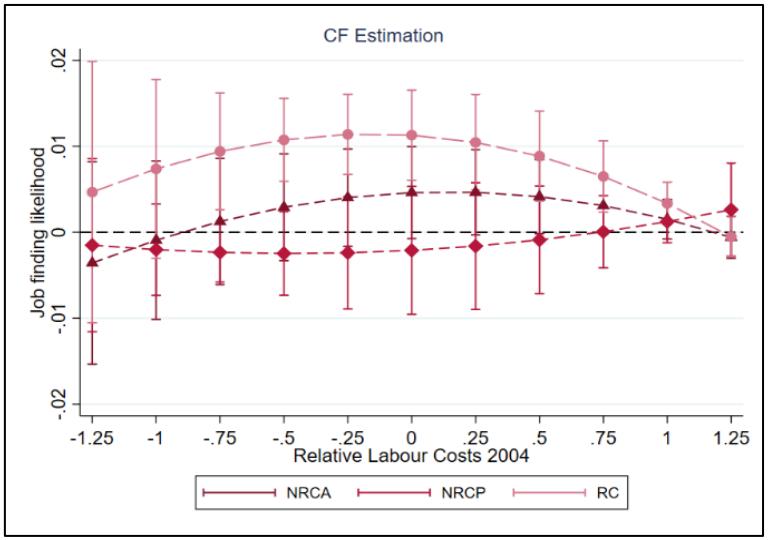
Marginal effects of robots wrt labour costs



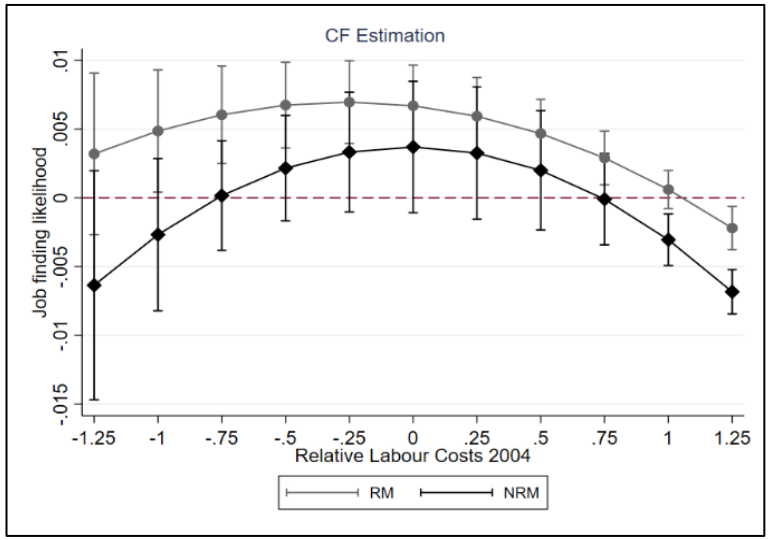
Job Finding Flow

Marginal effects of robots wrt labour costs

Cognitive task group



Manual task group



Counterfactual Analysis

- Quantify the effect of robots on labour market flows and stocks
- Counterfactual scenario: Robot exposure fixed at 2004 level

Steps:

1. Calculate predicted flow probability
2. Predict flow probability using robot exposure in 2004
3. Recursively calculate predicted levels of employment
4. Calculate difference between the predicted and counterfactual scenario
5. Assess contribution of job separation and finding channel

Results: Counterfactual Analysis

- Job separations most important channel for the employment and unemployment level
- Counterfactual analysis for task groups:
  - Evidence of substition between automation and routine manual work
  - Evidence for complementarity between automation and non-routine work, both manual and cognitive

Conclusion

- Robot exposure has a relatively strong effect on labour-market transitions of European workers
- Strong heterogeneity based on initial development of a country
  - Negative effect on job separations -> decreases with labour costs
  - Positive effect on job finding -> strongest effect for middle income countries
- Effect varies between worker groups measured by occupational task content

➢ Productivity effect seems to dominate displacement effect

➢ Robot adoption leads to the expansion of firms and increased labour demand

Thank you!