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The Effects of Robots on the Workplace

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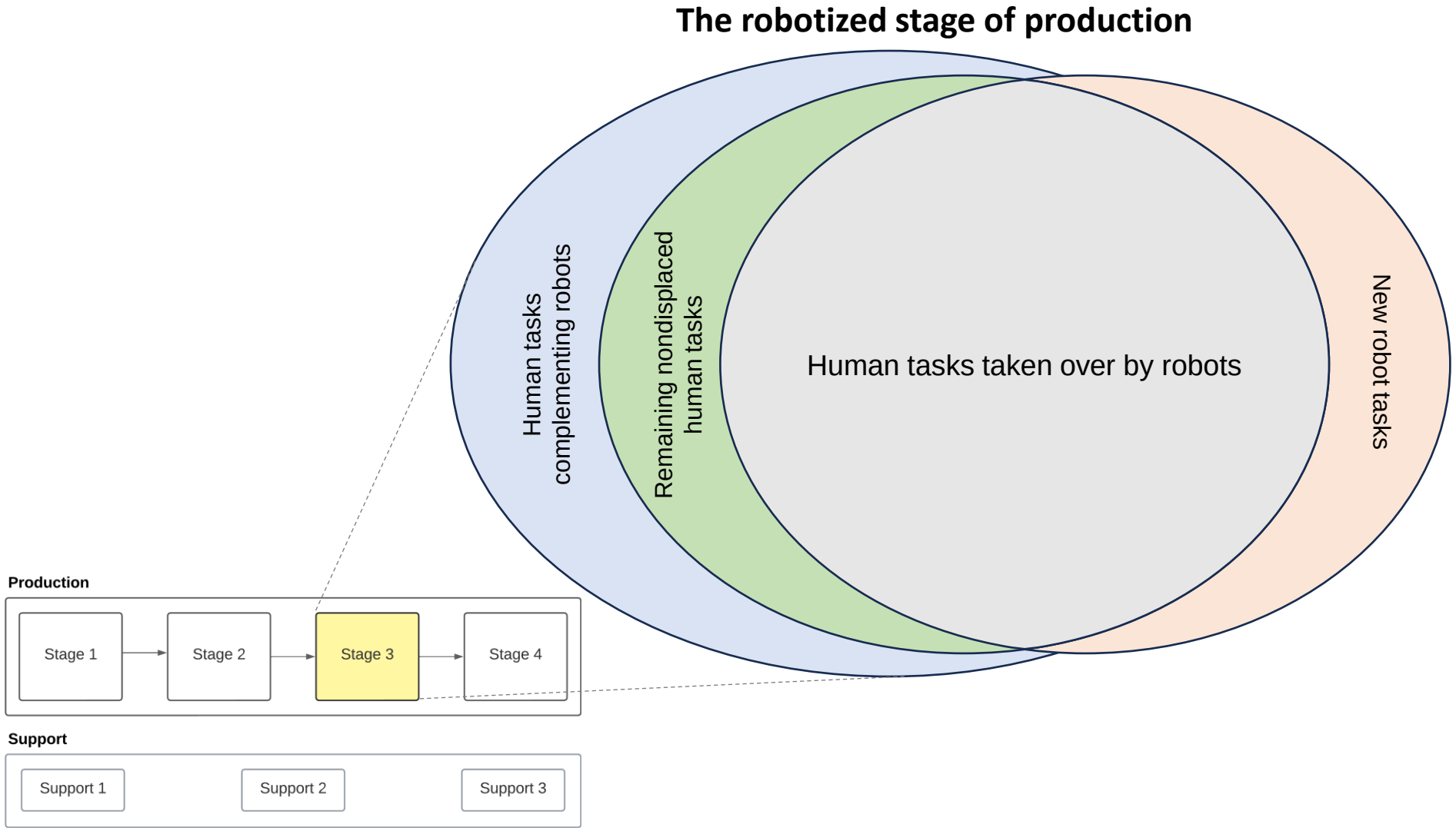
https://cdmcd.co/9Wbwax

The multifaceted effects of robots



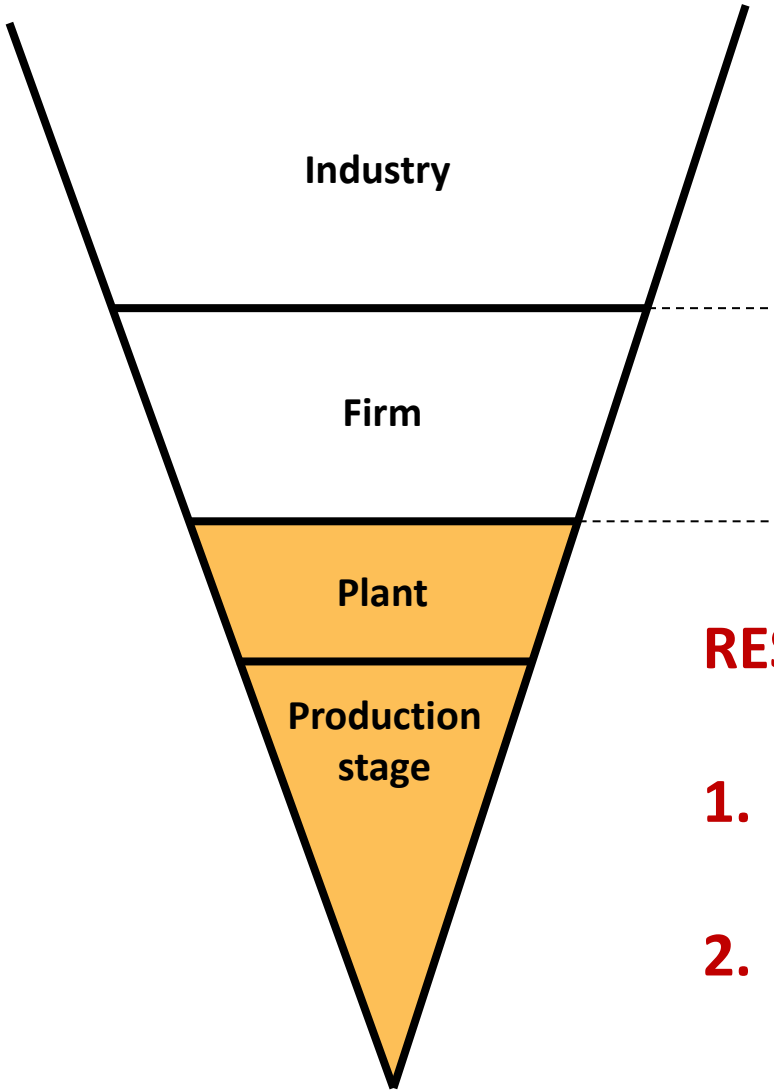
- Displacement
- Complementarity
- Productivity enhancement

Studying employment effect of robots at aggregated level gives conflicting findings

Robot adopters are outnumbered by nonadopters

Firm size	Firms	% Robotic plants per firm
A. Adopters	534	37.58
1 plant	*101*	*100*
2-5 plants	*140*	*41.7*
6-20 plants	*161*	*18.98*
21-100 plants	*112*	*8.71*
>100 plants	*20*	*4.88*
B. Non-adopters	8,041	0

The net aggregate effect depends on:
1. Size of displacement and productivity effects
2. Number of adopters and nonadopters



Negative effect on jobs **Positive effect on jobs**

Mostly positive effect on jobs in adopting firms

RESEARCH QUESTIONS:

1. **Do industrial robots displace or add jobs at the establishment level?**
2. **Is there within-firm heterogeneity?**

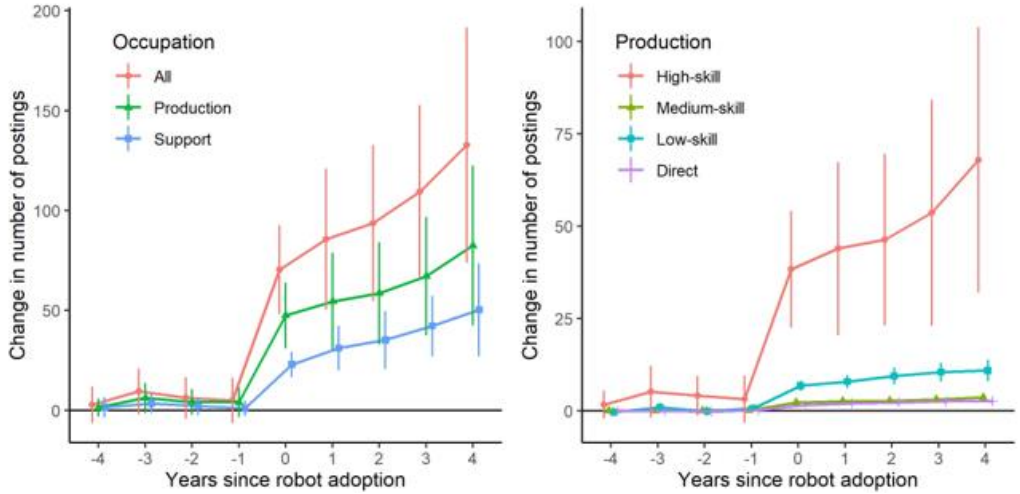
What we do in this study

- We use online job postings and employment
- We focus on US manufacturing, 2010-2022
- We separate occupations into:
  - Production
    - High-skill (production managers, engineers, computers)
    - Medium-skill (technicians)
    - Low-skill (operators)
      - Direct (assembler, welder, material handler, painter, packager)
  - Support
    - Finance, HR, logistics, etc.
- We perform difference-in-differences and instrumental variables analyses.
- We analyze specific skills directly related to robotic operations (technical) and general skills that are important on the job.

Statistics

Robot adoption effect on hiring
Staggered difference-in-differences

	Pre-adoption Postings	Change in postings pre-to-post
A. Adopting vs. non-adopting plants		
All postings	**64.71**	**98.36*** (14.01)**



- Plant-level employment increases by **15%** post-adoption
- Positive but nonsignificant increase in employment at the firm-level

- Robot adoption gradually increases hiring and employment.
- The increase is larger for production activities, and the increase is similar across high, medium, and low skill occupations
- Robot adoption has spillover effect to support activities
- Within an adopting firm, robot adoption also increases hiring in non-robotic plants, albeit in smaller magnitudes.
- This is probably due to higher productivity

* Same results for employment, which increases by 15%.

Employment in nonadopting competitors and industry
Results from instrumental variables analysis

- Employment in nonadopters decreases by **0.4%** one year later, and further to **0.5%** in two years.
- No significant effect at the industry level

	Period relative to adoption rate in t_0		
	0	1	2
Plant-level log of employment in nonadopting firm	-0.000	-0.004**	-0.005**
	(0.002)	(0.001)	(0.002)
Industry-level log of employment	0.0009	0.0026	0.0031
	(0.0018)	(0.0025)	(0.0028)

Notes: Table shows the effect of changing the stock of robots per 1,000 workers in an industry by one unit on the log of full-time employment. standard errors (in parentheses) are clustered by industry. In stage 1 (not shown), the number of US industrial robot stock per 1,000 workers is predicted by the number of industrial robot stock per 1,000 workers and R&D capital stock per 1,000 workers in Denmark, Finland, France, Italy, and Sweden. Included as controls, US industry-level real GDP, year fixed effects, and plant fixed effects. Significance levels: * 10%, ** 5%, *** 1%.

Technical skill requirements for robotic job postings
Results from two-way difference-in-differences analysis

- Robotic jobs experience a significant change post-adoption in skills closely related to robotic operations
- Zero effect on non-robotic jobs
- Zero effect on general skills

	Design (1)
High-skill robotic job	0.56*** (0.05)
Medium-skill robotic job	0.01 (0.06)
Low-skill robotic job	0.13*** (0.04)

Notes: Skills are measured as the plant-level average frequency the skill is used in production occupations. Significance levels: * 10%, ** 5%, *** 1%.

Implications

1. Robots can displace certain production tasks and create new opportunities for employment and skill development

2. Need to support workers displaced by robotics, not in adopting plants but elsewhere in the economy.

3. Provision of training for reskilling workers to transition into new roles created by automation.

4. Technical education should focus on programming, maintenance, and supervision of robotic systems and their integration with AI.

5. Encourage robot adoption by firms by enhancing their technical and human resource capabilities.

6. Improve data collection on robot adoption and its effects on employment to enable more detailed and comprehensive studies.

Thank you!