

Robots and Firm Investment

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Overview

- ▶ This paper studies the impact of robots on firms and makes two main points
 1. Investment in robots is small at the aggregate level and concentrated in a few industries
 2. The negative impact of robots on labor is limited: positive effect on firm-level employment and modest negative effect on industry-level or region-level employment
- ▶ The setting is Germany: arguably the country with the highest robot investments

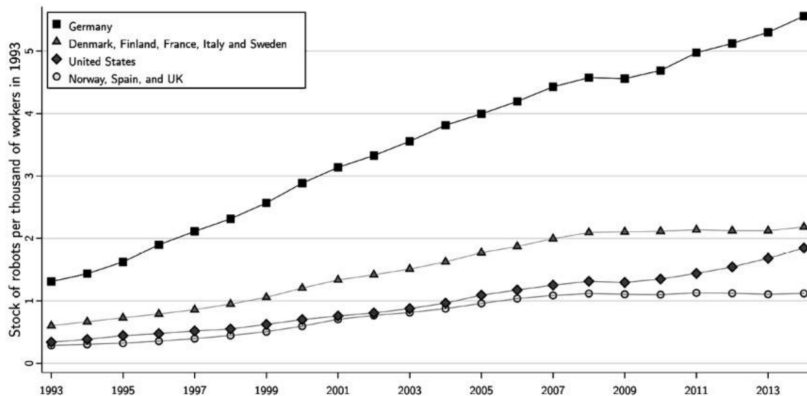
Patterns of Robot Investment

- ▶ Number of new robots: 0.97 per 1000 workers in manufacturing, 0.24 per 1000 workers across all sectors
- ▶ Value of robot investments: 2 percent of capital expenditure in manufacturing, and 0.3% across all sectors
- ▶ The investment is much lower compared to other technologies: IT accounts for 3% of capital expenditures across the whole economy

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- ▶ For robots, **stock** matters more than flows
 - ▶ Other technologies are more about flows: software license, data analytics
 - ▶ Table 1: stock of robots/1000 workers = 2.23, about twice higher than shipments

Robot Stock



Source: Acemoglu and Restrepo (2020)

Value of Investments

- ▶ Is value of investments a good measure of the importance of technologies?
- ▶ An example is electricity
- ▶ An alternative measure of exposure: how many firms/workers are exposed to robots?

Evidence from US Census

	TECHNOLOGY USERS	
	Share of firms using technology	Share of workers employed at firms using technology
	(1)	(2)
Artificial Intelligence	3.2%	12.6%
Robotics	2.0%	15.7%
Dedicated Equipment	19.6%	36.4%
Specialized software	40.2%	64.4%
Cloud computing	34.0%	61.8%
Any technology	.	.

Source: [Acemoglu et al. \(2022\)](#)

The Effect of Robots on Labor

- ▶ The paper finds a positive effect on firm employment:
 - ▶ Many recent papers on robots agree: [Acemoglu et al. \(2020\)](#); [Bessen et al. \(2020\)](#); [Aghion et al. \(2020\)](#); [Bonfiglioli et al. \(2020\)](#); [Dixon et al. \(2021\)](#); [Humlum \(2021\)](#); [Koch et al. \(2021\)](#); [Eggleson et al. \(2021\)](#); [Hirvonen et al. \(2022\)](#); [Curtis et al. \(2022\)](#)
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- ▶ So what is going on?
 - ▶ Omitted variable bias
 - ▶ Positive productivity effects and negative spillover effects
 - ▶ Other effects of robots dominate labor-replacing effect

Omitted Variables

- ▶ Firms that are growing fast invest in robots and increase employment
- ▶ Firms/regions that are growing fast are more likely to have “labor shortage”: demand > supply
- ▶ Suggestions:
 - ▶ Event study to establish causality
 - ▶ Look at labor share
 - ▶ Also useful on its own for understanding the effects of labor
 - ▶ The evidence is mixed: Acemoglu, LeLarge, and Restrepo (2020) find 4 percentage point decline in labor share and Aghion et al. (2020) find no effect
 - ▶ Instrument labor scarcity using labor supply shocks: aging ([Acemoglu and Restrepo 2021](#)), immigration ([Lewis 2011](#))

Reallocation and Spillovers

- ▶ Acemoglu, LeLarge, and Restrepo (2020) find that negative spillovers to industry competitors dominate positive employment effects on robot adopters
- ▶ Regional vs industry spillovers?
- ▶ Look at reallocation: types of workers that are hired by the robot-investing firms and fired by their competitors?
- ▶ Effects on wages?

Other Channels Besides Replacing Labor?

- ▶ Babina, Fedyk, He, and Hodson (2021) find that the main effects of AI is spurring product innovation and not replacing workers
 - ▶ Similar evidence for robot in Hirvonen et al. (2022): piston manufacturers use robots to produce more high-quality pistons
- ▶ Is there any way to measure this in the data?
- ▶ Robots may even allow firms to expand into more labor-intensive products/industries

Minor points

- ▶ Are results robust without winsorizing? Less than 10% of firms invest in robots
- ▶ The IV strategy in Acemoglu and Restrepo (2020) may not work in this case: Germany is the earliest adopter of robots among those countries and many shocks are correlated with other European countries
 - ▶ Acemoglu and Restrepo: “Focusing on countries that are ahead of the United States helps us isolate the source of variation coming from global technological advances (rather than idiosyncratic US factors).”
- ▶ Do high-adoption areas adopt robots more because they have a lot of high-adopting industries? Why not define *Adoption* in equation 1 using adoption rates at region*industry level?
- ▶ Can you replicate the regional specification in Acemoglu and Restrepo (2020) (which capture GE effects) and contrast with their results?

Conclusion

- ▶ Very important paper that challenges the conventional wisdom
- ▶ My suggestions:
 - ▶ Measure stock of robots and exposure to robots
 - ▶ Consider potential effects on labor share, reallocation, and product market

Thanks!

