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MEASURING AUTOMATION: A FIRM-LEVEL VIEW FROM THE 2019 ANNUAL BUSINESS SURVEY

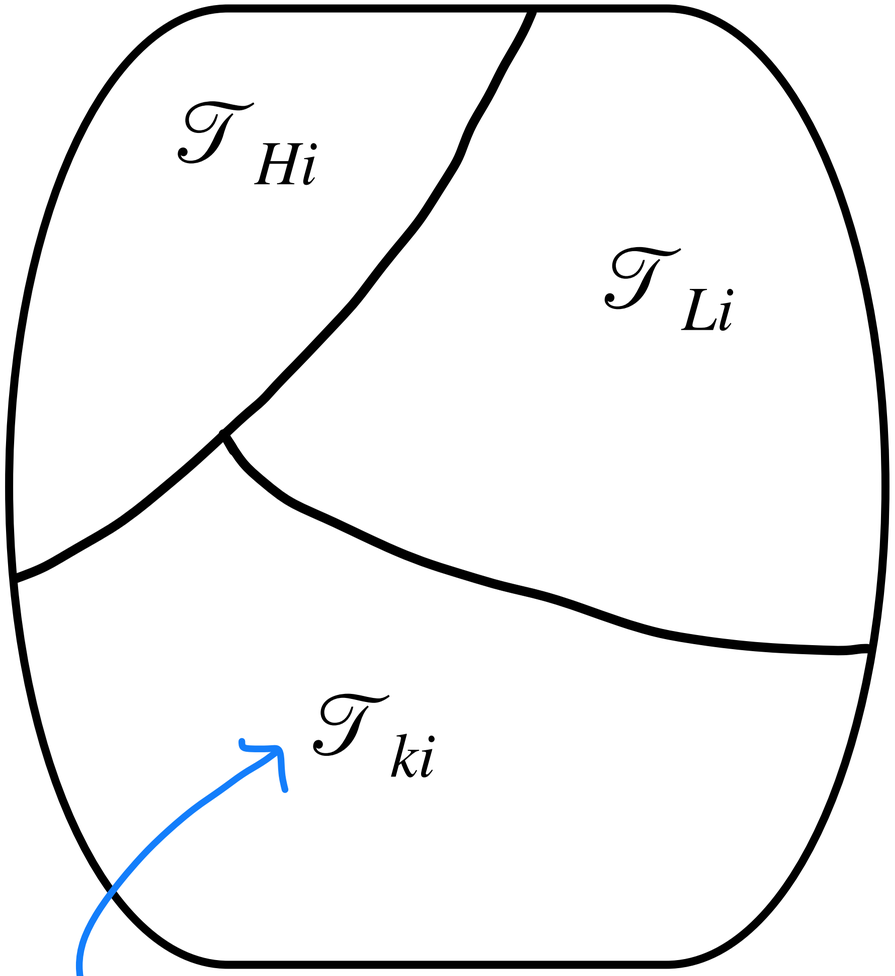
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MEASURING AUTOMATION TECHNOLOGIES

- Automation believed to play key role behind recent trends: rising inequality, the dynamics of the labor share, and changes in industry concentration.
- But knowledge about automation—how big of a force it is and its diffusion across firms and industries—remains limited due to lack of data.
- This presentation describes work by the US Census to measure automation and its diffusion across US firms using the 2019 Annual Business Survey.

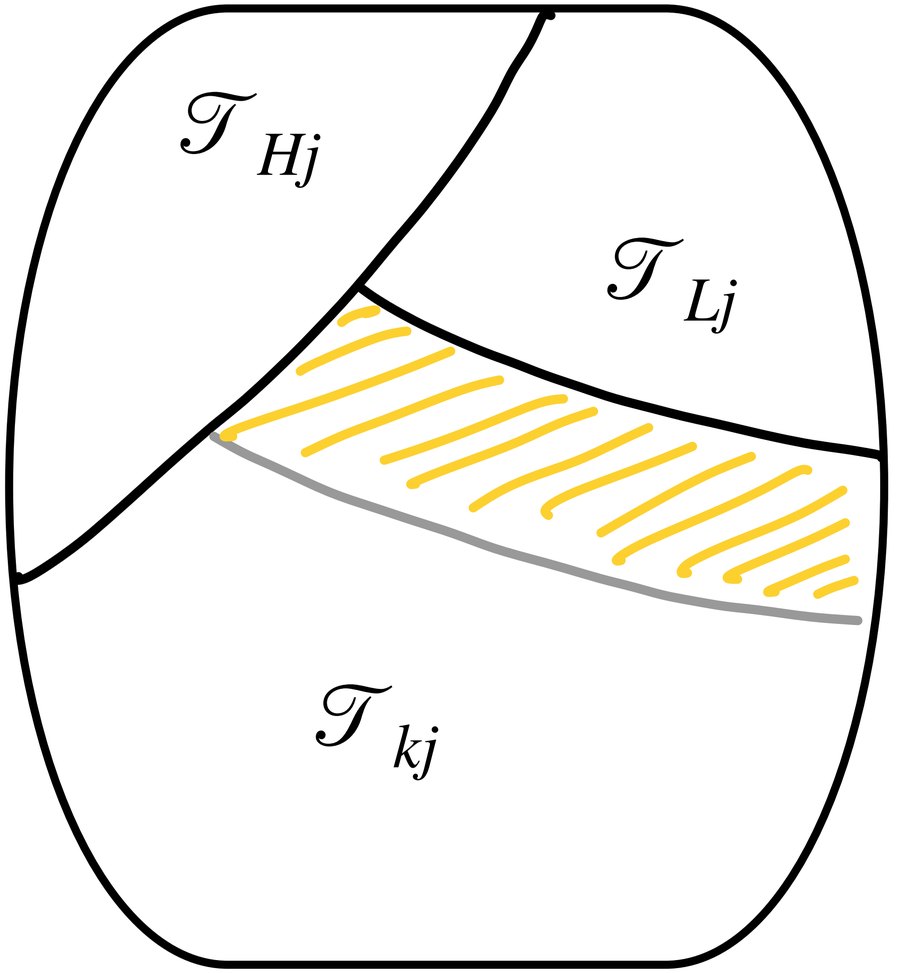
THE PRODUCTION STRUCTURES OF FIRMS

Firm i production structure



Tasks allocated to software and machinery after paying fixed cost $\kappa_{i,a,s}$

Firm j production structure



More automated tasks in firm j

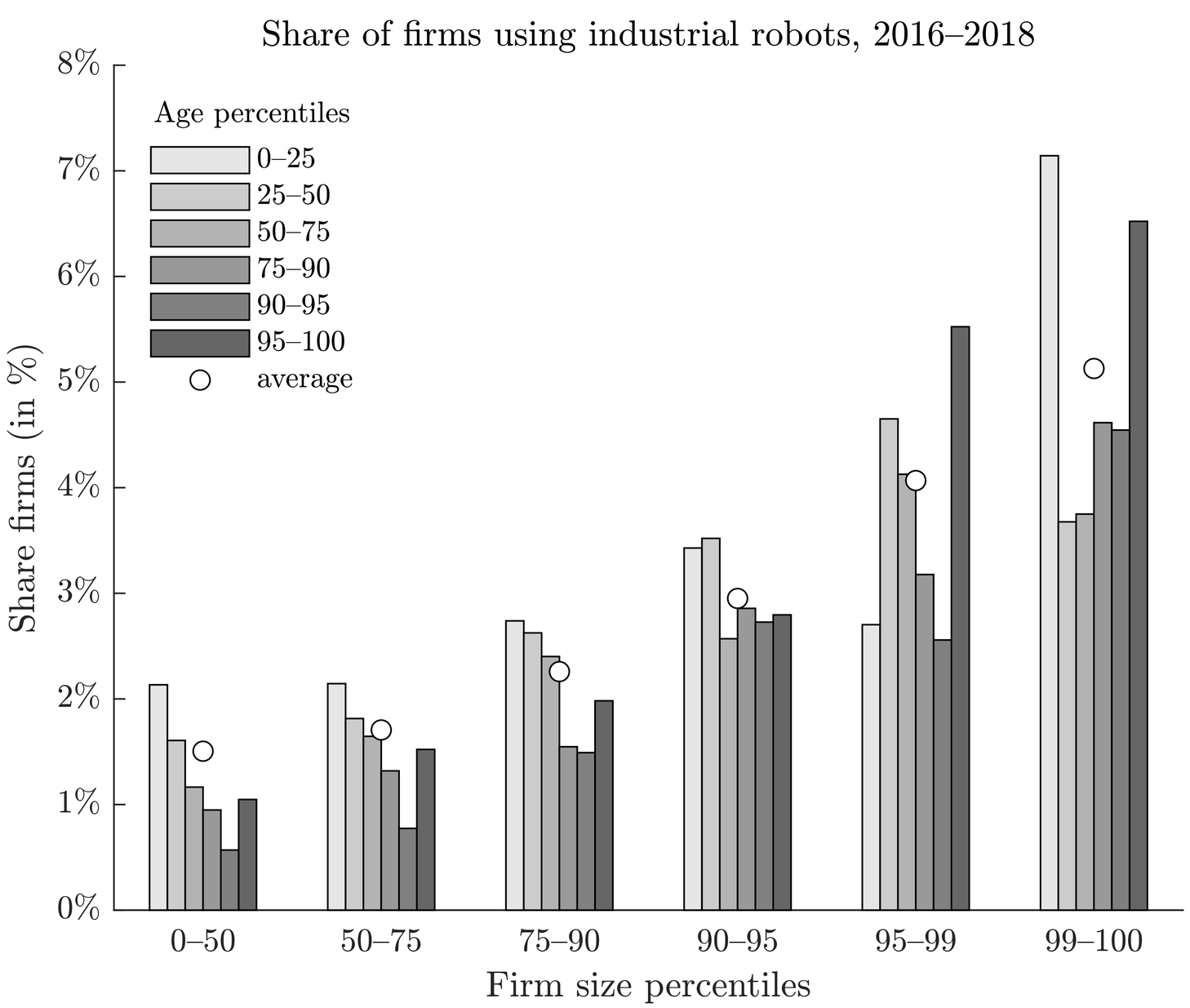
IMPLICATIONS

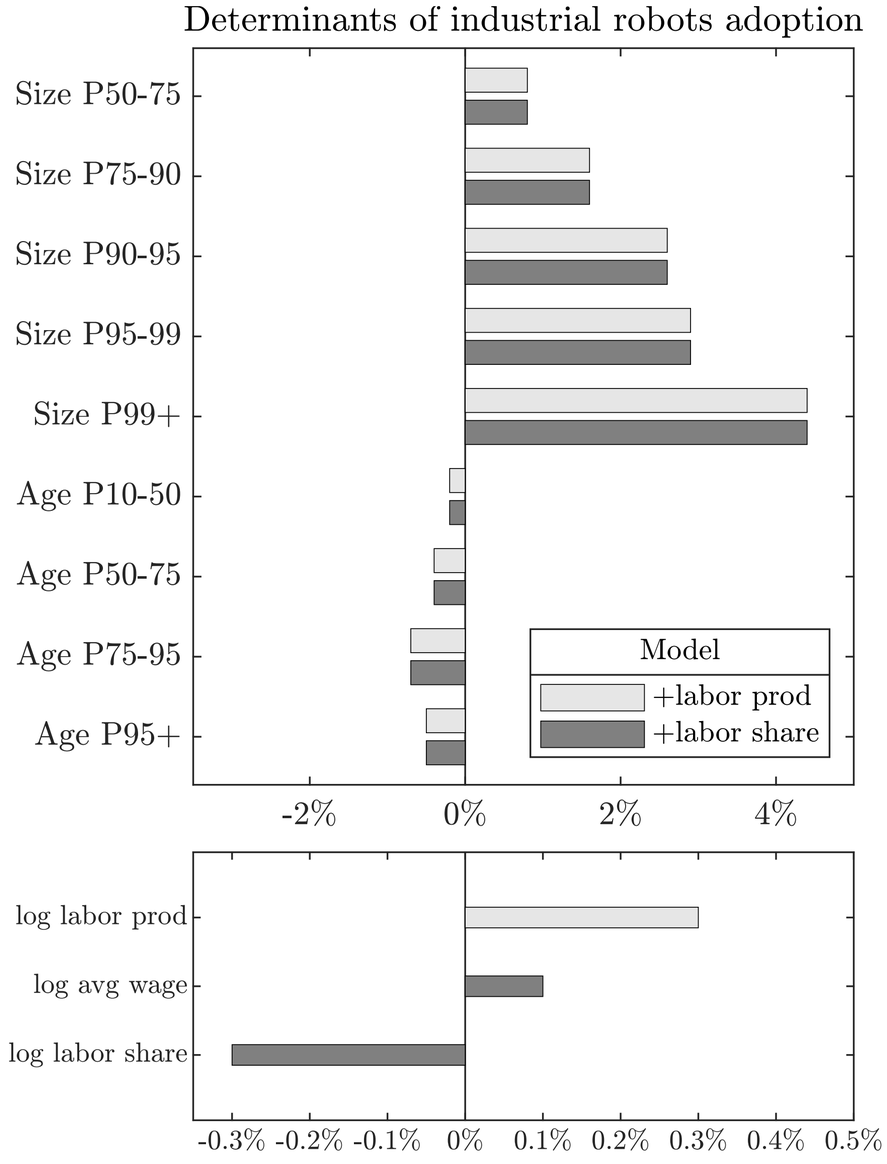
1. Firms in same market operate different production structures, with some being more automated than others and having lower labor shares, higher output per worker, and requiring workers with different skills.
2. Production structures linked to the deployment of automation technologies.
3. Large firms will operate more automated production structures. Among small firms, younger ones are more likely to automate their processes due to the lack of organizational barriers.

THE 2019 ANNUAL BUSINESS SURVEY

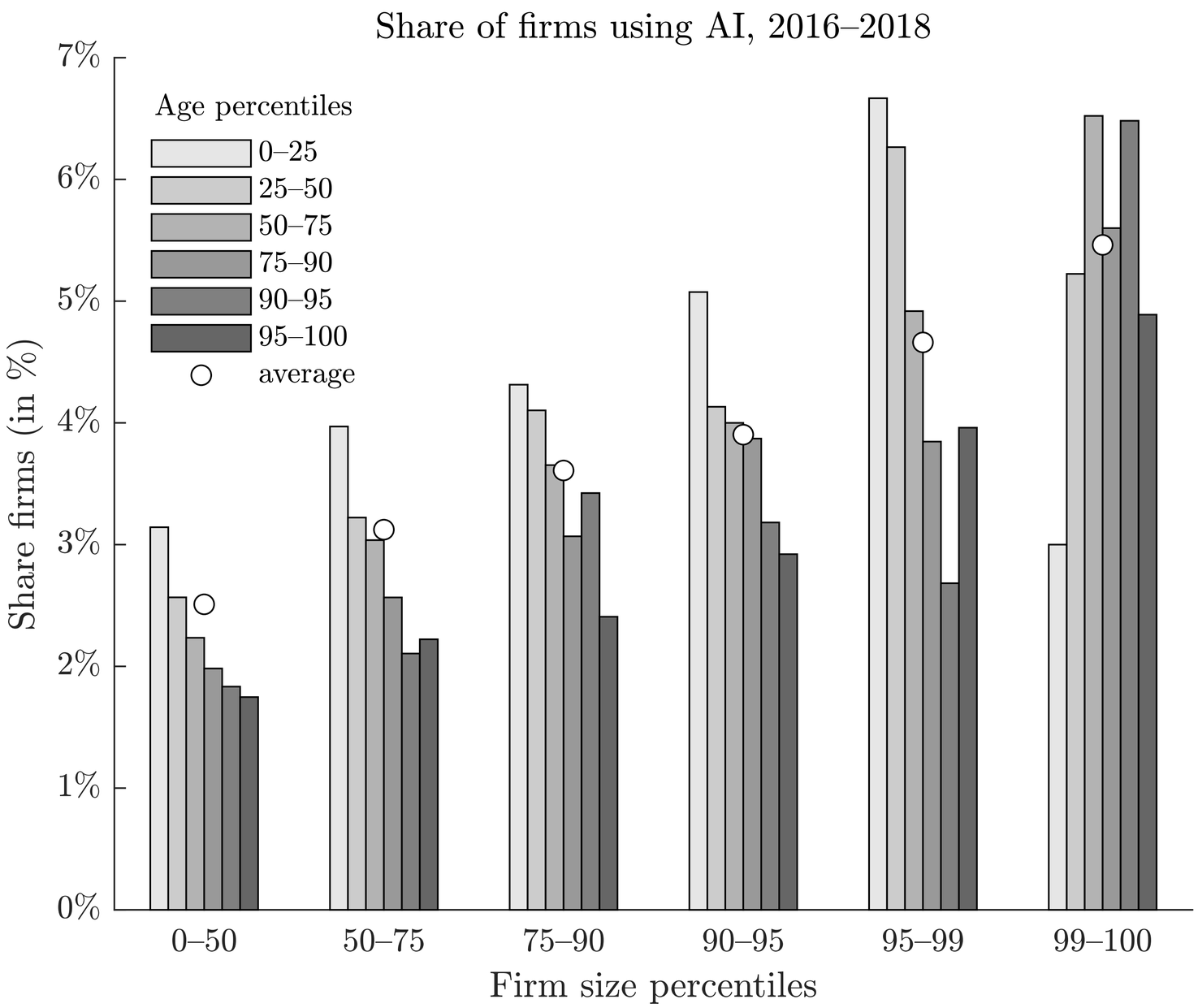
- Enterprise-level survey first conducted in 2018 (joint effort between US Census, NSF, NCSES).
- Mailed to 300,000 (800,000 in first year) nationally representative firms, with 208,000 responses.
- New modules introduced each year:
  - 2018: digitization
  - 2019: automation and the workforce
- **This presentation:** 2019 ABS data on users of AI, robotics, specialized software, and dedicated machinery (cloud computing in the paper).

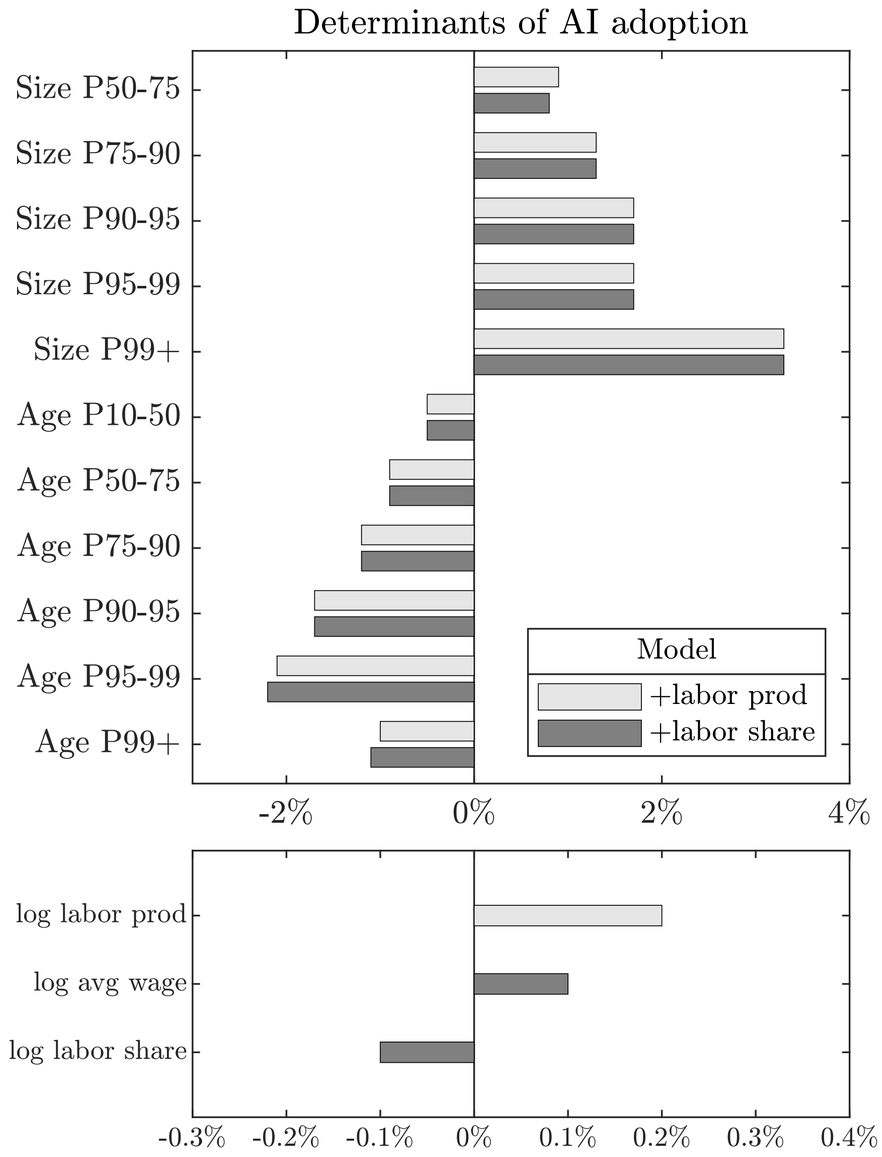
TECHNOLOGY ADOPTION WITHIN 6-DIGIT INDUSTRIES



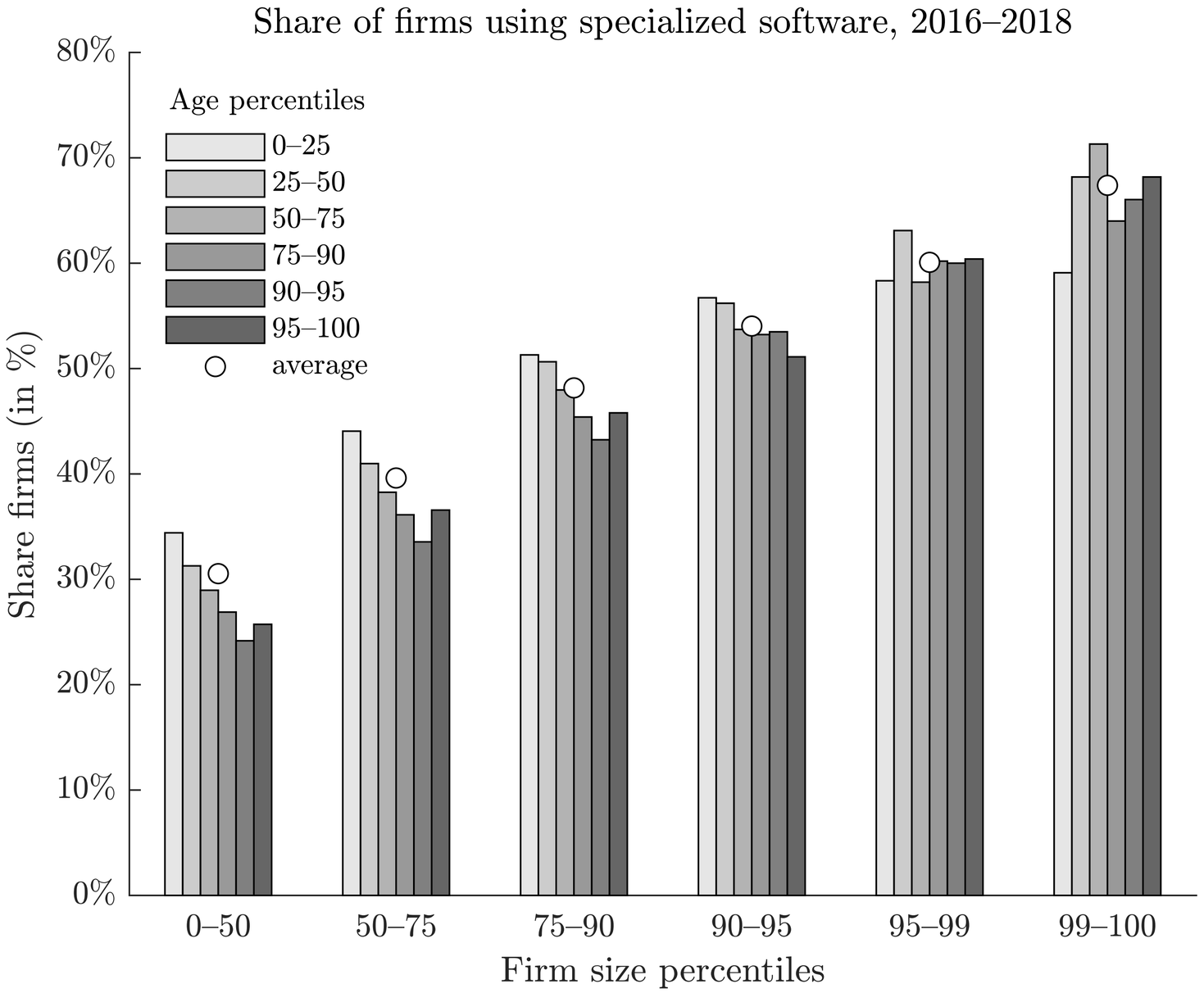


TECHNOLOGY ADOPTION WITHIN 6-DIGIT INDUSTRIES



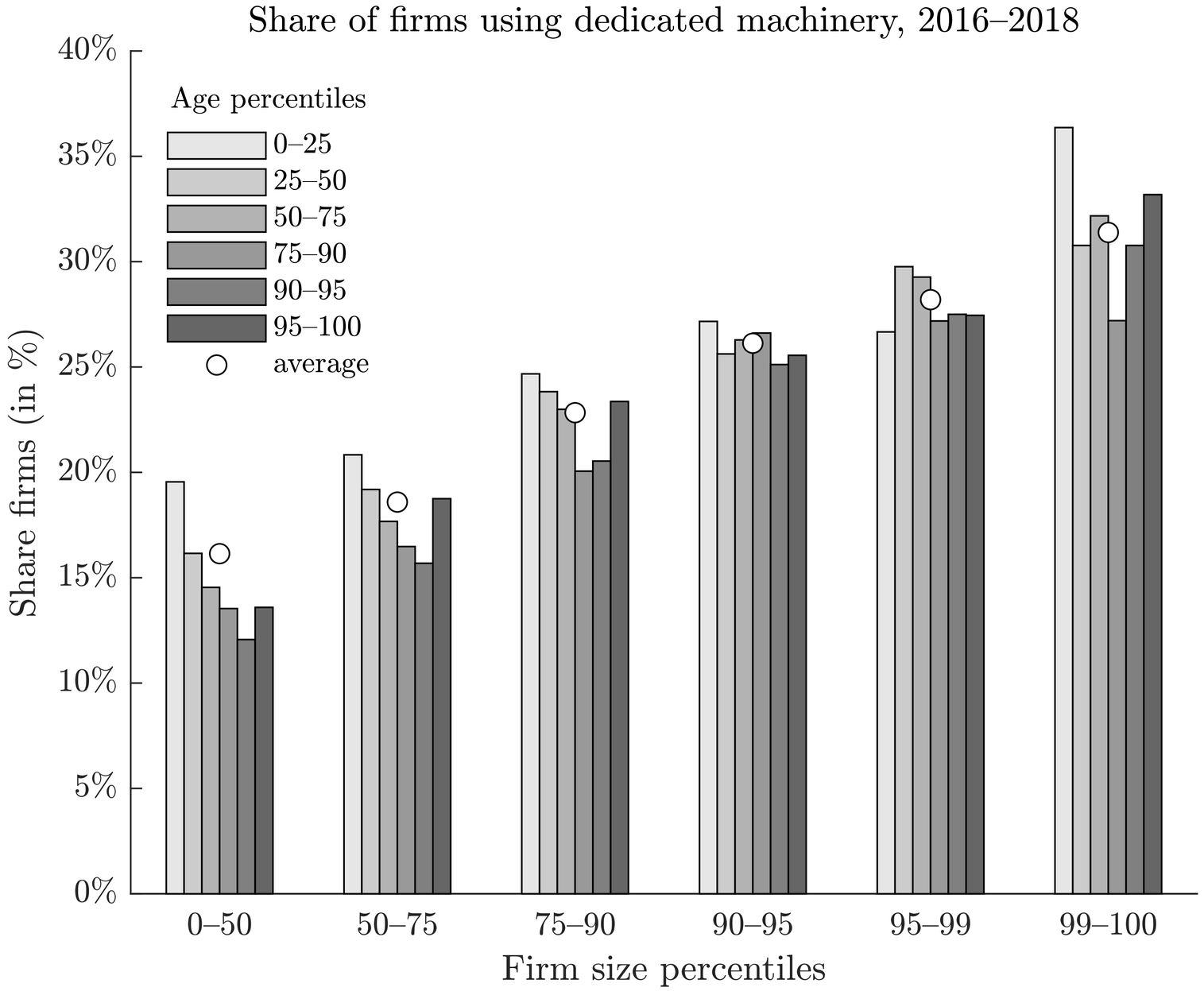


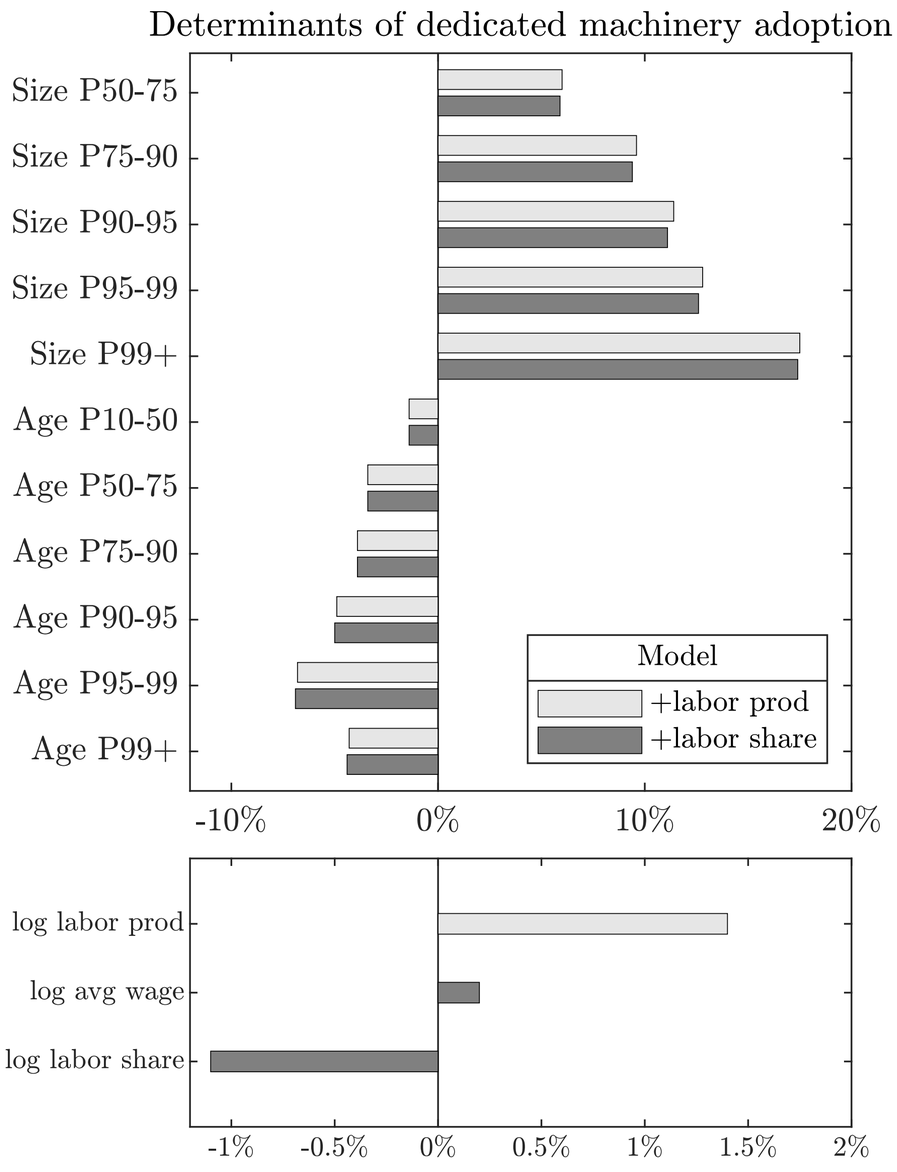
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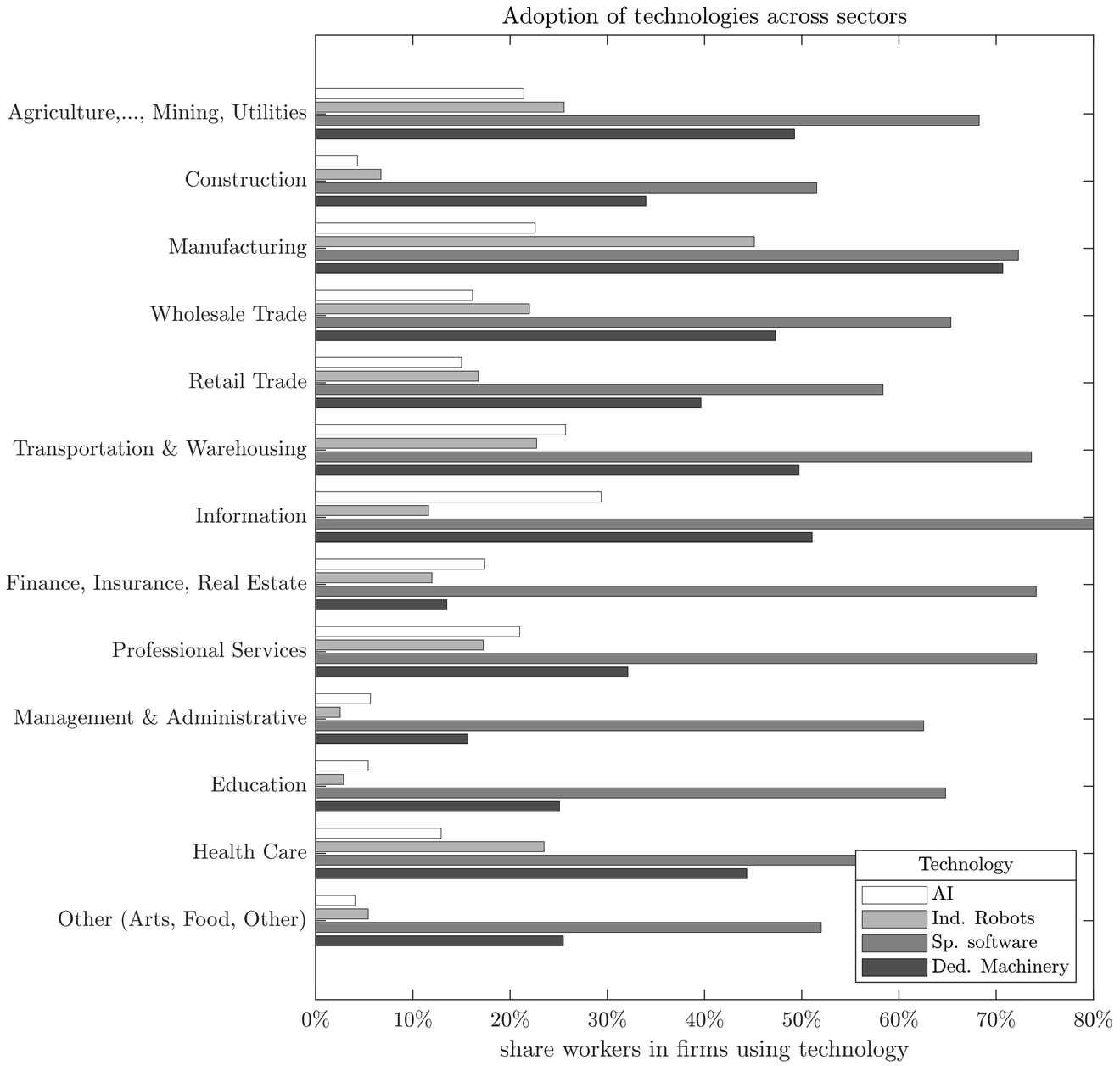
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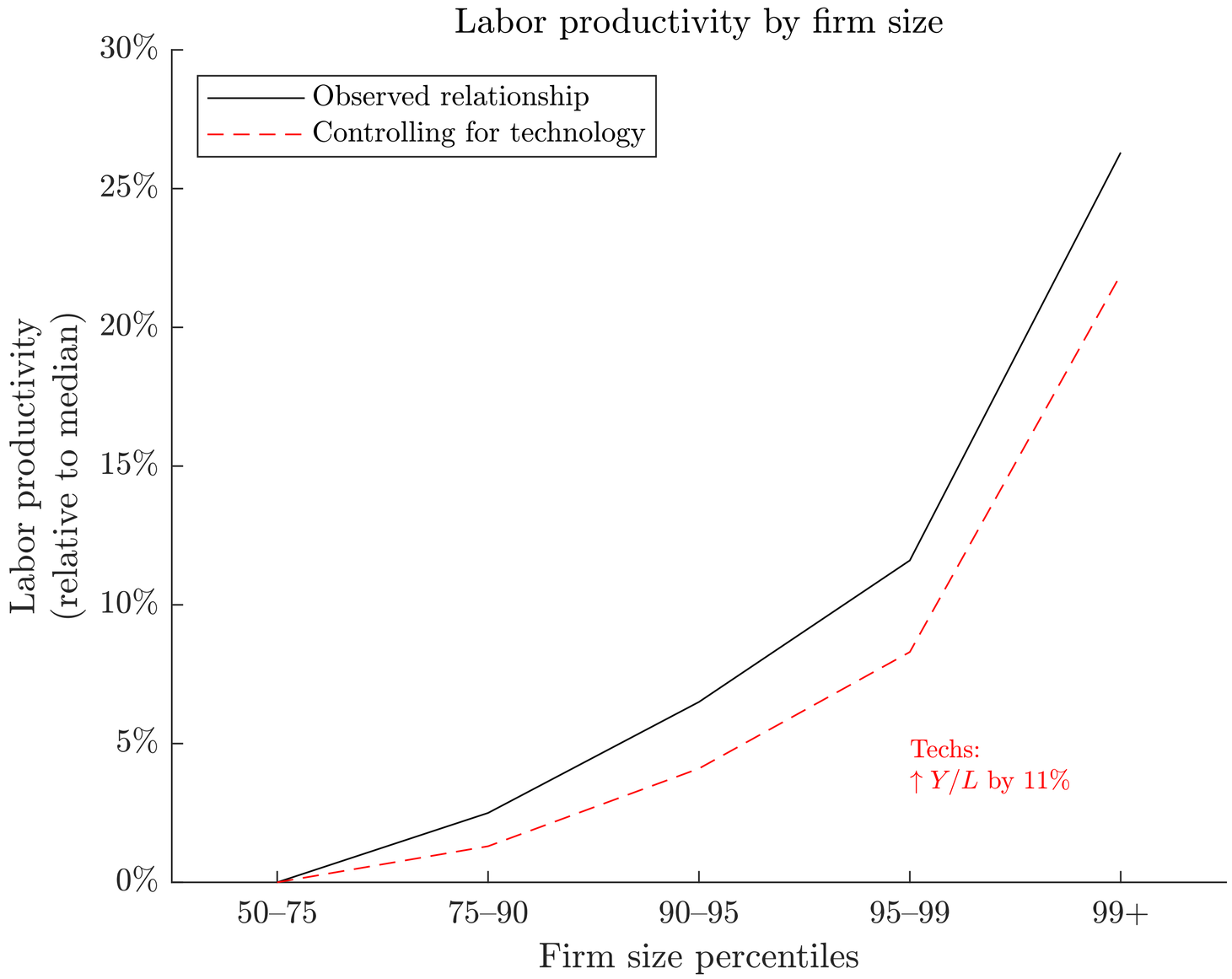


TECHNOLOGY ADOPTION ACROSS SECTORS

- Vast differences across sectors
- 6-digit industry dummies **explain 10–30% of the variation in adoption** rates
- Consistent with sectors having different task structures and adoption costs

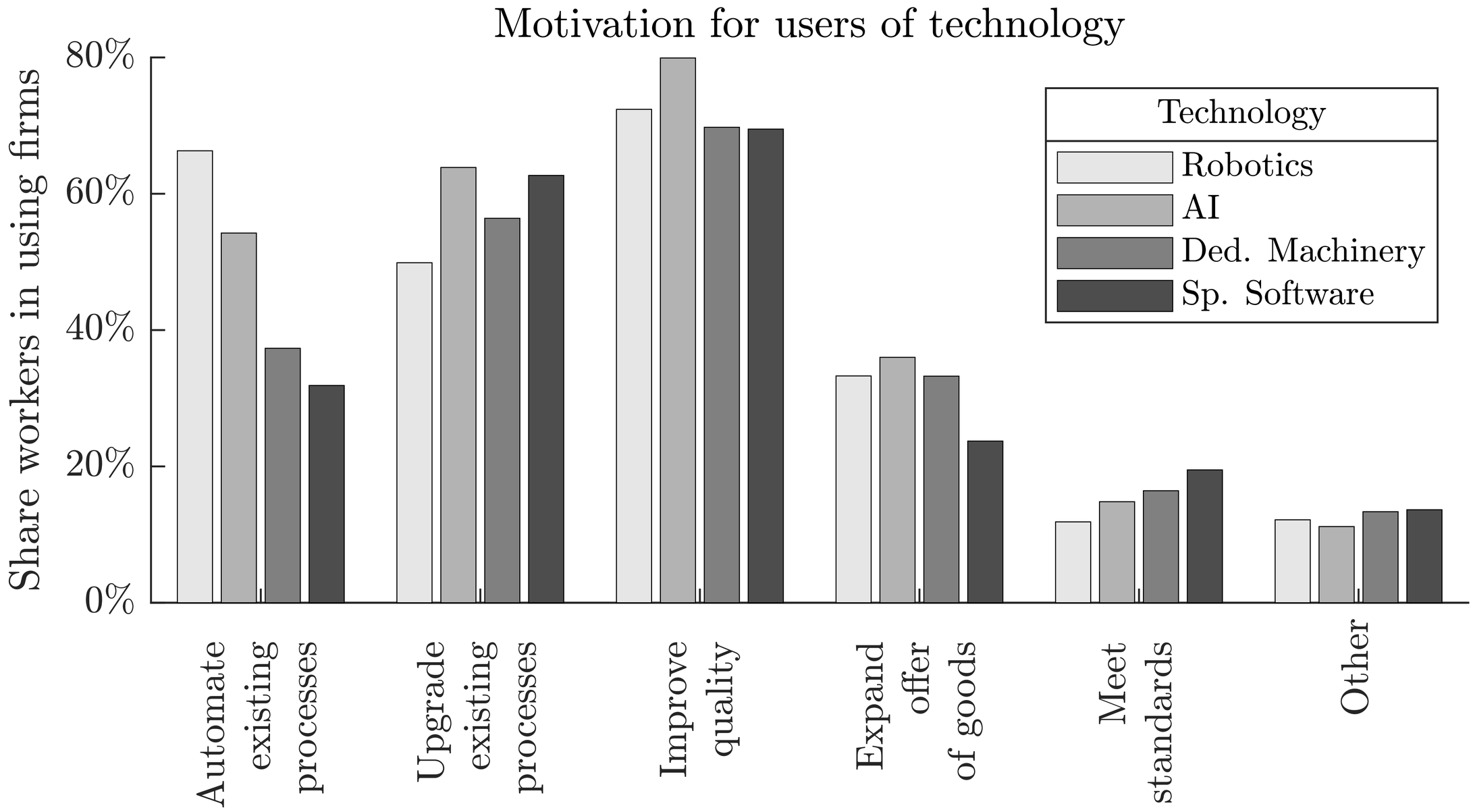


TECHNOLOGY AND DIFFERENCES IN LABOR PRODUCTIVITY

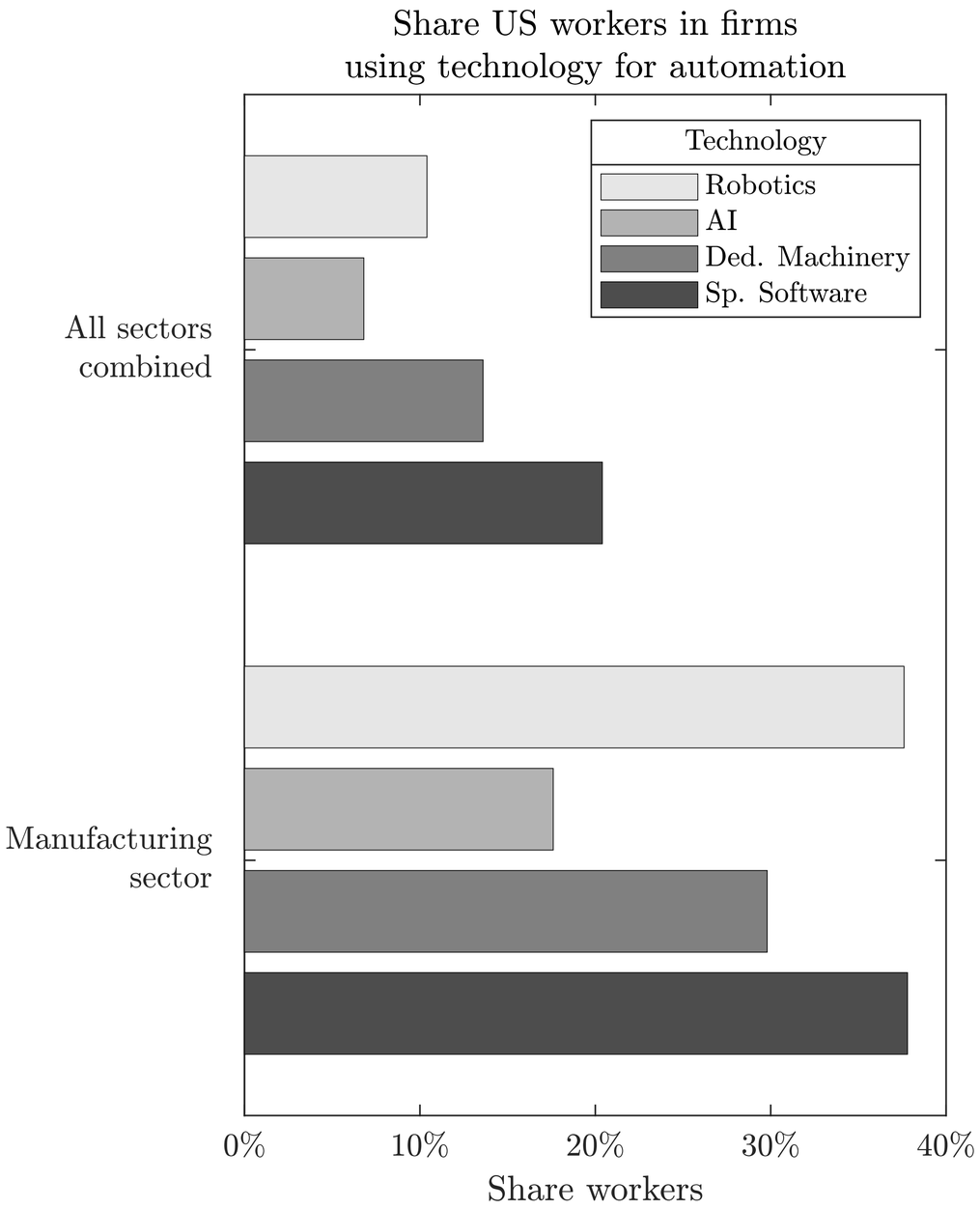


- Use of AI, robots, specialized software and dedicated machinery associated with **11-14% higher output per worker**
- Uneven use of technology explains at least **30% of the higher labor productivity** among large firms
- Similar within and outside of manufacturing

ARE THESE TECHNOLOGIES BEING USED TO AUTOMATE TASKS?



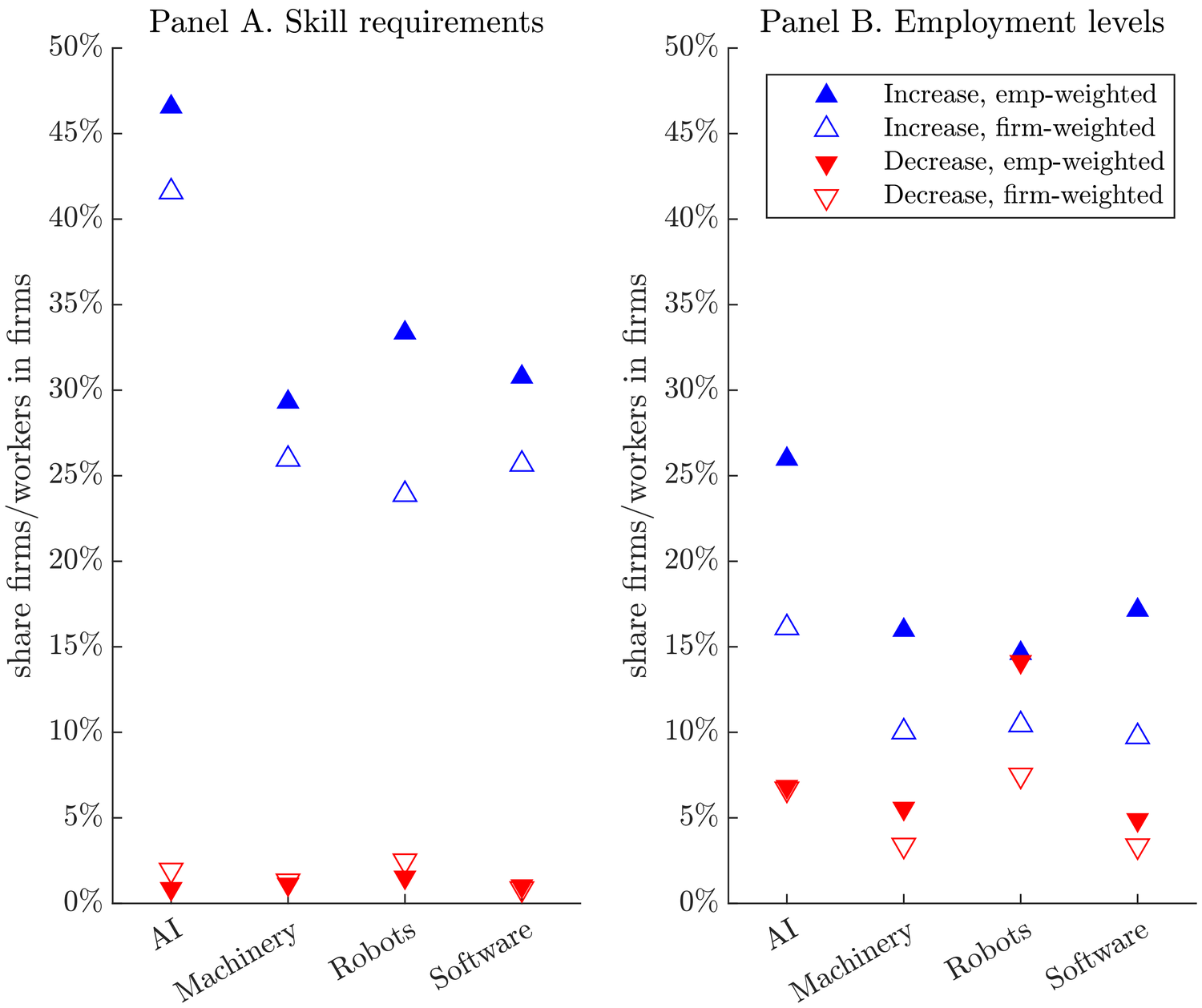
HOW IMPORTANT IS AUTOMATION IN THE US ECONOMY?



- High share of US workers are at firms using these technologies for automation:
  - from **7% for AI**
  - to **20% for specialized software**
- Sizable differences across industries
- **37% of US manufacturing workers** are at firms using robotics and specialized software to automate tasks

ARE TECHNOLOGIES CHANGING LABOR DEMAND BY FIRMS?

- Among firms using these technologies, **30-45% report requiring workers with higher skill levels**
- Change in composition of workers more than their sheer number



TAKING STOCK

1. Adoption varies across sectors, but concentrates in large firms and new cohorts.
2. Adopters have higher labor productivity and skill requirements, but do not report increasing their employment levels.
3. Consistent with firms using these technologies to automate additional tasks.

RESEARCH DIRECTIONS

- Track adoption over time ⇒Panel dimension
- Passthrough to productivity and prices ⇒ Welfare
- Measurement of capital and TFP
- Skills and tasks at different firms ⇒ Implications for inequality
- Specialized software and automation outside of manufacturing