Artificial Intelligence, Firm Growth, and Product Innovation

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Artificial Intelligence

Washington Post

AI is replacing customer service jobs across the globe

Artificial intelligence chatbots will upend how call centers and customer service hotlines operate. Countries like India and the Philippines...

2 days ago

Fox News

AI and job losses: How worried should we be?

In March 2023, OpenAI reported that at least 80% of the U.S. labor force could have at least 10% of their work-related tasks affected by the...

2 days ago

CBC

Learn AI now or risk losing your job, experts warn

Most people in the workforce need to understand how to work with artificial intelligence or they will face the risk of losing their jobs,...

1 week ago

Artificial Intelligence

- What is Artificial Intelligence (AI)?

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  - Sci-fi: super-human intelligence, taking over the world
  - In practice: algorithms that make predictions from data
    - ★ Innovations: modeling complex, non-linear relationships + processing larger datasets, unstructured data (visual, language)

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    - ★ Innovations: modeling complex, non-linear relationships + processing larger datasets, unstructured data (visual, language)
- Explosion in corporate AI investment in recent years
  - Tens of billions of dollars *on aggregate*
- But what does AI do for firms and workers?
  - Research: answer this question with comprehensive empirical **data**
  - Detailed info on individual job postings and workers at each firm

Measuring Firm-Level AI Investments: Data

1. Job postings: BurningGlass Technologies
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   - Comprehensive coverage of online job openings in 2007 and 2010-2018
   - Detailed taxonomy of required skills

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2. Employment profiles (resumes): Cognism, aggregator of public profile information
   - 535 million full profiles globally
   - Job histories, skills, education, publications, patents, awards
   - Captures actual hiring, not just demand

Measuring Firm-Level AI Investments: Data

Resume Data Strengths

1. High coverage: as of 2018, cover 64% of U.S. employees and 3.8 million firms
2. Capture actual hiring, not just demand
3. Reflect AI-skilled labor onboarded via acquisitions
4. Ability to measure and control for the use of other IT and data technologies
5. Extension incorporating external AI software into our internal AI-investments measure

AI-Skilled Human Capital

Babina, Fedyk, He, and Hodson (JFE 2024): AI, Firm Growth, and Product Innovation

1. Identify relevant skills in job postings
   - Core AI areas: AI ML NLP Computer Vision
   - AI-relatedness score of skill s = % of jobs requiring skill s that explicitly mention at least one core AI area

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Examples

- *"deep learning": 86% of job postings also list one of core AI areas*
- *"information retrieval": 37% co-occurence with core AI areas*
- *"communication skills": 0.3% co-occurence*

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2. Locate the most relevant skills in resumes (thanks to Cognism, Inc.)
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Examples

- *Job title: "Senior Machine Learning Developer"*
- *Job description: "develop Chatbots using Python with scikit learn, tensorflow and deep learning models..."*
- *Publication: "A New Cluster-Aware Regularization of Neural Networks"*

What does AI do for firms?

Two potential theories

1. Productivity enhancement
   - Automate some of the tasks
   - Cut costs
   - Produce things more effectively (e.g., with less human labor)
   - **This channel would lead to AI "stealing" jobs**

2. Product innovation
   - Increase the potetial to explore new products
   - Complement "soft" skills such as sales
   - Completemt technical human labor (running experiments, product develoipment, etc.)
   - **In this channel, AI does not "steal" jobs and can increase employment**

Artificial Intelligence as Automating Human Tasks

Fedyk, Fedyk, Hodson, and Khimich (RAST 2022). Does AI Improve the Audit Process?

- Setting especially well-suited to automation via AI: audit
  - Relatively standardized product with clear regulation
  - Audit relies on prediction and anomaly detection
  - High penetration of AI in audit firms (PwC, KPMG, Deloitte, EY, etc.)

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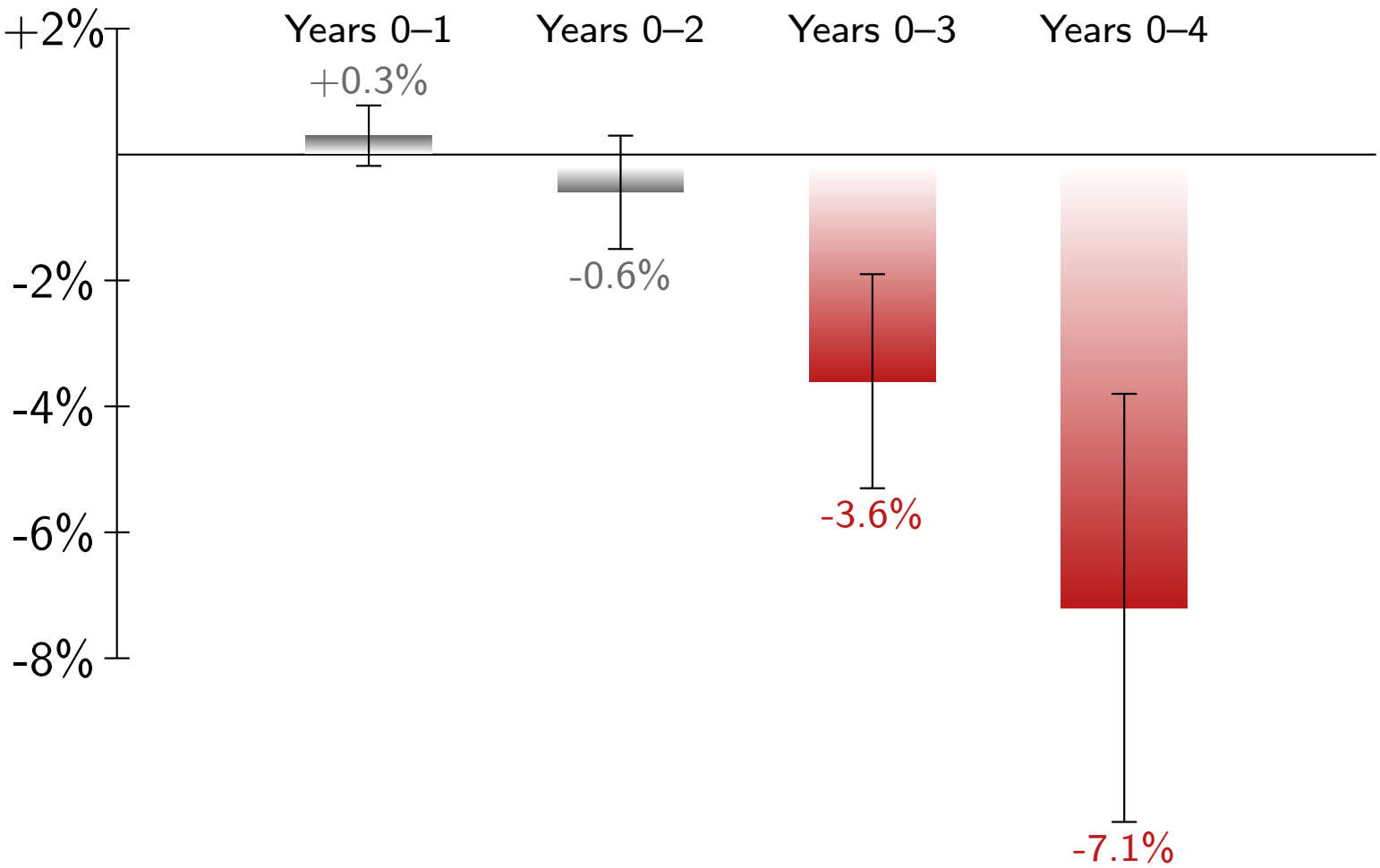
- When audit firms invest in AI, we see:
  - Fewer restatements, including material restatements
  - Fewer SEC investigations
  - Lower audit fees (suggesting efficiency gains passed onto clients)

Artificial Intelligence as Automating Human Tasks

What happens to the audit firms' workforce?

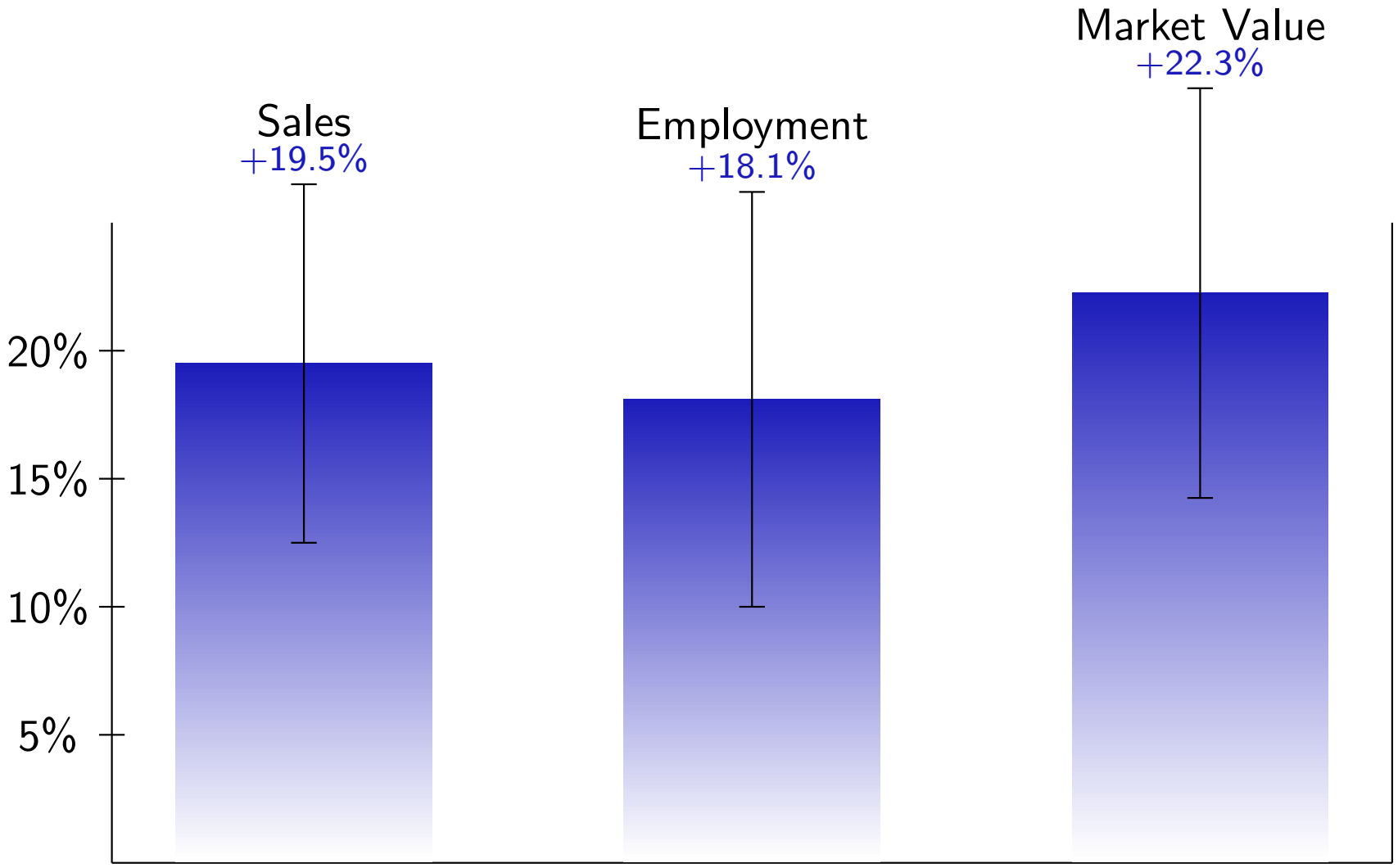


AI in Other Sectors

Babina, Fedyk, He, and Hodson (JFE 2024): AI, Firm Growth, and Product Innovation

- Industry surveys: top uses of AI are product creation, improvement, and tailoring to customer tastes
- Two key ways how AI can be used to increase product innovation:
  1. Learn about customer preferences and tailor products to those tastes
  2. Learn about more promising projects, reducing costs of lengthy experimentation with uncertain benefits: e.g., Moderna used AI to develop and produce COVID-19 vaccine in just 65 days

AI in Other Sectors



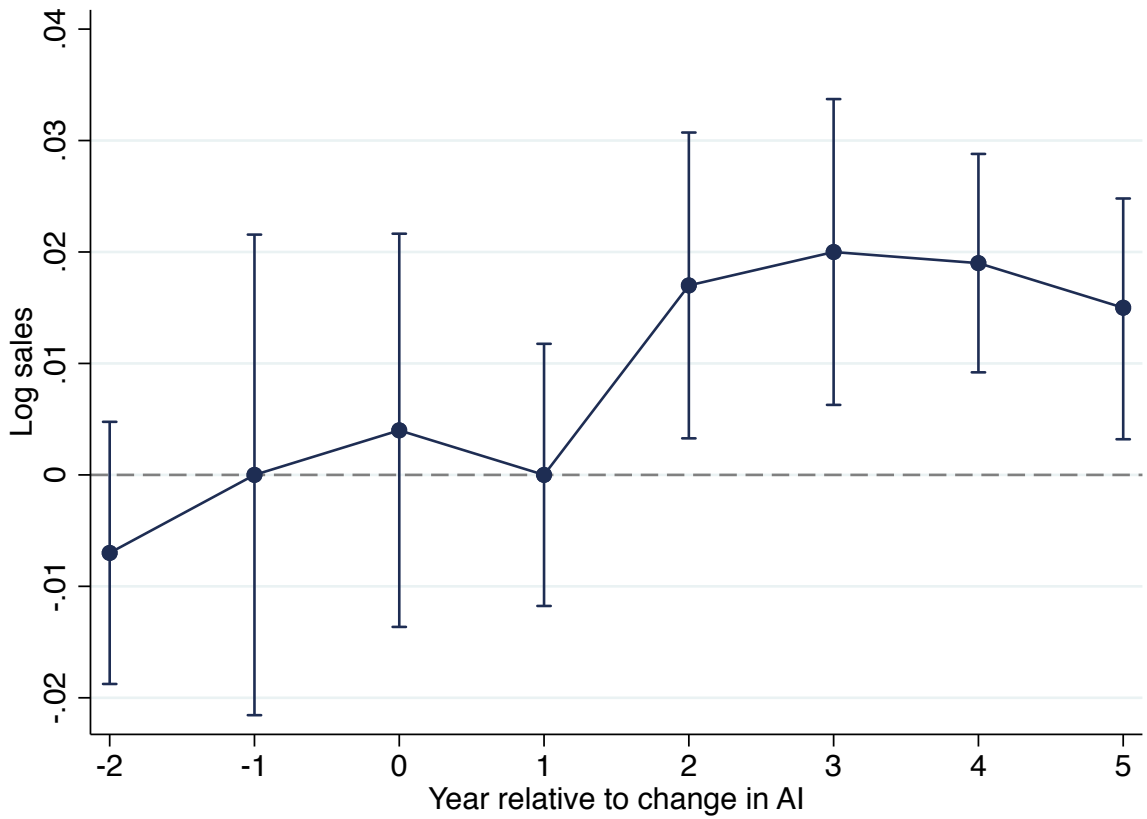
AI Investments and Firm Growth

Dynamic Effects of AI by Year from Adoption

- Distributed lead-lag model (Stock and Watson 2015; Aghion, Antonin, Budel, Jaravel 2020):

$$Sales_{it} = \Sigma_{k=-2}^{5} \delta_k ShareAIWorkers_{i,t-k} + \mu_i + \lambda_{st} + \epsilon_{it}$$

Back



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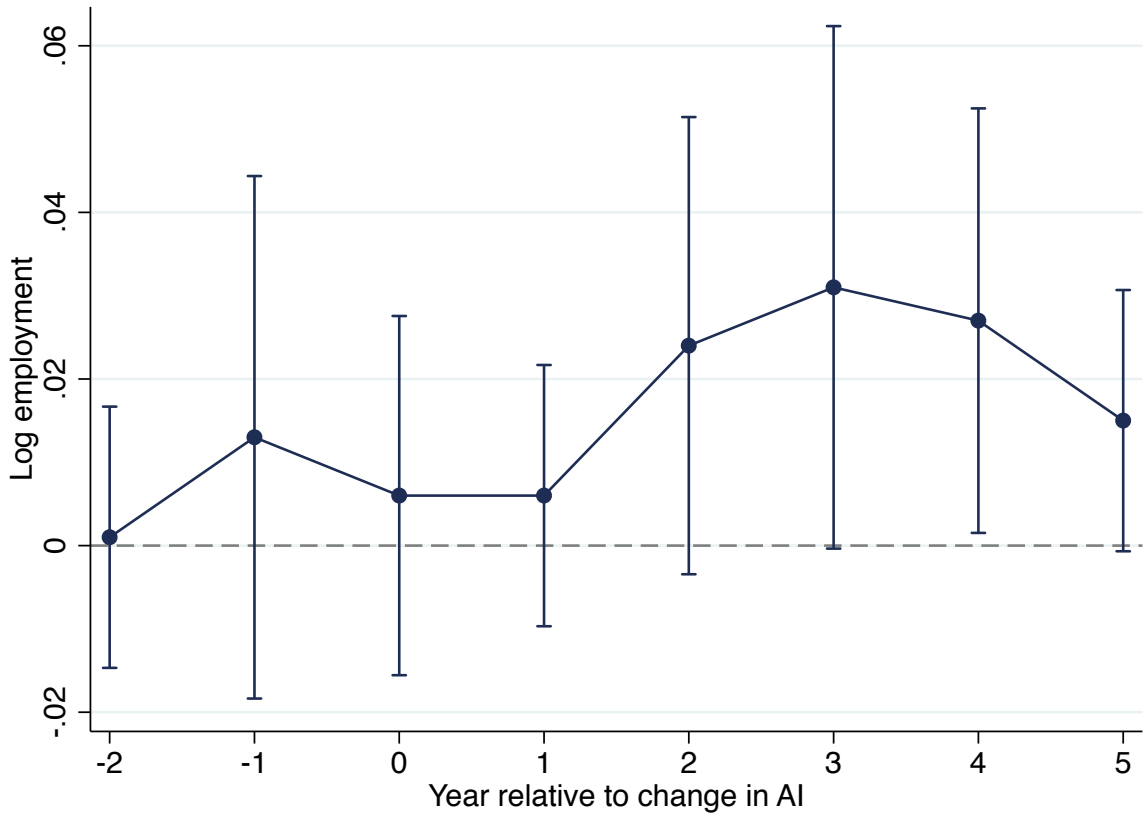

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   - Test: Panel study on dynamic effects shows similar patterns
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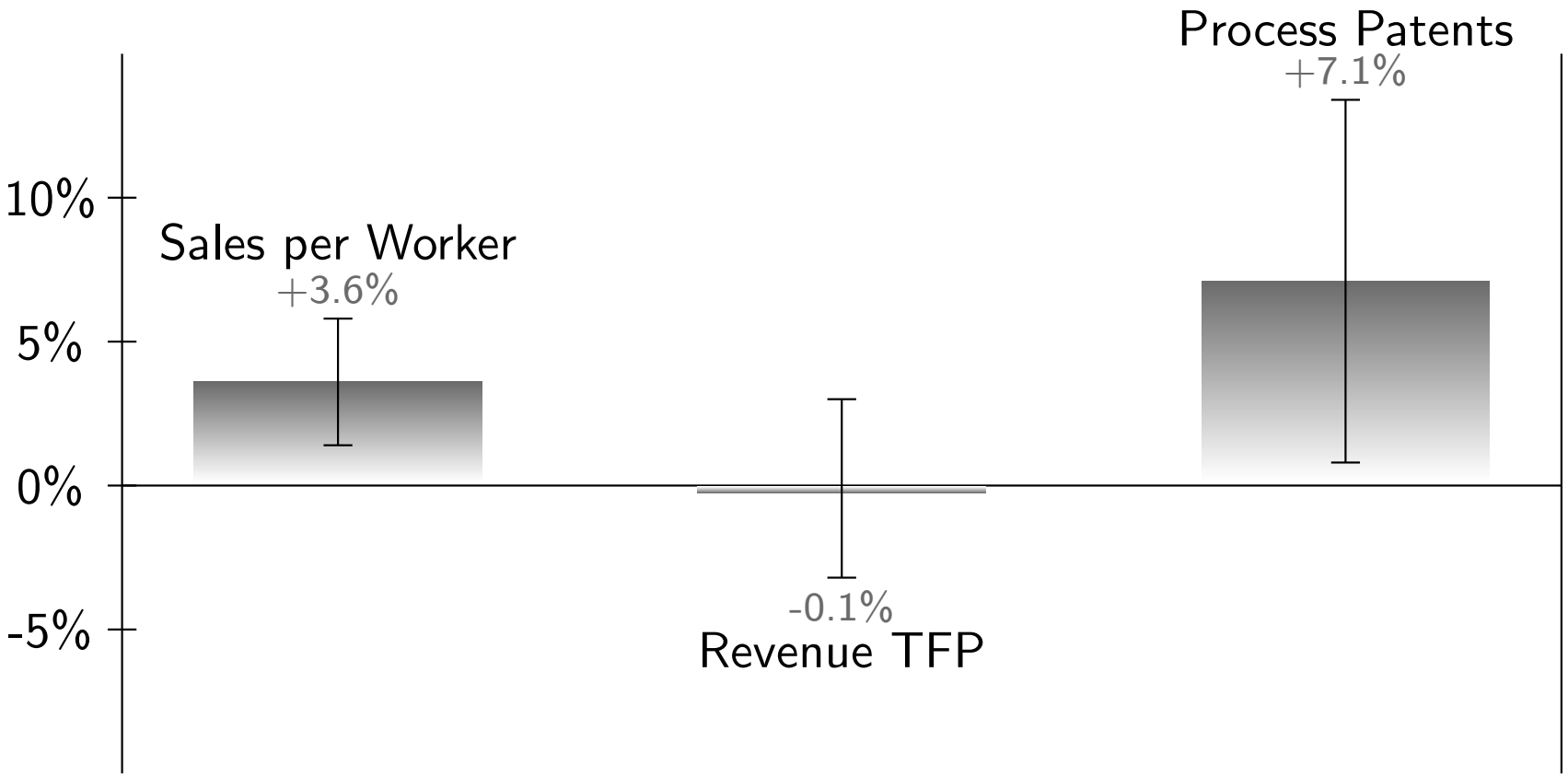
5. Remaining endogeneity concerns
   - Test: Use Instrumental Variables (IV) approach

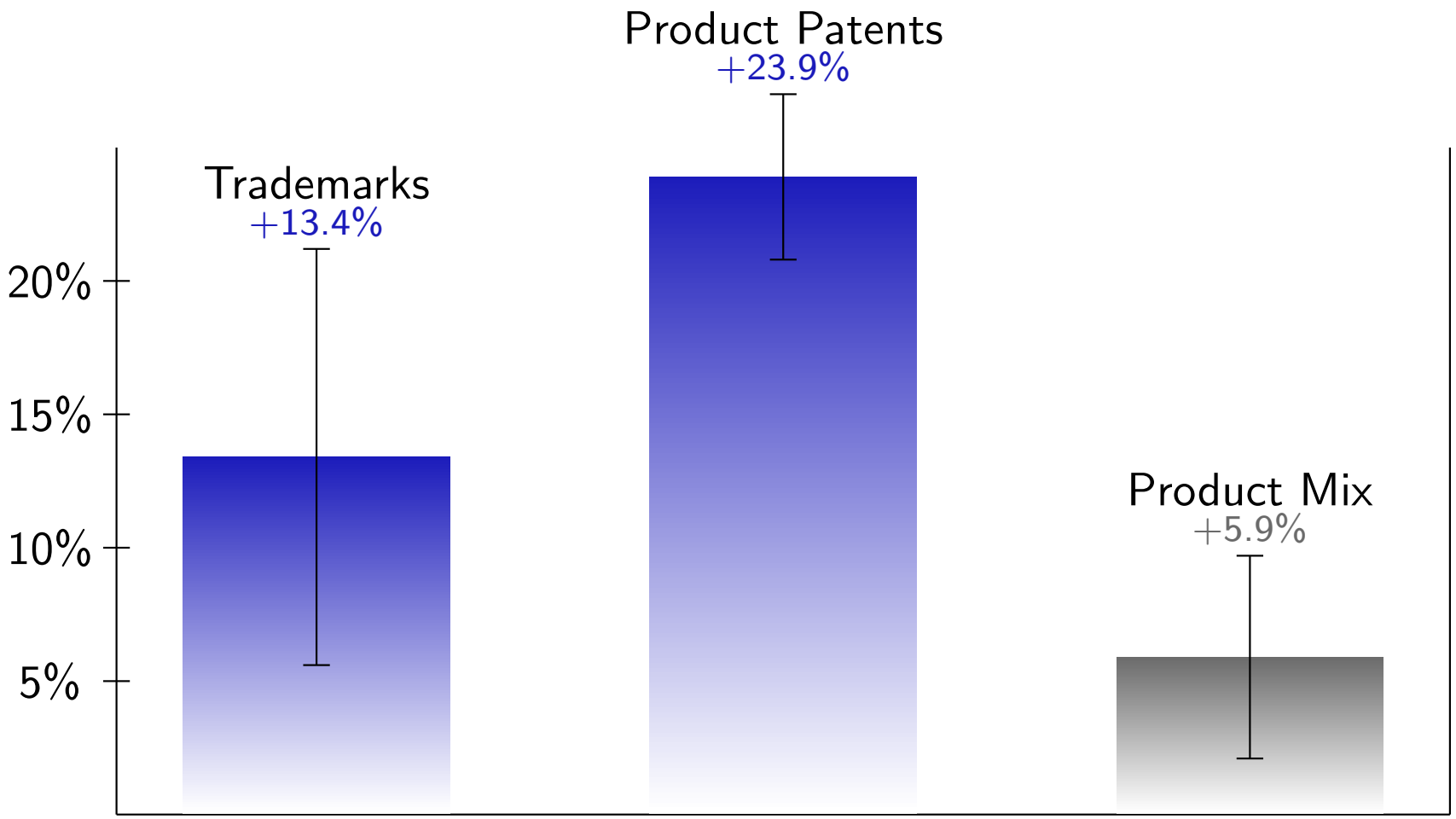
Mechanisms: What is Driving AI-Spurred Growth?

Productivity: sales per worker, revenue TFP, process patents



Mechanisms: What is Driving AI-Spurred Growth?

Product innovation: trademarks, product patents, product mix



How does the Workforce Change with AI?

Babina, Fedyk, He, and Hodson (NBER 2024): Firm Investments in AI Technologies and Changes in Workforce Composition

In most firms, employment **increases** with AI. But does the makeup of the workforce change?

- Do AI-investing firms upskill or replace high-skilled labor?
  - View 1: Facilitate skill-biased technological change, like IT has done
  - View 2: Replace high-skilled labor performing prediction tasks
- How do AI investments change workforce organization?
  - View 1: Increased growth and product scope might increase organizational complexity and management positions
  - View 2: Increase worker autonomy and decentralization due to improved prediction and decision-making

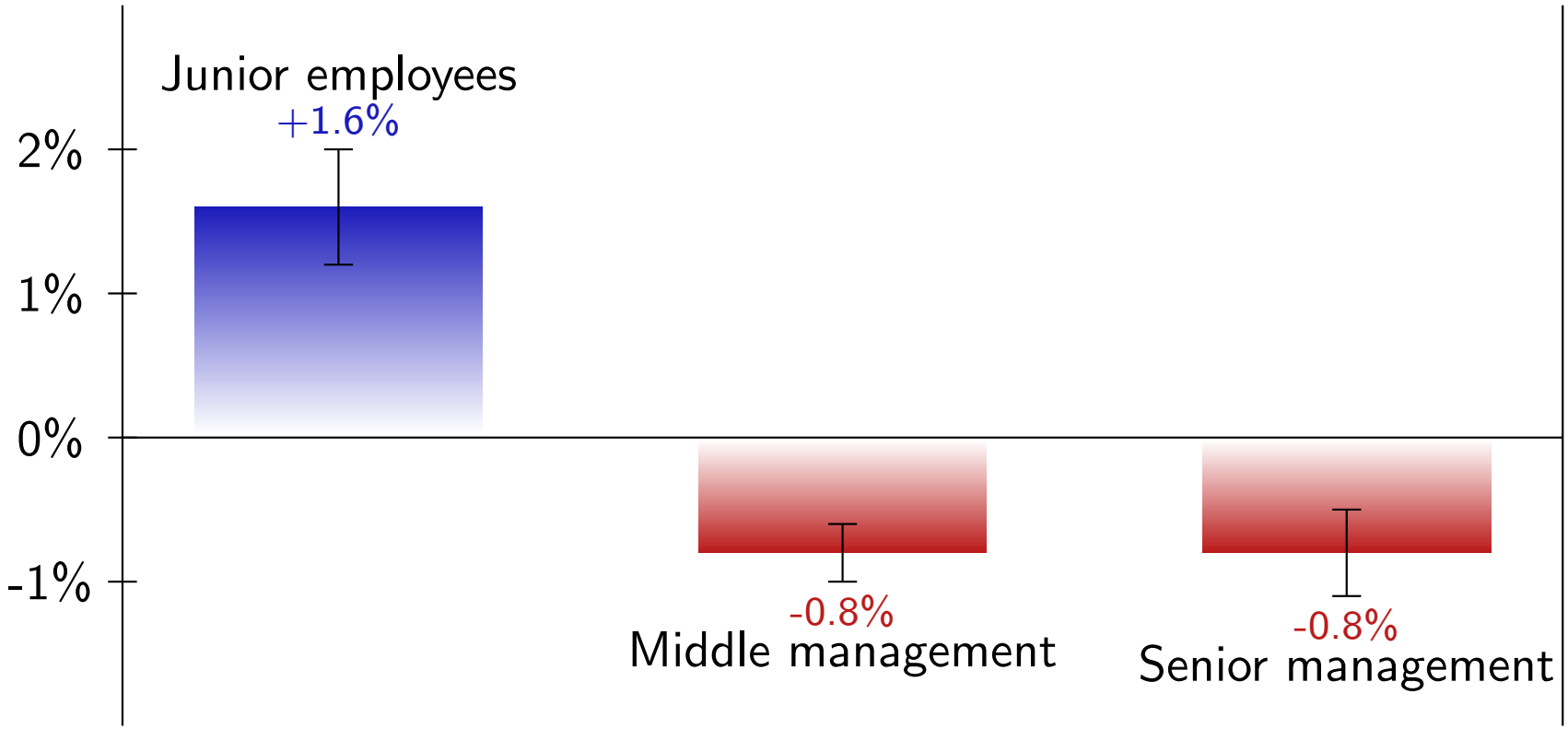
How does the Workforce Change with AI?

Babina, Fedyk, He, and Hodson (2023): Firm Investments in AI Technologies and Changes in Workforce Composition

- Educational attainment:
  - No college degree; college degree; masters degree; doctoral degree
  - **AI ↑ share of college, masters, doctoral degrees; ↓ no-college**
- Technical specialization:
  - College majors: STEM, Social Science, Humanities, Fine Arts, Medicine
  - **AI ↑ STEM workers; ↓ social science and medicine.**
- Technical skills:
  - Skill clusters from BurningGlass (required skills in job postings): IT, Data Analysis, Finance, HR, Legal, etc.
  - **AI ↑ IT and analysis; ↓ finance, supply chain, and maintenance**

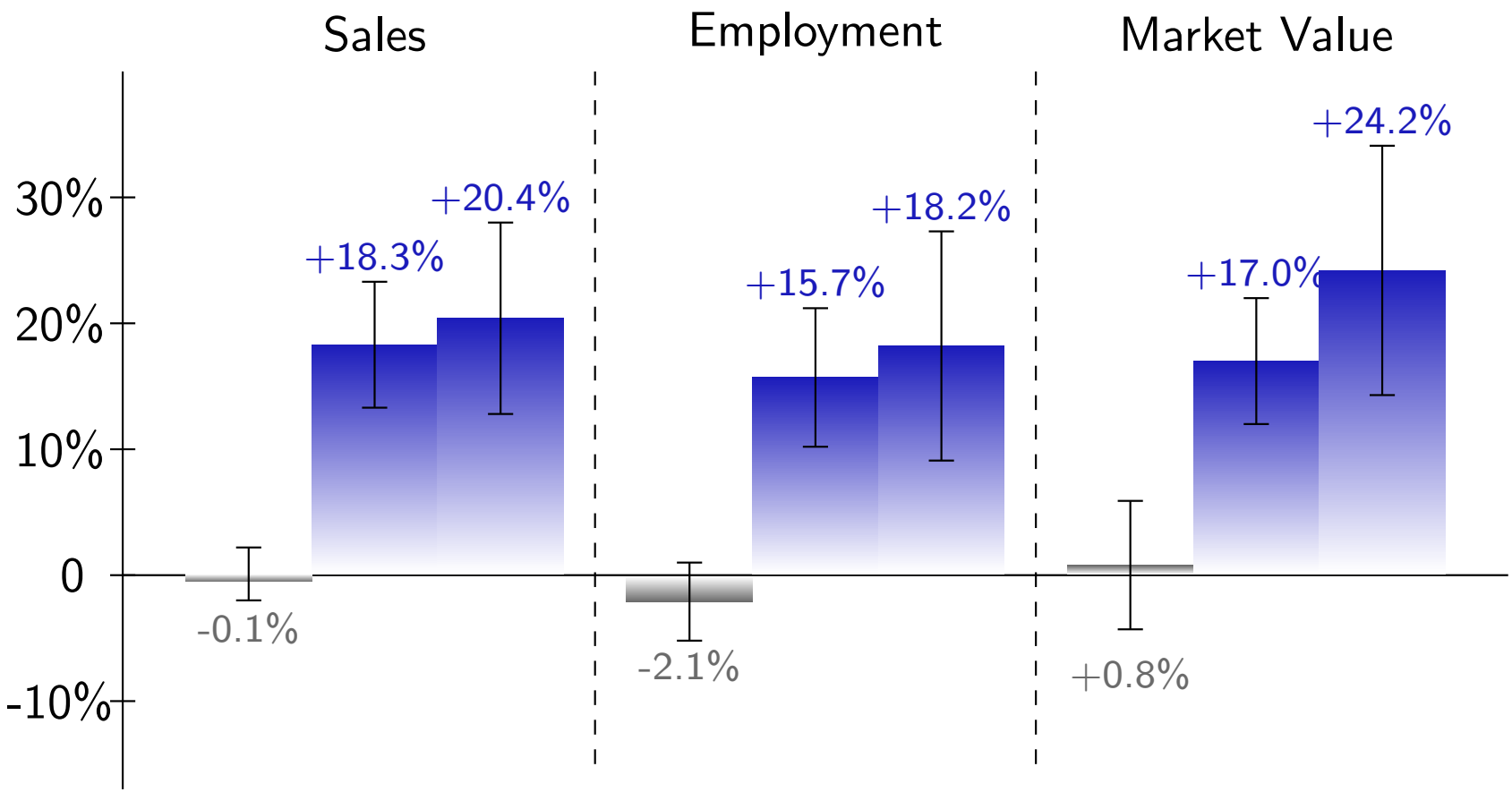
How does the Workforce Change with AI?

Changes in hierarchical composition with firms' AI investments:

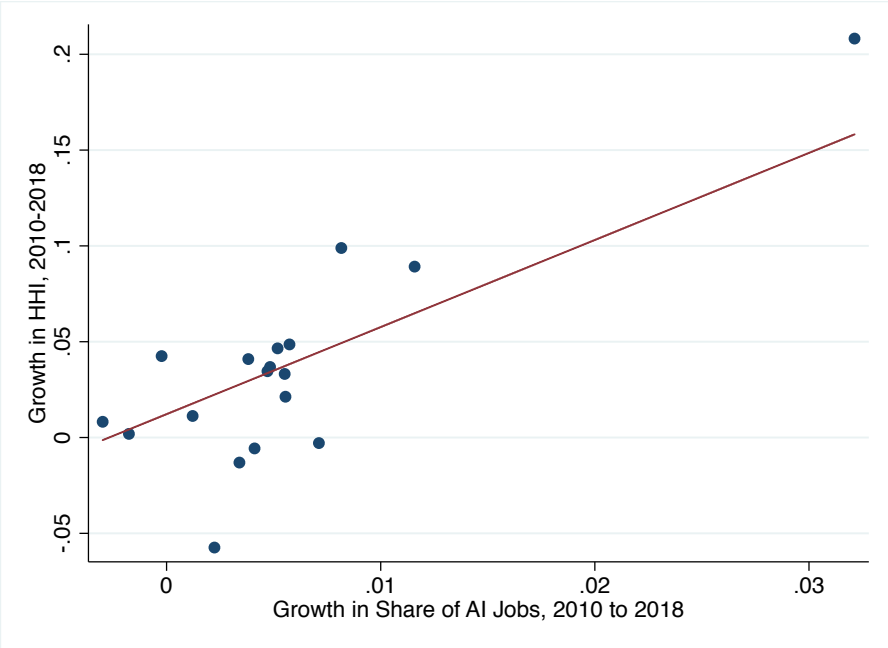


Macro Implications: AI-Fueled Growth is Concentrated among the Largest Firms

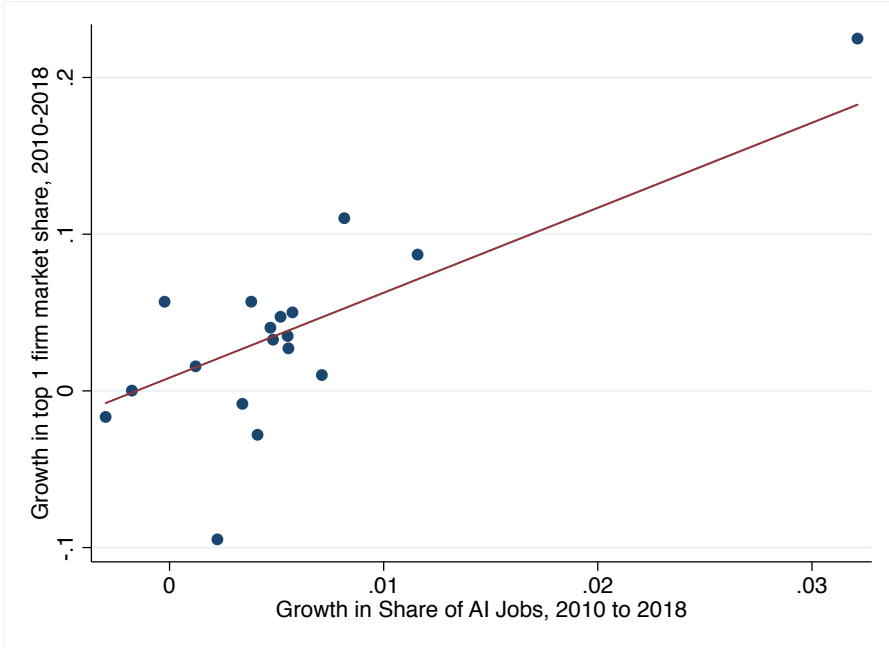
Babina, Fedyk, He, and Hodson (JFE 2024): AI, Firm Growth, and Product Innovation



AI Investments Linked to Increased Industry Concentration



(a) HHI



(b) Top Firm Market Share

Conclusion

- Investing in AI does benefit firms!
  - In some industries (e.g., audit), AI can automate key tasks
  - In most industries, AI spurs growth through product innovation
  - In most industries, AI is actually complementary to human employment
- Firms' workforces change with AI investments
  - Workforce becoming more educated and technical (STEM degrees)
  - But the hierarchy is flattening—AI-investing firms are moving towards more deputized high-skilled individual contributors
- "Dangers of AI"
  - Is AI reducing jobs? NO
  - Does AI mean workers need to upskill? YES
  - + AI is making industries more concentrated