Discussion of “Quantifying the Impact of AI on Productivity and Labor Demand: Evidence from U.S. Census Microdata”

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*The views expressed herein do not necessarily represent the position of the Federal Reserve Bank of Philadelphia, the Federal Reserve System, or the Federal Reserve Board of Governors.

Background

- AI: Field of computer science, to develop systems “that respond to stimulation consistent with traditional responses from humans” (Shubhendu and Vijay, 2013)
- More AI patents in 2014-2018 than in all years before 2014.
- Some optimism that implementation of AI will mitigate (or reverse) productivity slowdown experienced since 1973 (excepting 1995-2005 boom).
- A subset of *automation*: the replacement of human-performed tasks by automatic systems.
  - Led to a reduction in the demand for low-to-middle-skill workers (Autor, Levy, and Murnane, 2003), a reduction in the labor share (Autor and Salomons, 2018; Dao et al., 2017).

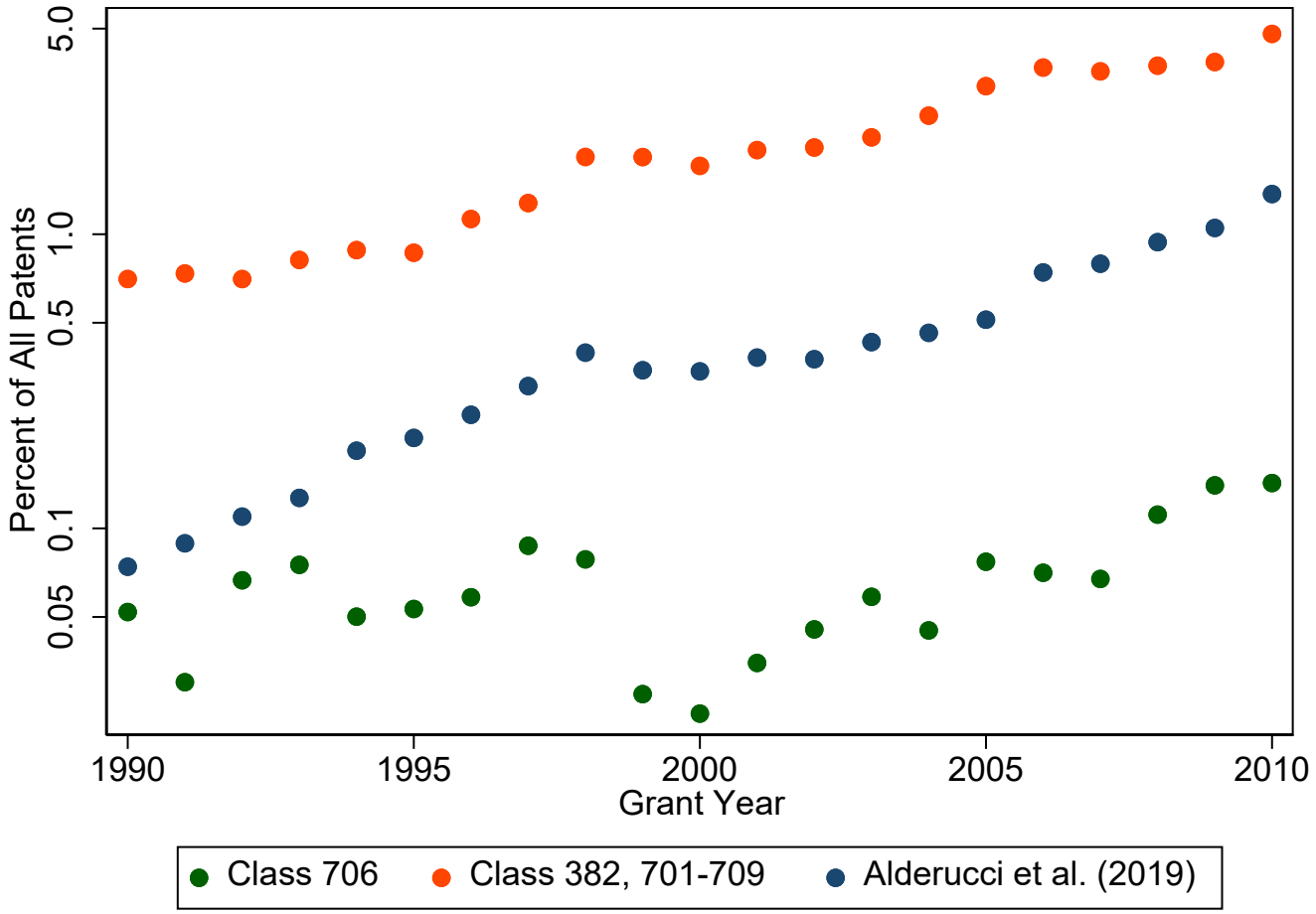
This Paper

- New Measure of AI-Related Patents
  - There are substantially more AI-related patents than those in US Patent Class 706.
- Link patenting data to firm-level U.S. Census data (Census of Manuf., LBD, LEHD)
  - Firms with AI patents are larger, more productive, pay higher wages, dominated by Information/Computer Systems firms (e.g., IBM, Google, Microsoft)
  - Upon receiving first AI patent, firms' employment/revenue growth increases, within-firm income inequality increases.

Outline

- The measure of AI-related patents
- Where is AI innovation likely to be felt?
- The impact of patenting on revenues—comparison to past work.

New Measure of AI-Related Patents



- 382: Image Analysis
- 701: Data Processing – Vehicles, Navigation
- 702: Data Processing – Measuring, Calibrating, Testing
- …
- 706: Data Processing – Artificial Intelligence
- 707: Data Processing – Database, Data Mining, File Management
- 708: Electrical Computers – Arithmetic Processing and Calculating
- 709: Electrical Computers and Digital Processing Systems – Multicomputer Data Transferring

New Measure of AI-Related Patents

- Tremendous amount of effort spent to identify AI-related patents.
- Other possible measures:
  - “Data Processing”: Class 382 + Class 701-709
  - Mann and Puttman (2018): Analysis of patents’ text to determine which patents are automation-related.
  - What distinguishes AI from “Data Processing” or “Automation”?
    - Both the set of Data Processing patents and the narrower class of AI patents are “high impact” (Kogan et al. , 2017) and are “newer”.

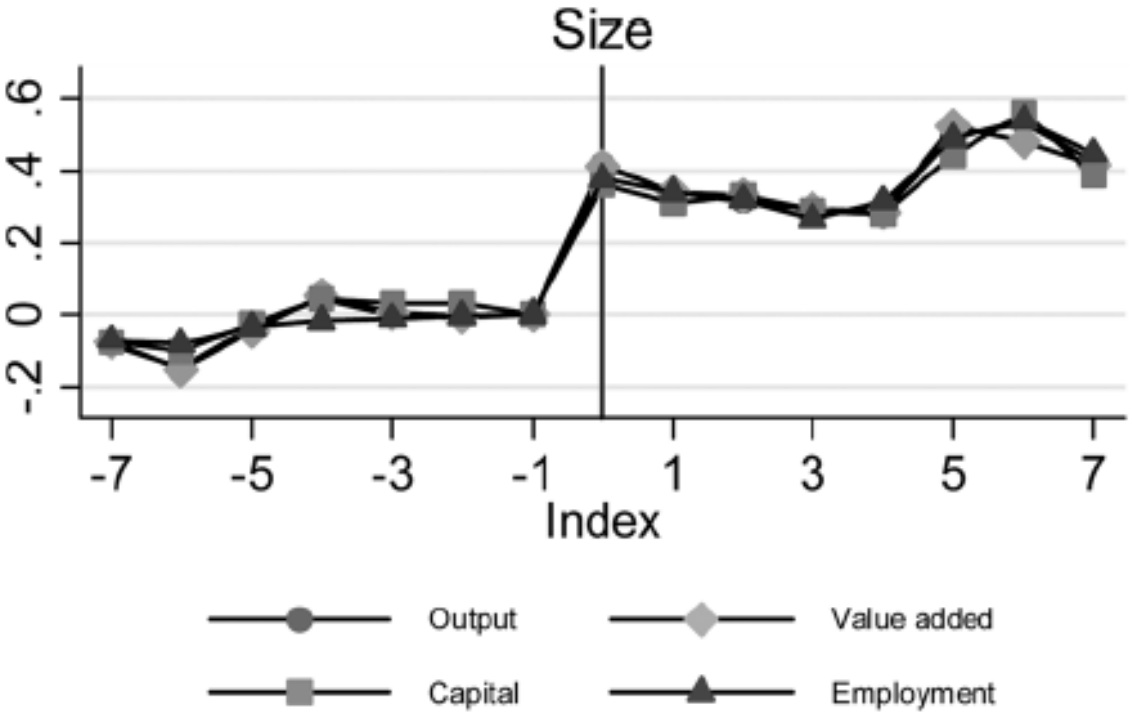
New Measure of AI-Related Patents: Suggestions

- Use text within the patent, or citations, to classify the *application* of AI (similar to Lybbert and Zolas, 2014)
  - IBM's patent #6390097 "A method and system for providing artificial intelligence for planning and risk assessment of surgical paths to a tumor in an organ." (cited by class=128, surgery, patents)
  - Microsoft's patent #6330554: "… may be used to… target marketing information to users based on user inputs."
- Other possible classifications: The benefits of AI:
  - Bessen et al. (2019) ask AI-developing firms whether their technology (i) "makes better predictions or decisions", (ii) "manage or understand data better", (iii) "gain new capabilities to improve services or provide new products" , (iv) "automate routine tasks", etc…
- It would be very useful to know how the nature AI is changing over time
- So would a publicly available mapping between patent numbers and the paper's classification of AI-ness

Where is AI innovation likely to be felt?

- Stiroh (2002): “Information Technology and the U.S. Productivity Revival: What Do the Industry Data Say?”
  - Between 1987-1995 and 1995-2000, labor productivity growth in IT-producing industries by 4.4 pp
  - Between the same two periods, labor productivity growth in *IT-using* industries increased by 1.5 pp
  - IT producing industries are small (4 percent of employment in SIC 35, 36); most of the late 90s acceleration occurs in industries *using* the new technologies.

Comparison to Balasubramanian and Sivadasan (2011)



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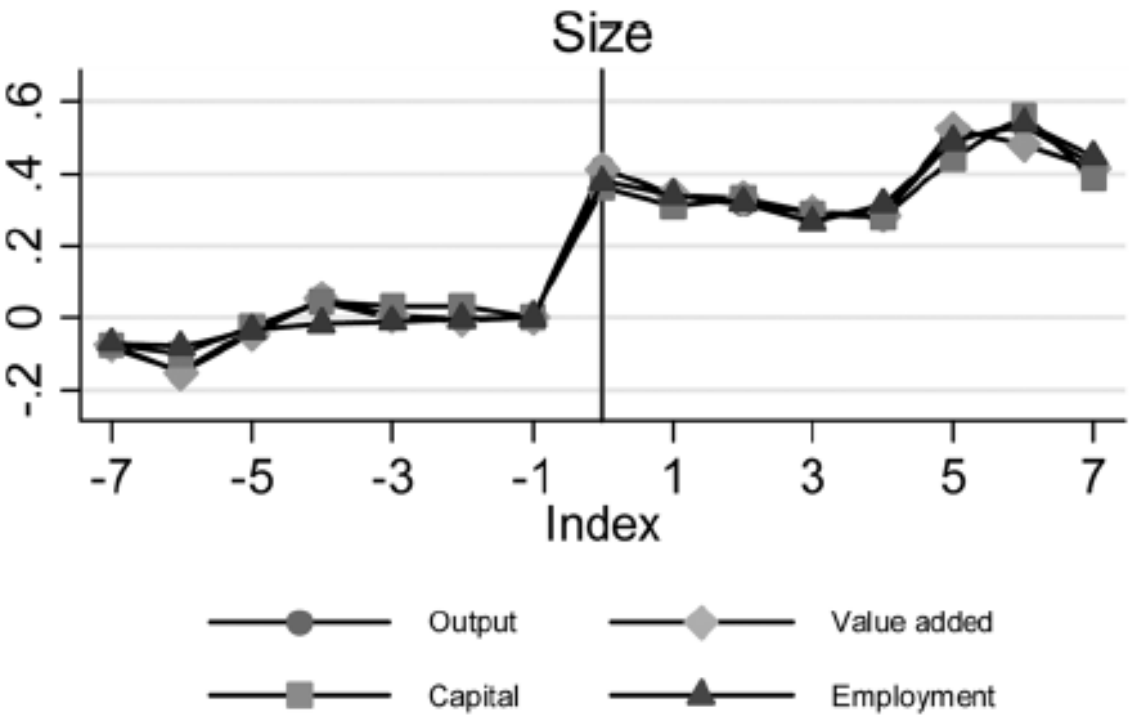

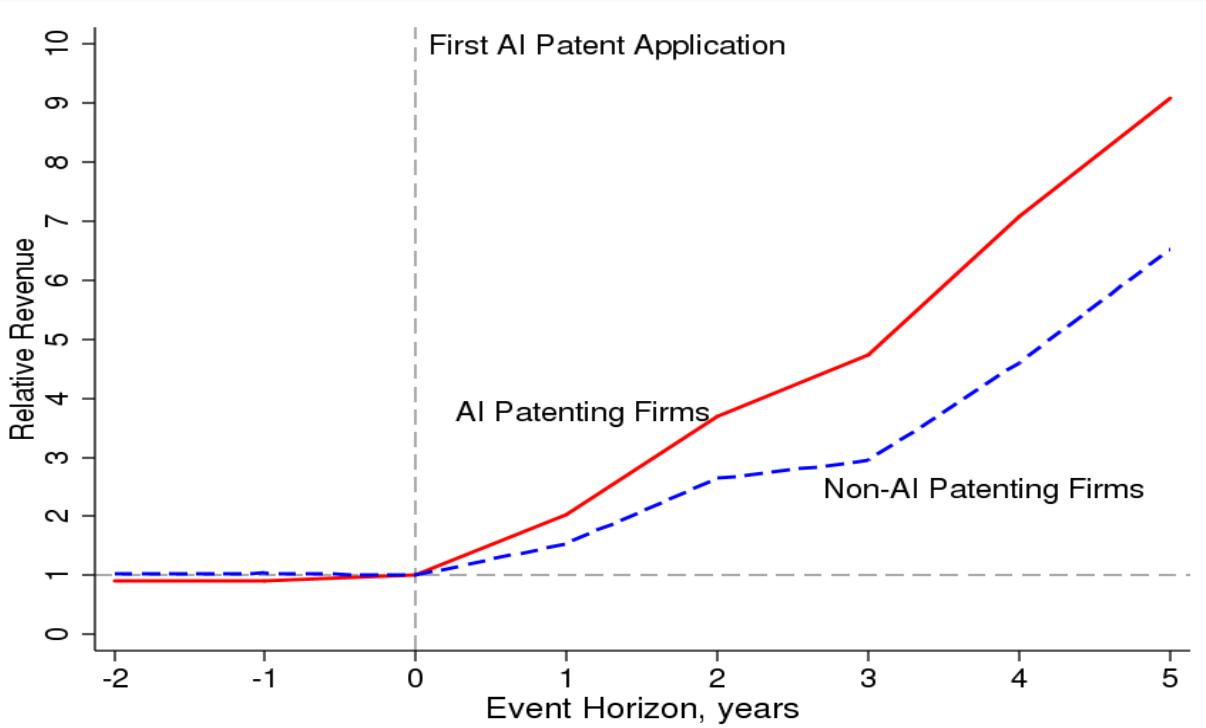

Figure 8. Pre/Post AI Patent Revenue Growth

- 50 percent figure similar to results in Farre-Mensa, Hedge, Ljungqvist (2017, "What is a patent worth? Evidence from the US patent "lottery")
- For manufacturing firms, can check balance on other characteristics.

Summary

- AI innovation is special:
  - Compared to other types of patents, AI-related patents are higher impact
  - Firms that have AI patents are larger and more productive (both in general and compared to other patenting firms)
  - The first AI patent is associated with larger employment, revenue per employee growth than other patents.