Productivity Dynamics and Technology: Developing Evidence from Micro Data

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Any opinions and conclusions expressed herein are those of the author and do not represent the views of the U.S. Census Bureau. All figures use publicly available data and/or previously published results and are cited. Emek Basker, Emin Dinlersoz, John Eltinge, Nathan Goldschlag, Cheryl Grim, John Haltiwanger, Henry Hyatt, and Erika McEntarfer provided helpful discussion.
Productivity Dynamics: Micro to Aggregate
Annual Survey of Manufactures, Economic Census

• Use Census Bureau establishment level data to understand aggregate productivity growth building on Foster, Haltiwanger, Syverson (2008).
• Tremendous productivity heterogeneity within narrowly defined industries
• Reallocation of economic activity across businesses within these narrowly defined industries -- shifting market shares across incumbent businesses or through entry and exit
• Reallocation is (usually) productivity enhancing

Source: presentation of Blackwood et al. (2022)
Declining Dynamism, High Applications

Business Dynamics Statistics, Business Formation Statistics

See also Decker et al. (2016)

See also Bayard et al. (2018)
Productivity Dynamics and Innovation
Longitudinal Business Database


• Using economy-wide measure of labor productivity, find following a 1% change in entry, productivity growth increases but only with a lag of 7-9 years.
Technology Adoption: Artificial Intelligence

Annual Business Survey

• Annual Business Survey (ABS): 800K firms in 2018 (Economic Census year), 300K in most years in partnership with NCSES.

• ABS 2018: Module three questions concerning 9 advanced technologies developed with Brynjolfsson and McElheran.
  • automated-guided vehicles systems, machine learning, machine vision, natural language processing, voice recognition software

• McElheran et al. (2024): adoption is 6% but concentrated in large (and when control for size/industry, young). Startups using AI tend to have a growth-oriented business strategy, venture capital, and recent innovation.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Full</th>
<th>AI Yes</th>
<th>AI No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible Hours</td>
<td>54.5</td>
<td>52.8</td>
<td>54.7</td>
</tr>
<tr>
<td>Best Avenue for Ideas</td>
<td>56.9</td>
<td>61.8</td>
<td>56.7</td>
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<tr>
<td>Funded by Venture Cap</td>
<td>0.9</td>
<td>2.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Startup Cap &lt;25K</td>
<td>38.4</td>
<td>38.2</td>
<td>38.4</td>
</tr>
<tr>
<td>Startup Cap 25K-1M</td>
<td>38.9</td>
<td>42.7</td>
<td>38.8</td>
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<tr>
<td>Startup Cap 1M+</td>
<td>2.5</td>
<td>3.8</td>
<td>2.4</td>
</tr>
<tr>
<td>No Startup Capital</td>
<td>8.4</td>
<td>6.3</td>
<td>8.5</td>
</tr>
<tr>
<td>Process Innovation</td>
<td>19.9</td>
<td>39.3</td>
<td>18.7</td>
</tr>
<tr>
<td>IP Important</td>
<td>19.5</td>
<td>40.4</td>
<td>18.1</td>
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Technology Adoption: Automation

Annual Business Survey

• Annual Business Survey 2019 (300K) module developed with Acemoglu and Restrepo.

• Use, reason, reported labor force impact of: AI, robotics, cloud computing, specialized software, dedicated equipment.

• Acemoglu et al. (2022): 2-3% adoption of AI and robotics; higher worker exposure (large firms).
  • Controlling for size, adoption also higher in younger firms.
  • Employment not changed, skills ↑

• Use of the 5 technologies associated with 11% higher labor productivity. Technology accounts for 16-30% of superstar productivity differential.

<table>
<thead>
<tr>
<th></th>
<th>AI Use</th>
<th>Robotics Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firms</td>
<td>3 %</td>
<td>2 %</td>
</tr>
<tr>
<td>Worker Exposure</td>
<td>13 %</td>
<td>16 %</td>
</tr>
<tr>
<td>Manufacture Worker Exposure</td>
<td>23 %</td>
<td>45 %</td>
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</table>
“Real-Time” Diffusion of Artificial Intelligence

Business Trends and Outlook Survey

- Business Trends and Outlook Survey (BTOS). Biweekly collection of ~ 200,000 businesses.
  - Pairs of questions about recent and expected changes in core concepts (employment, hours, prices) and AI use.
- National: current (3.9%), expected (6.5%)
- Construction: current (1.2%), expected (2.0%)
- Information: current (13.8%), expected (21.8%)

Source: Breaux and Dinlersoz (2023):

Potential Complements to Tech Adoption
Management and Organizational Practices Survey, Dispersion Statistics on Productivity

**Management Practices**
  - Index of structured management practices using 16 questions on monitoring, targets, and incentives.
- Bloom et al. (2019) find structured management practices are positively associated with productivity. Account for about 20% of the variation in productivity.

**Skilled Workers**
- Blackwood et al. (2022) preliminary work on adding worker skills and tasks. Create 5 types of measures using BLS’ Occupational Employment and Wage Statistics; Occupational Information Network (O*NET); share of STEM workers.
  - Industry: within-industry dispersions of productivity and skill are strongly correlated – especially in high tech industries.
  - Micro: coming soon.
Summing Up

• Using Census Bureau micro data shows that one driver of aggregate productivity growth is the reallocation of economic activity from low productivity to high productivity businesses (through changes in shares of incumbents, entry, and exit). Entrants and young businesses are more productive than incumbents.

• Entrants and young businesses are more likely to adopt technology when conditioning on size. But advanced technologies are concentrated in large firms which could feed into the superstar phenomenon.

• Those entrants that do adopt are more likely to have a growth-oriented business strategy.

• Productivity impact of innovation likely to happen with a lag.

• Complementary inputs, such as structured management practices and skilled workers, may be important for technology adoption.
Thank you!

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Additional Slides

Examples of Census Bureau products that can be used to inform research questions into:

• **Demographics**: Decennial (age of population), American Community Survey (mobility of population), Job-to-Job Flows (mobility of workers)

• **Environment**: Community Resilience Estimates, Environmental Impact Frame, Annual Business Survey

• **Global Economy**: Longitudinal Firm Trade Transactions Database (LFTTD), Business Dynamics Statistics-Goods Traders (BDS-GT)
Demographics – Shifting Age Profile
Decennial Census

Figure 2.
(In millions)

Source: U.S. Census Bureau, Census 2000 Summary File 1 (SF1), 2010 Census Summary File 1 (SF1) and 2020 Census Demographic and Housing Characteristics File (DHC).

Demographics – Mobility of People & Workers

American Community Survey, Job-to-Job Flows

Source: Figure from Henry Hyatt using Census Bureau’s J2J and BDS.

Environment -- Impact on Population
Community Resilience Estimates, Environmental Impacts Frame

• Community Resilience Estimates (CRE): Provides national, state, county, and census tract estimates of resilience to stresses including heat.

• Environmental Impacts Frame (EIF): Links together administrative data. A public product will be created.

Environment – Impact on Businesses

Annual Business Survey

• Annual Business Survey: 2023 (800K firms)
• Section H: Sustainability and Climate Impact
• Eleven questions including whether they are tracking carbon emissions and questions about climate events (see right).
De-Globalization, Global Supply Chain

Longitudinal Firm Trade Transactions Database, Business Dynamics Statistics-Goods Trader

- **Longitudinal Firm Trade Transactions Database (LFTTD):** links individual trade transactions to the US firms that make them. The export and import transactions are the universe of trade transactions data collected by the Customs Bureau during the importation or exportation process.

- **Business Dynamics Statistics-Goods Traders (BDS-GT):** provides annual measures of business dynamics by four mutually exclusive goods-trading classifications: exporter only, importer only, exporter and importer, non-trader.

![Figure 1. Share of Firms, Establishments, & Employment by Trader Status U.S. Economy, Average 1992-2019](image)

**Notes:** This figure plots the average share of firms, establishments, and employment in the U.S. economy over 1992-2019 by four mutually exclusive goods-trading classifications (defined in Section 2.2.1). “Non-Trader” are firms that neither export nor import goods in year $t$; “Exporter” are firms that only export goods in year $t$; “Importer” are firms that only import goods in year $t$; “Exporter-Importer” are firms that both export and import goods in year $t$.

**Source:** Handley et al. (2021)
References


References (con’t)


