Direct and Indirect Measures of the Economic Impact of the Digital Economy

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Disclaimer: Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed.

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Goal of Presentation

- Questions:
  - How can we use survey data to target specific questions of interest?
  - How can we leverage existing data to identify sectors affected by the digital economy?
  - How do we develop forward looking uses of big data to measure the digital economy?
- Today:
  - Many-course tasting
  - Brief overview of active and potential projects

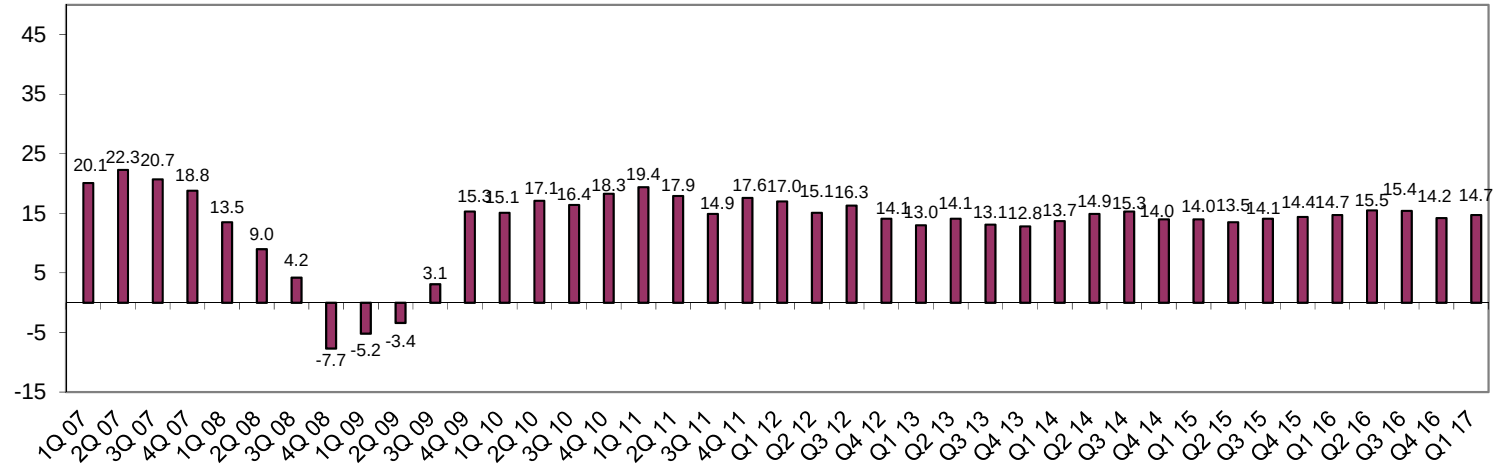
Measurement Agenda

- Survey Data
  - E-Commerce
  - ABS, MOPS, ASM
- Administrative Data
  - BDS, QWI High Tech
  - Gig Economy
  - Occupation Dynamics
- Big Data
  - Firm Technology Profiles
  - Technology Shipments

E-commerce Statistics

- Annual E-Stats publication, since 1999, multi-sector report
  - ASM, AWTS, ARTS, SAS
- Quarterly Retail E-Commerce stats
  - $32 bn (3%) in 2007Q1 to $106 bn (8.5%) in 2017Q1

Percent Change in Quarterly Retail E-commerce Sales from Prior Year 1st Quarter 2007 - 1st Quarter 2017
(Data adjusted for seasonal variation and holiday and trading-day differences)

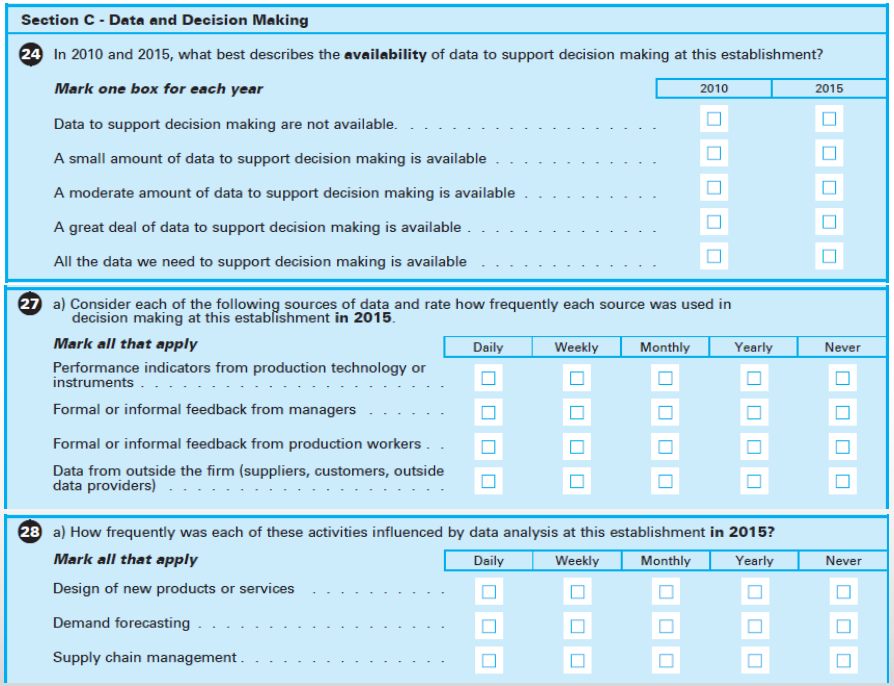


2017 ABS Technology

- Annual Business Survey (ABS) samples ~850,000 firms across all sectors excluding agriculture
- Questions added to measure intensity (slight, moderate, intensive) of use of technologies
  - Augmented reality
  - Digitization of business data
  - Cloud services
  - Machine learning
  - Automation technologies
  - RFID inventory systems

Management and Organizational Practices

- Survey of more than 30,000 establishments in manufacturing (ASM mail sample), 2010 and 2015
- Topics include management practices, organization, data and decision making, and uncertainty
- MOPS 2015 and the use of data:
  1. Availability of data
  2. Use of data
  3. Who chooses data
  4. Sources of data
  5. Activities using data
  6. Reliance on predictive analytics



Section C - Data and Decision Making

24 In 2010 and 2015, what best describes the **availability** of data to support decision making at this establishment?

Mark one box for each year	2010	2015
Data to support decision making are not available.	☐	☐
A small amount of data to support decision making is available	☐	☐
A moderate amount of data to support decision making is available	☐	☐
A great deal of data to support decision making is available	☐	☐
All the data we need to support decision making is available	☐	☐

27 a) Consider each of the following sources of data and rate how frequently each source was used in decision making at this establishment **in 2015**.

Mark all that apply	Daily	Weekly	Monthly	Yearly	Never
Performance indicators from production technology or instruments	☐	☐	☐	☐	☐
Formal or informal feedback from managers	☐	☐	☐	☐	☐
Formal or informal feedback from production workers	☐	☐	☐	☐	☐
Data from outside the firm (suppliers, customers, outside data providers)	☐	☐	☐	☐	☐

28 a) How frequently was each of these activities influenced by data analysis at this establishment **in 2015?**

Mark all that apply	Daily	Weekly	Monthly	Yearly	Never
Design of new products or services	☐	☐	☐	☐	☐
Demand forecasting	☐	☐	☐	☐	☐
Supply chain management	☐	☐	☐	☐	☐

2018 ASM Industrial Robotics

- Industrial robot is an automatically controlled, reprogrammable, and multipurpose machine used in industrial automation
- Mobile, stand-alone stations, or integrated into production
- Used in welding, material handling, machine tending, dispensing, and pick and place
- 2018 ASM questions on industrial robots
  - Gross value of robotic equipment
  - Capital expenditures on robotic equip.

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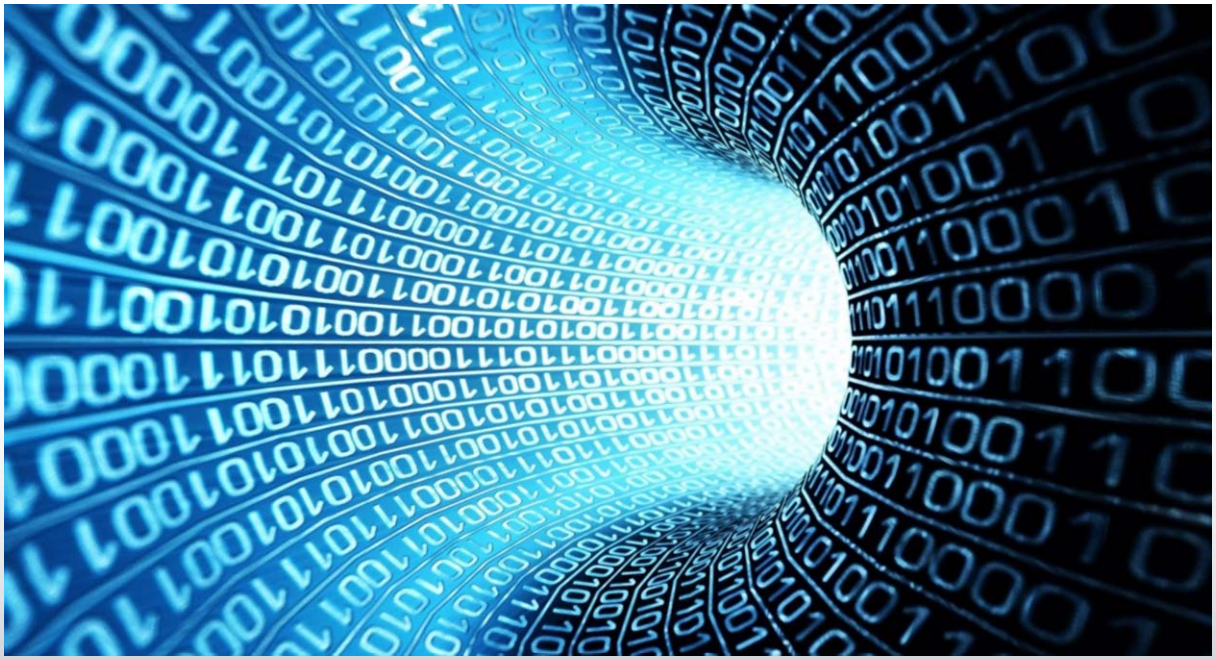
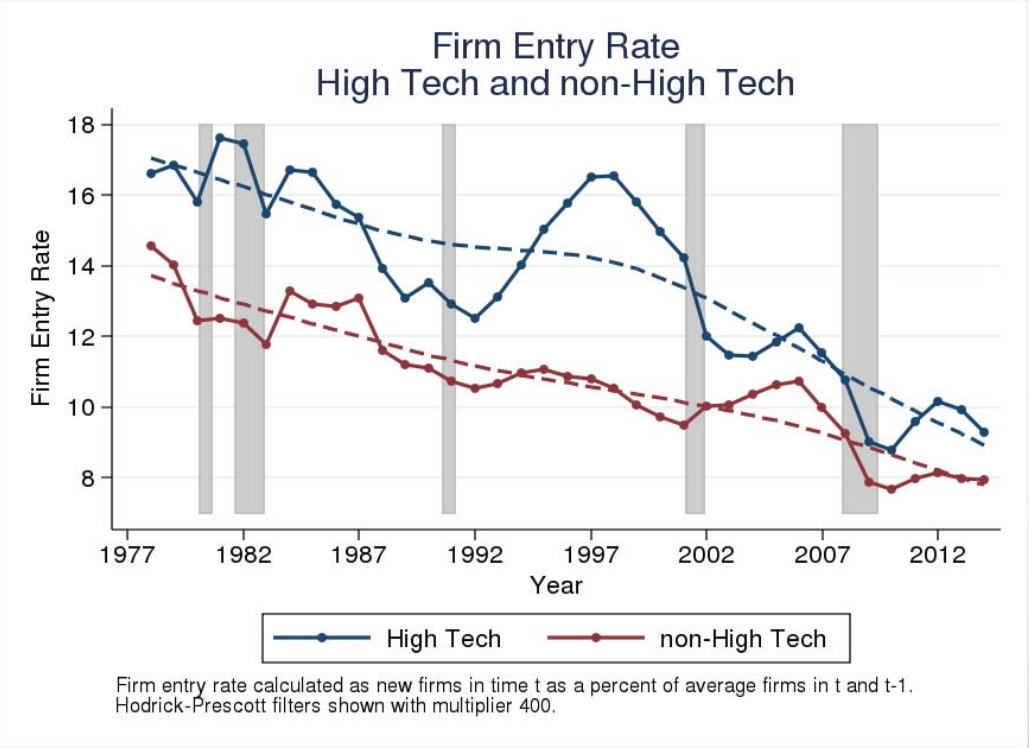


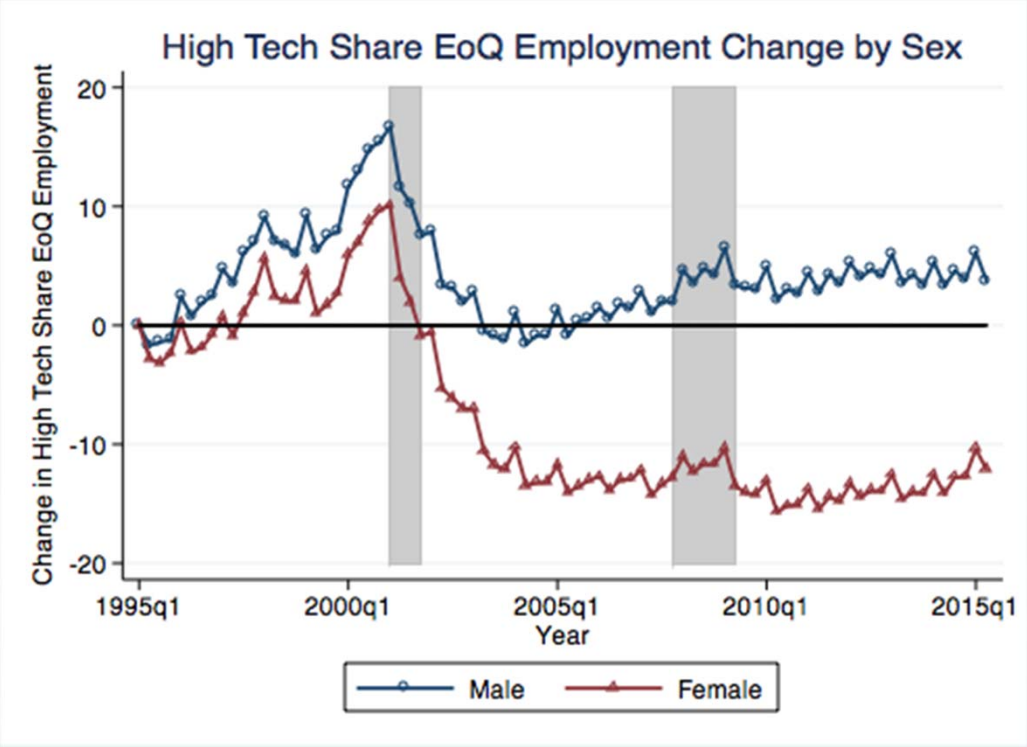
Business Dynamics of High Tech Industries

- High Tech industries using/producing good/services impacting digital economy
- Goldschlag & Miranda (2016) update Hecker (2005)
  - OES STEM employment concentration
  - Includes gas extraction, manufacturing, information, and professional services
- Use that classification to generate statistics from LBD/BDS administrative data

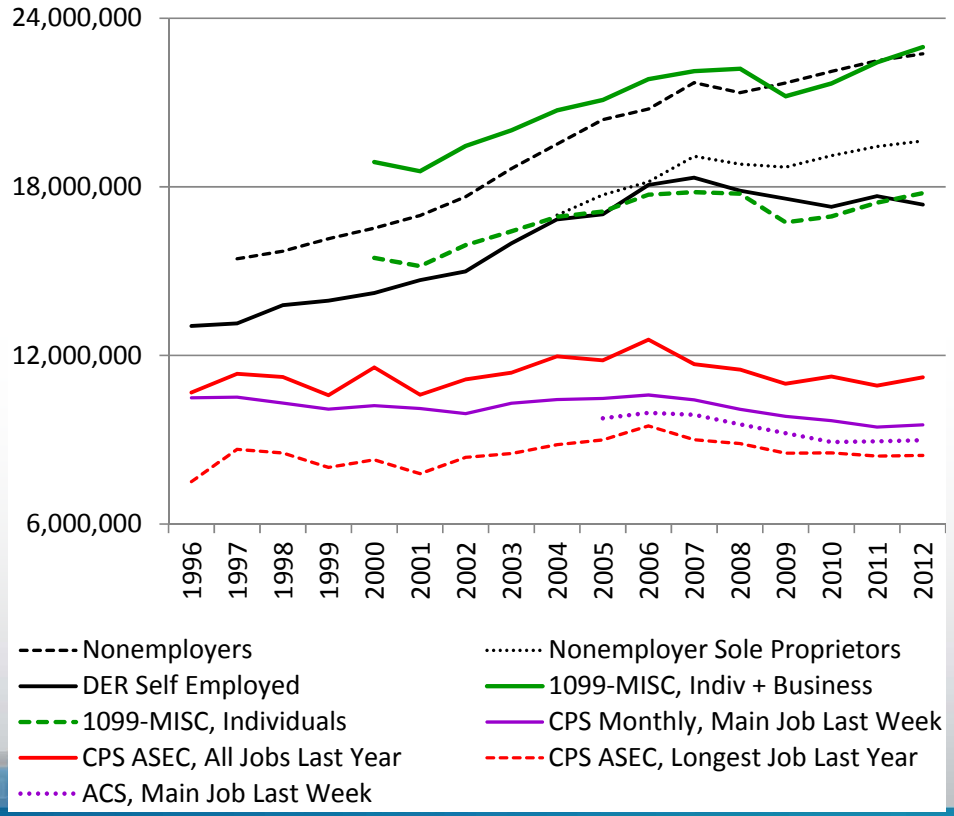


High Tech Employment Dynamics

- LEHD infrastructure provides
  - Demographics and dynamics in HT [QWI]
  - Fine geographic details [QWI]
  - Sources of employment flows (geography, industries) [J2J]
- Alternate classification of High Tech industries
  - Direct measures (ACS link to LEHD) to identify industries



Measuring the Gig Economy



- Gig workers are, by definition, self-employed
- The measurement of self-employment differs across household surveys (CPS, ACS) and administrative tax data
- Questions:
  - Who are these workers?
  - Are these 2nd jobs?
  - Are we measuring these jobs in our surveys?

Occupational Dynamics

- Better measures of trends and dynamics of occupational employment (e.g. longitudinal OES)
  - Technology replacing routine manual jobs
  - Examples: self-checkout machines, travel agents
- Promising avenues:
  - Occupational text fields from 1040 tax forms? Bakija, Cole, & Heim (2012)
  - Big data sources such as web-scraped job postings data

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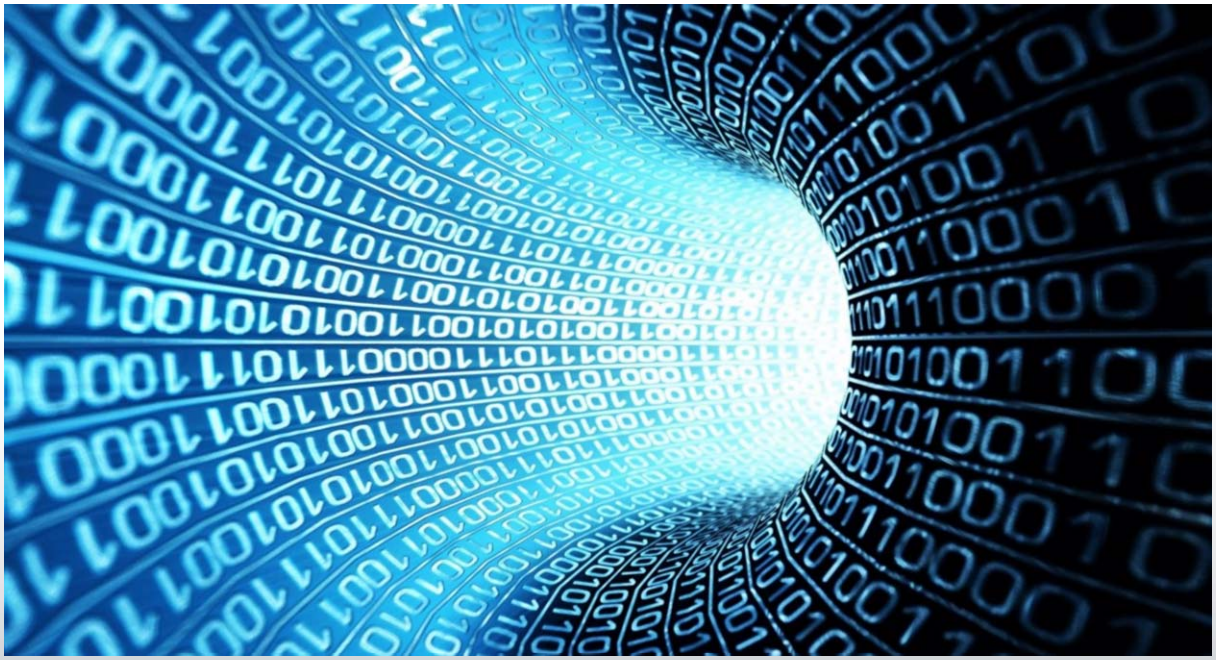

Firm Technology Profiles from Big Data

- Existing project using machine learning techniques to enhance industry classification
  - Easing respondent burden
  - Use public data (Google Places API) to generate industry classifications
- Retooling to measure digital economy
  - Use data from company websites, Google Places API
  - Firm technology profiles (e.g. data, analytics, robotics, artificial intelligence)

Producer Data – Robotics

- The Robotic Industries Association (RIA) collects data from producers of robotics
  - Measures of shipments to industries and geographies
- Partnerships with trade associations such as RIA could enhance/replace survey collections on robotics
- Trade associations and producers may benefit from statistical products using association data, reduce burden

Discussion and Questions

- How do we overcome barriers to leveraging existing administrative data? (1040s, pre-2005 W2s)
- How do we foster relationships with private data generating institutions? (RIA)
- How do we better leverage various types of "digital exhaust" to provide more timely estimates?
  - State business registries (Guzman and Stern 2016)
  - Google searches (Wu and Brynjolfsson 2015, Goel et al 2010)
  - Yelp data (Glaeser, Kim, and Luca 2017)
  - Cell phone data (Calabrese, Lorenzo, Ratti 2011)
  - Other sources? Cloud computing?
- How do we standardize the way we ingest and integrate non-traditional data?
- How do non-traditional data impact disclosure?