Robotics, Automation and the Economy

Rob Seamans

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Why Do We Care?

- Automation → Productivity growth
  - Bloom, Sadun, Van Reenen (AER 2012)

- Industrial robotics are type of automation, so Robots→(?)Growth
  Graetz & Michaels (2015): 0.36 to annual productivity growth

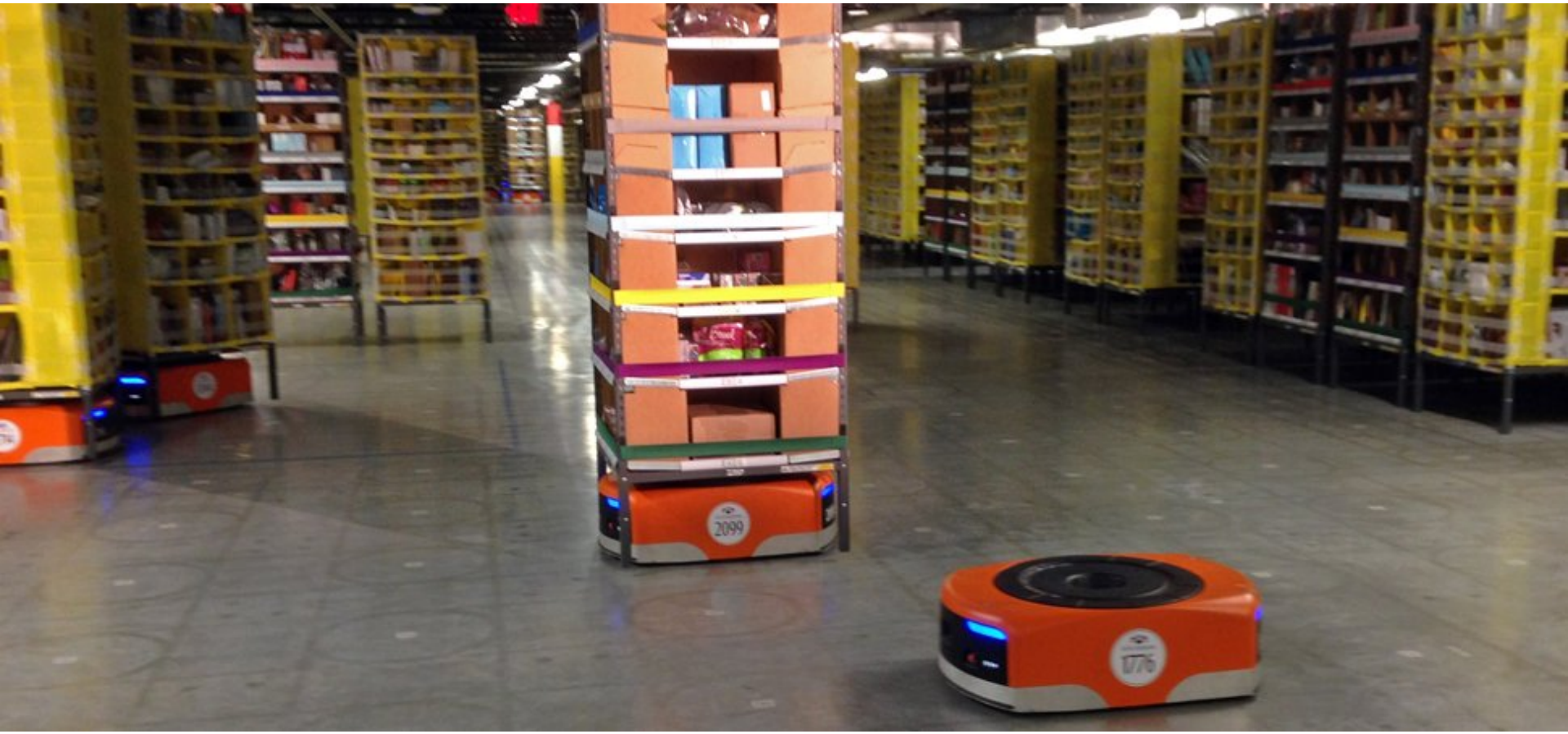
- Industrial robotics can complement or substitute for labor
  - At the industry level and at the occupation level

- Timely: recent popular press interest, July 2015 *JEP* on automation, ongoing NAS study (Brynjolfsson and Mitchell)

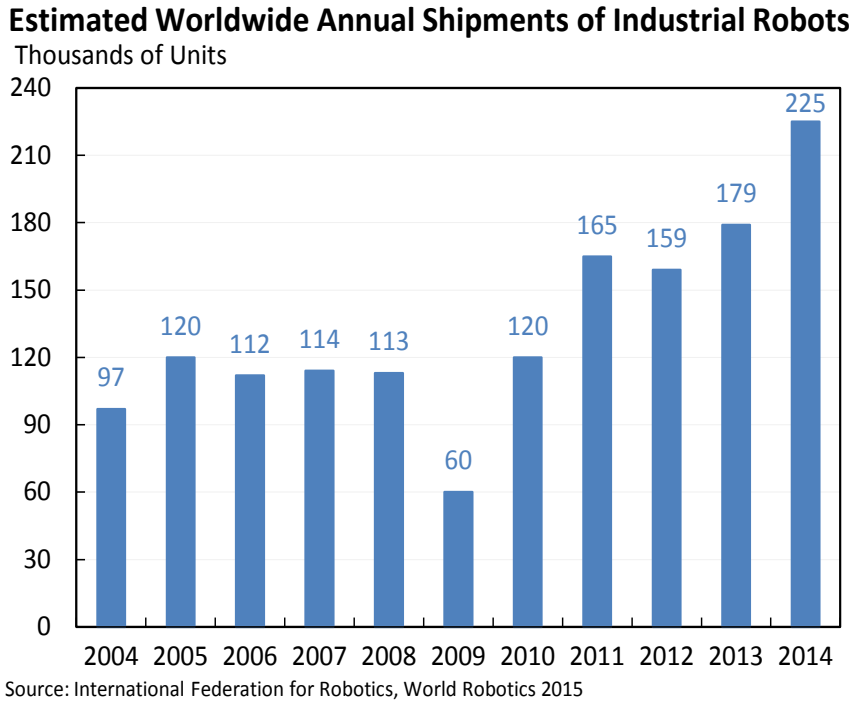
- 2016 *Economic Report of the President*, Chapter 5 (Technology and Innovation)

Automotive Assembly Line

Automated Warehouse Systems



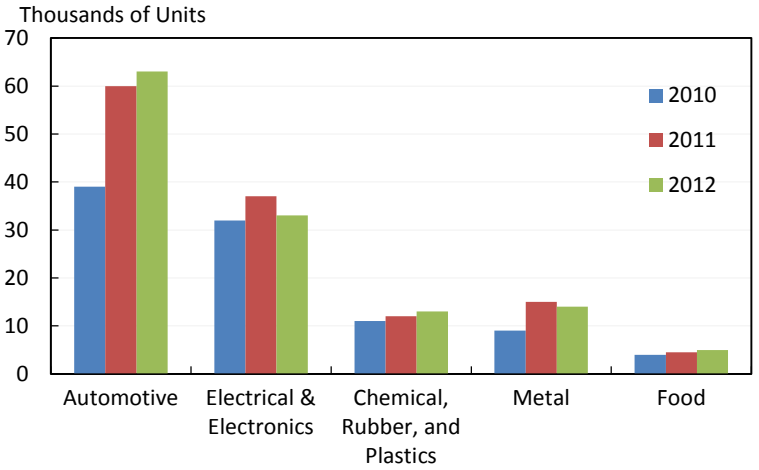
Increase in Worldwide Robotics Shipments



- The Boston Consulting Group (2014) has estimated that worldwide spending on robotics will be $26.9B in 2015 and will rise to $66.9B by 2025.
- Annual industrial robotics shipments have nearly doubled since 2010.

Automotive Leads All Industries

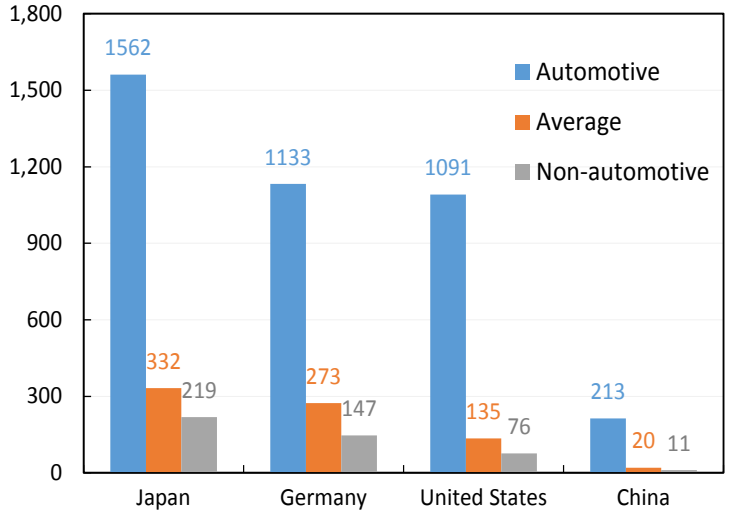
Estimated Annual Supply of Industrial Robots by Main Industries: 2010-2012



Source: International Federation for Robotics, World Robotics 2014

Robot Density: Automotive vs. Non-automotive (2012)

Number of Robots per 10,000 Workers

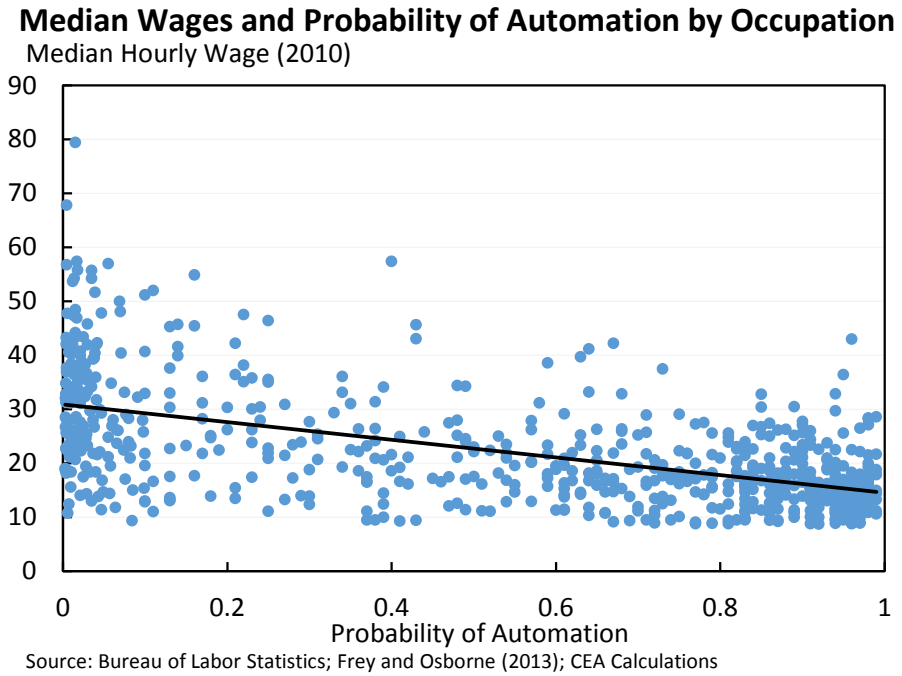


Source: Axium Solutions; International Federation for Robotics

- Automotive industry leads other industries, in number and number-per-worker.
- Increase since 2010 seems pronounced in automotive.
- Japan leads Germany and U.S.

Link between Occupational "Prob. of Automation" and Wages

Podiatrists, civil engineers, clergy interior designers, HR managers



Tax preparers, telemarketers, cashiers, office clerks

- Subjective, forward-looking measure (Frey and Osborne 2013)
- Occupations that are easier to automate have lower wages.
  - E.g., low reliance on manual dexterity, originality/creativity, social perceptiveness, negotiation and persuasion skills.

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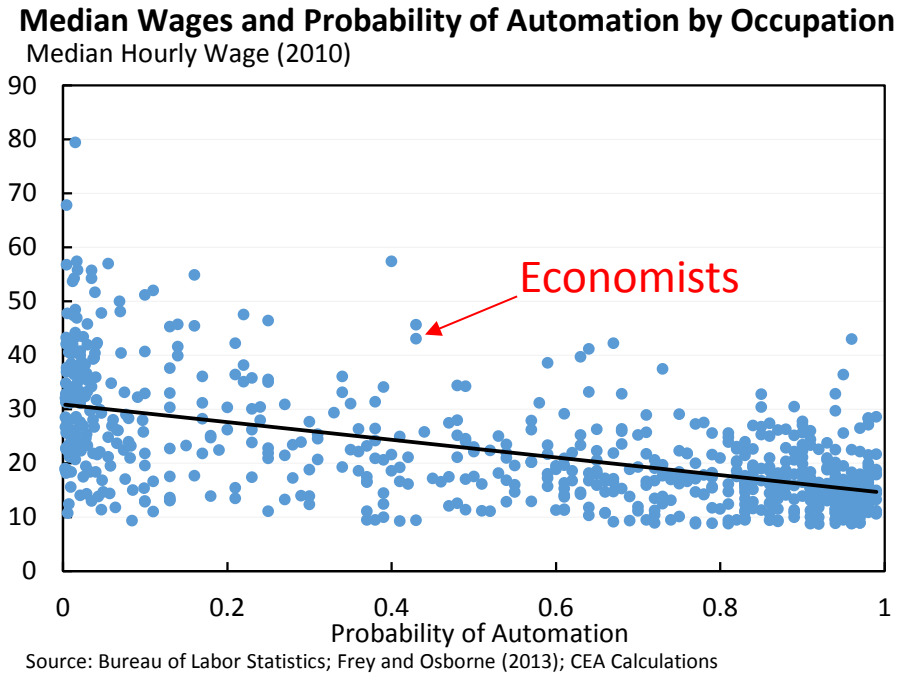

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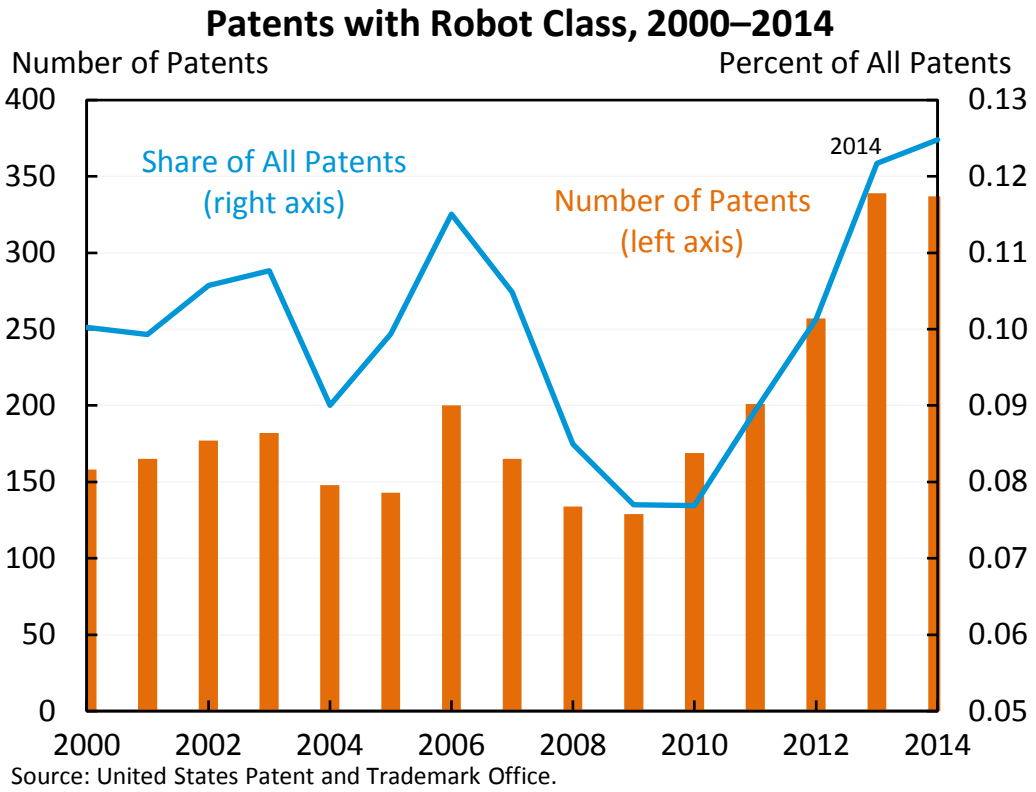
Upstream Activity: Recent Uptick in Patenting Activity



- Patenting activity has started to increase since 2012, both in number and in rate.
- No evidence of concentrated ownership across industries.

Summary So Far

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What We Know

- Robotics “sector” is small ($27B vs. $2T for mfg).
- Recent uptick since 2010 (units, revenues, patents).
- Upstream supply seems competitive.
- Potential for productivity growth, but also potential for labor displacement.

2

What We Hope to Know

- Need a better understanding of when robots (and automation) are substitute vs. complement.
- Need to better characterize the impact by geography.
- More research on effect on productivity and growth

Next Steps

- Researchers: continue to work with existing data
  - IFR shipments (country-industry-year level)
  - Subjective assessments of probability of automation
  - Patent applications w/ “robot” class
  - Census data on ICT, e-Business, etc.

- Researchers: develop (and share) new data sources
  - Systematic U.S. survey
    - e.g. “Last year, how much money did your establishment spend on robotics?” and “Has your establishment considered using robotics instead of human labor?”

- Policymakers: track affected industries and geographies
  - NSTC subcommittee on AI/ML