Digital Technologies: Economic Growth and the Future of Work

Dublin, January 10th 2019

John Van Reenen

Massachusetts Institute of Technology

OUTLINE OF TALK

What are the new digital technologies?

Productivity

Jobs and skills

Labor Share & Superstar Firms

Policy implications

INDUSTRIAL REVOLUTIONS

- First Industrial Revolution: 1760-1840
- Second Industrial Revolution: 1870-1914
- **Third Industrial Revolution: 1996-2004; Digital**
- Fourth Industrial Revolution: ???

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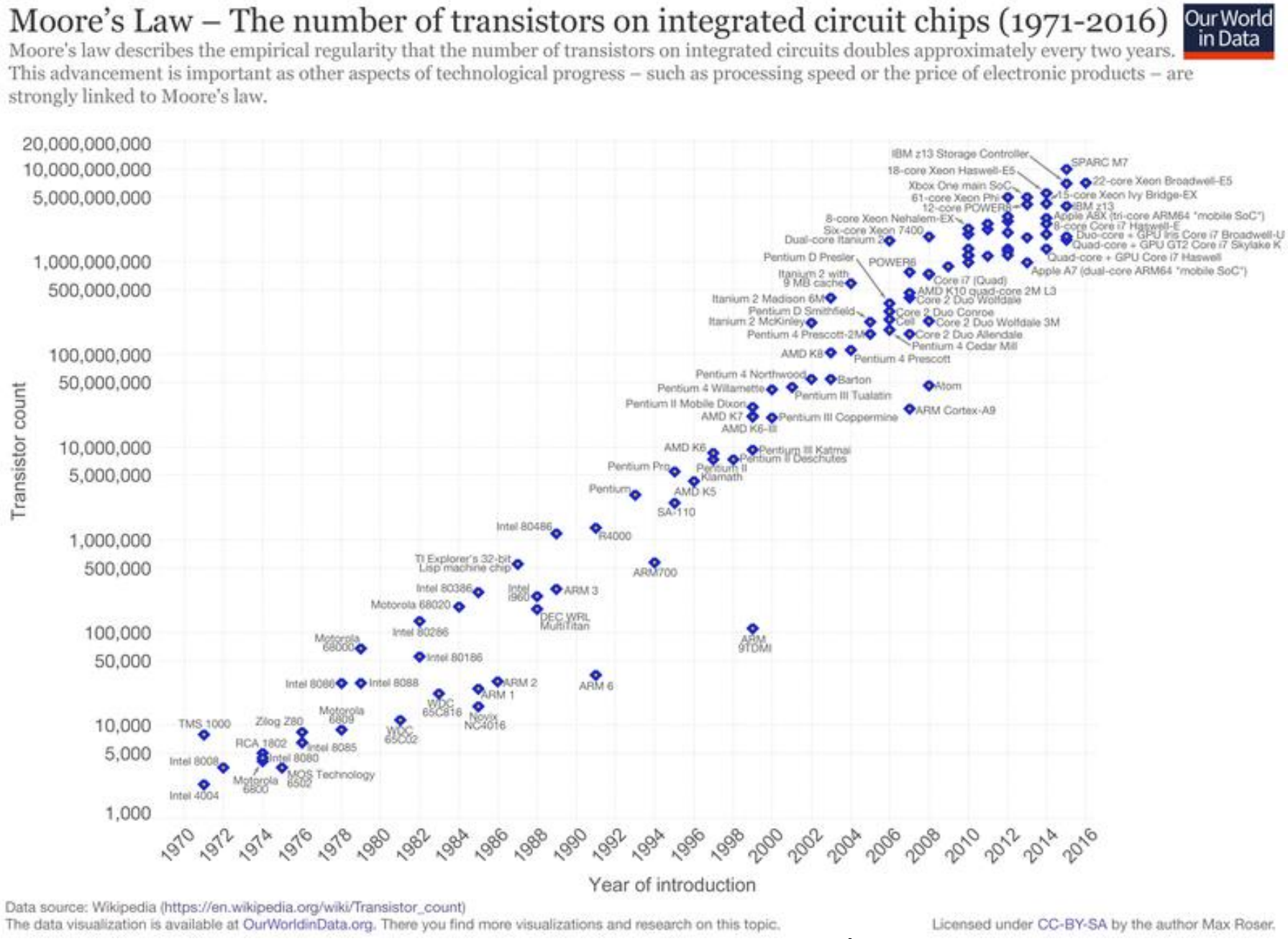
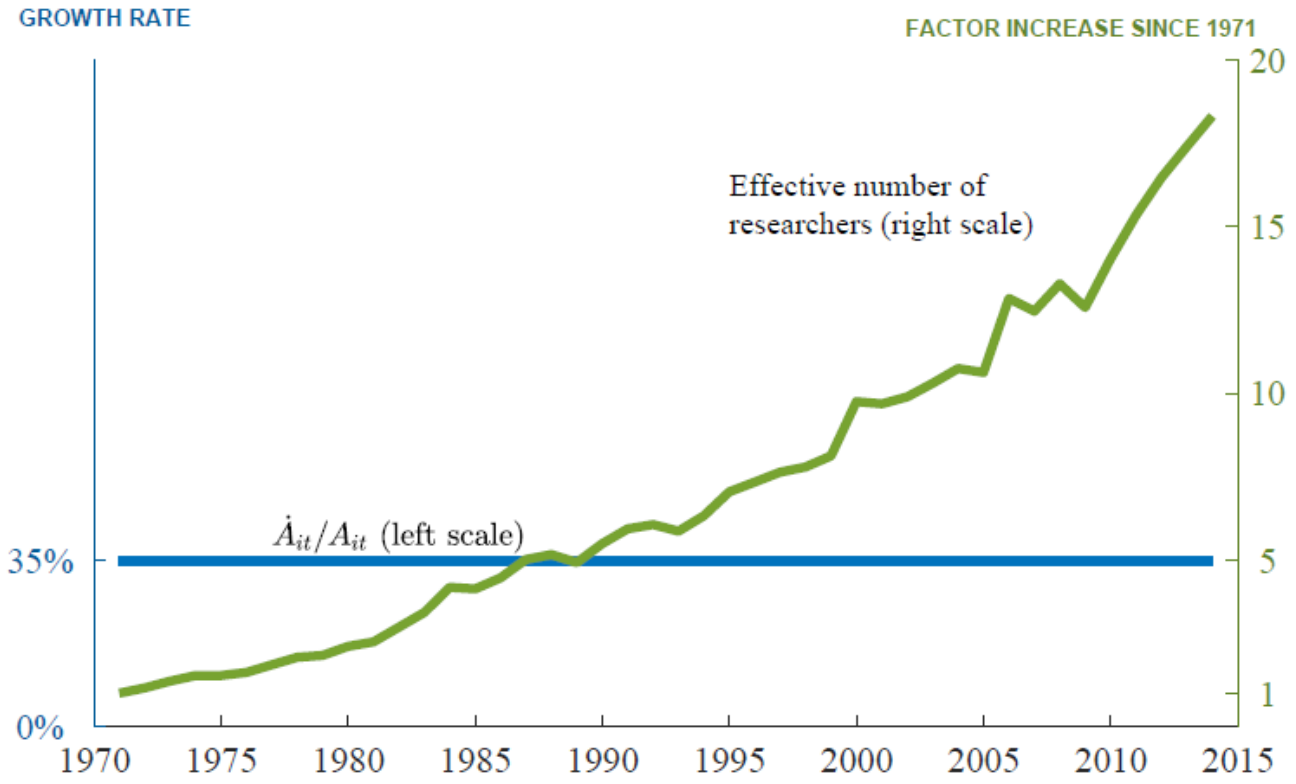
DIGITAL INDUSTRIAL REVOLUTION POWERED BY MOORE'S LAW



Data source: Wikipedia (https://en.wikipedia.org/wiki/Transistor_count)
The data visualization is available at OurWorldinData.org. There you find more visualizations and research on this topic.

Stable 35% p.a growth in semiconductor productivity required 18x growth in # researchers

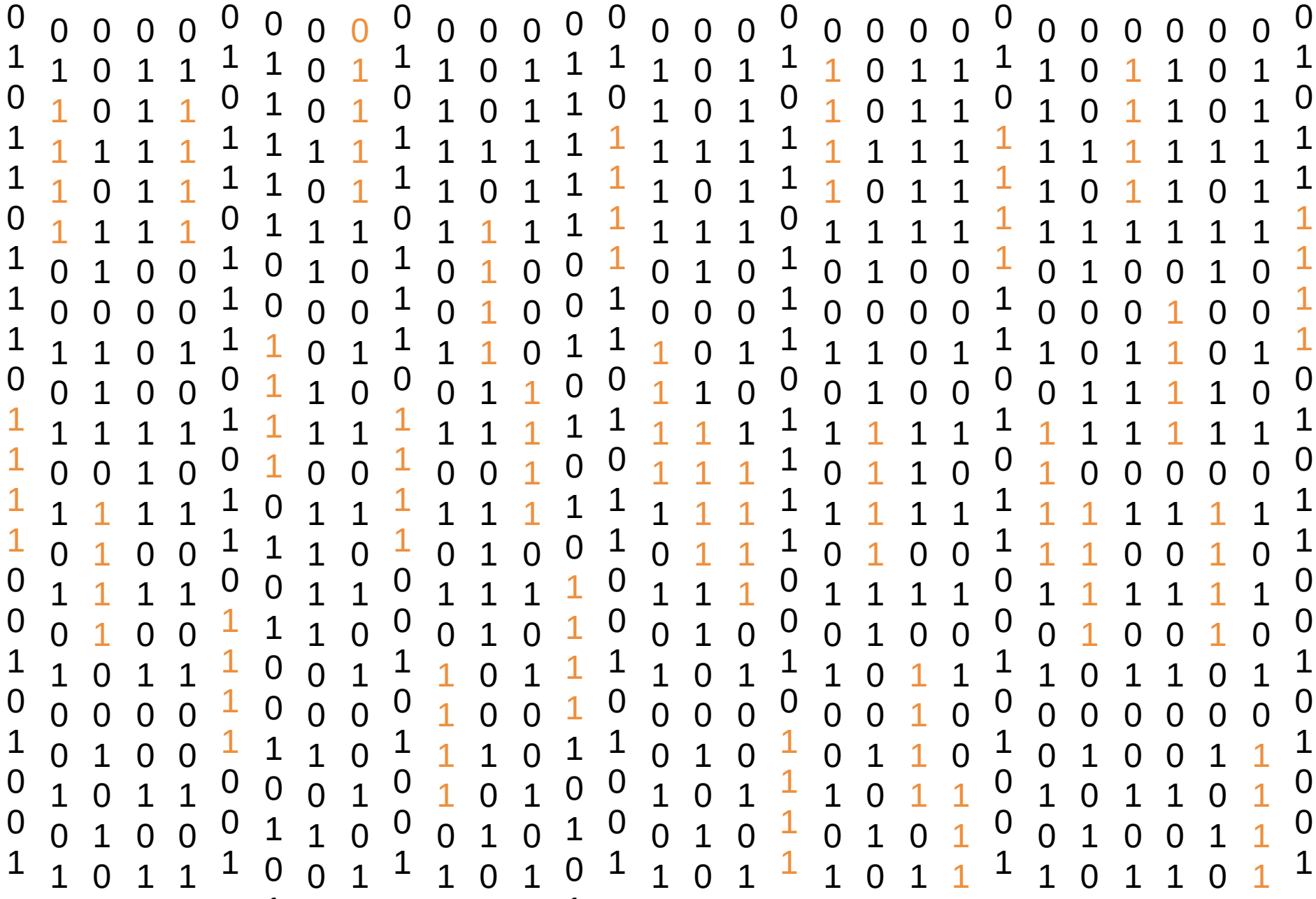
Figure 4: Data on Moore's Law



Note: The effective number of researchers is measured by deflating the nominal semiconductor R&D expenditures of key firms by the average wage of high-skilled workers. The R&D data includes research by Intel, Fairchild, National Semiconductor, Texas Instruments, Motorola, and more than two dozen other semiconductor firms and equipment manufacturers; see Table 1 for more details.

Source: Bloom, Jones, Van Reenen & Webb (2017)

Digital



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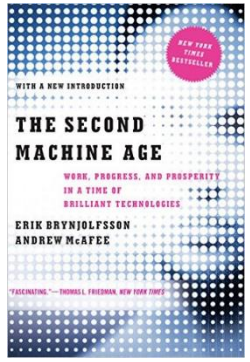
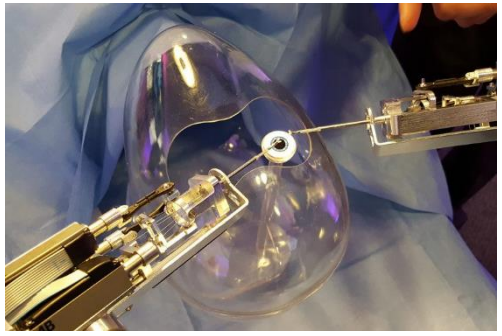
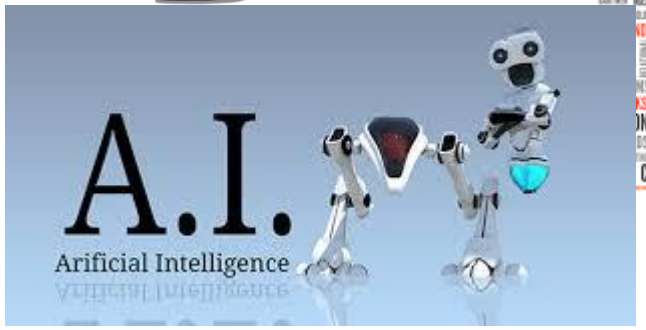
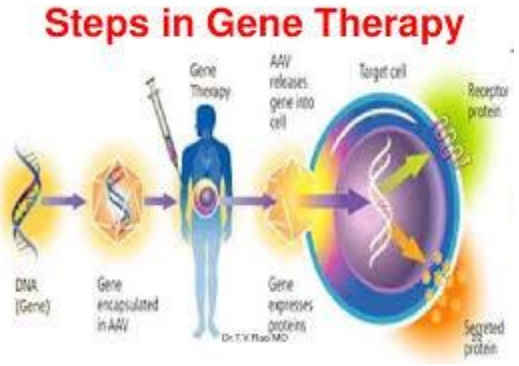









KUKA


WHERE'S WALDO?
A 30TH ANNIVERSARY ALBUM
WHERE'S WALDO?
DESTINATION: EVERYWHERE!
Featuring 12 classic scenes by
MARTIN HANDFORD
amazon


THINK
$18,200
$23,440
$5,600
FINAL
FINAL
FINAL
WILLIAM WILKINSON'S
"AN ACCOUNT OF THE PRINCIPALITIES OF
WALLACHIA AND MOLDAVIA"
INSPIRED THIS AUTHOR'S
MOST FAMOUS NOVEL


THINK
Who is Stoker?
(I FOR ONE WELCOME OUR NEW COMPUTER OVERLORDS)
$1,000

Demonstration of Watson Cancer Care Solution

IBM Watson Oncology Advisor

IBM Confidential: References to potential future products are subject to the Important Disclaimer provided earlier in the presentation

OUTLINE OF TALK

What are the new digital technologies?

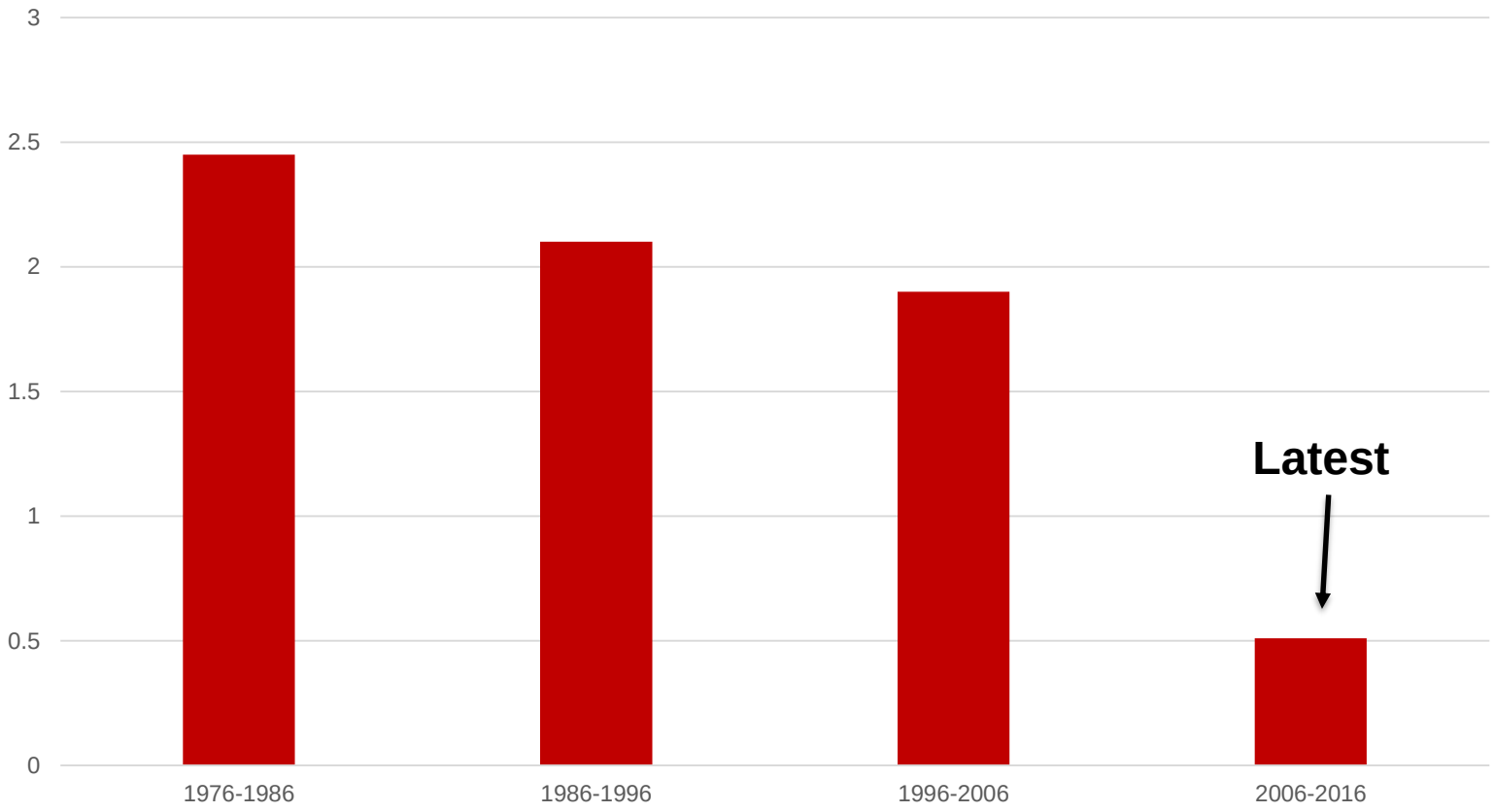
Productivity

Jobs and skills

Labor Share & Superstar Firms

Policy implications

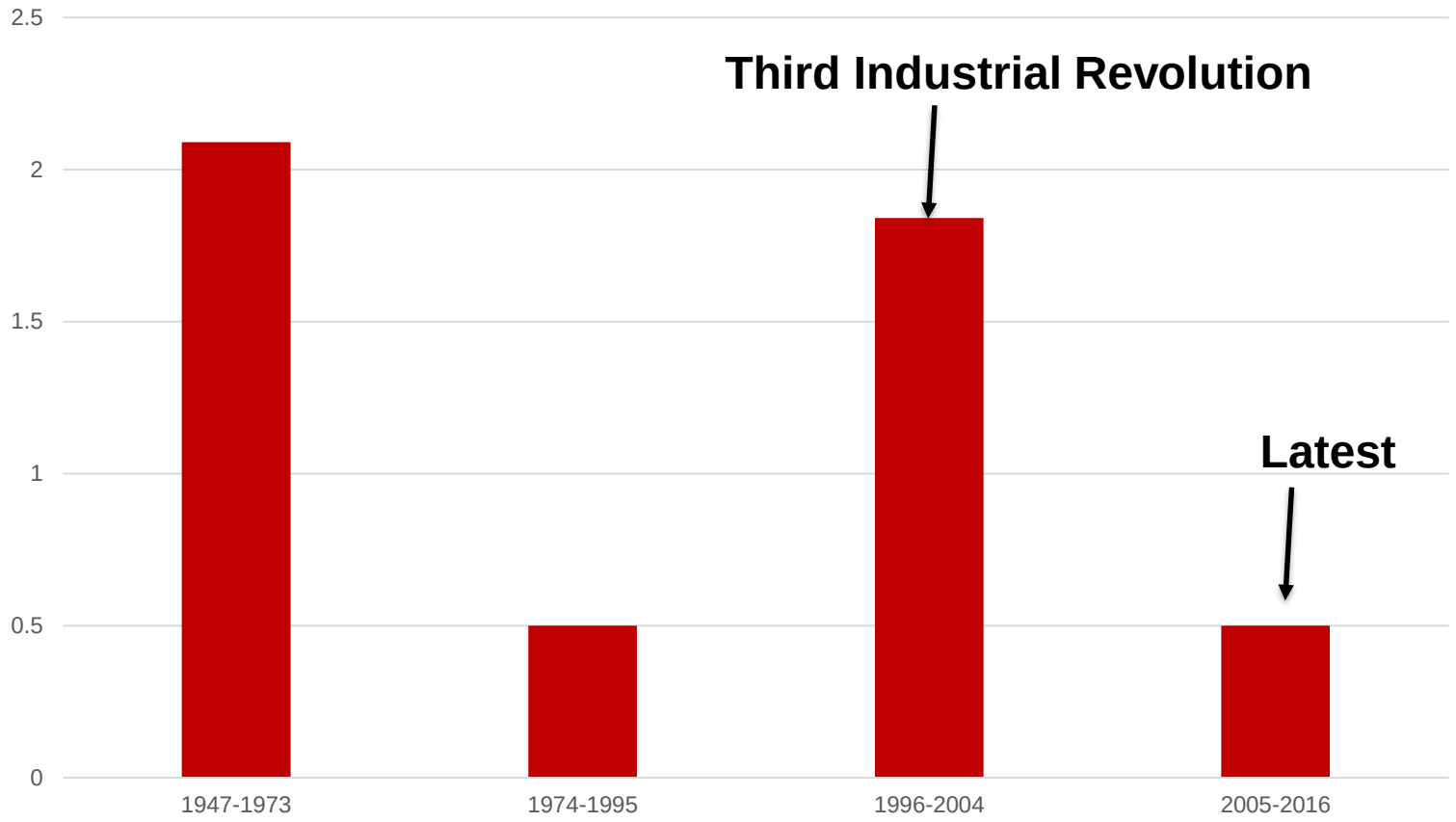
Growth Rate of GDP per capita, G7 Countries



Note: Annual average over decade; G7 = Canada, France, Germany, Italy, Japan, UK and US

Source: OECD (2018) http://stats.oecd.org/Index.aspx?DataSetCode=PDB_LV#

US (“Frontier”) Productivity Growth weak in last decade



Note: Total Factor Productivity (TFP); Annual average growth over different periods

Source: Fernald (2016)

Large Literature looking at impact of adopting digital technologies at firm level

- **Case Studies**
  - Fascinating, but hard to generalize
- **Statistical evidence**
  - Look at firm performance (productivity, profitability, growth, etc.) before and after introduction of technology
  - Control for other factors that could generate spurious correlation (industry, area, other investments, etc.)
  - Always issue that purely experimental variation is rare
- **My Summary of findings**
  - On average **positive** effect on firm performance
  - But impact is highly variable; e.g. organizations can spend huge amounts on ICT for zero benefit

theguardian

“Abandoned NHS IT system has cost £10 billion”

Sept 17, 2014

The bill for abortive plan, described as 'the biggest IT failure ever seen', was originally estimated to be £6.4bn

An abandoned NHS patient record system has so far cost the taxpayer nearly £10bn

When does technology successfully raise firm performance?

- Key to getting most out of new technologies is also having other “complementary” organizational factors
  - Early work by Bresnahan, Brynjolfsson & Hitt (2002) on US; Caroli & Van Reenen (2001) on EU

- **Management** is critical
  - Firm organization
  - Skills

- True at macro as well as micro level (e.g. Historian Paul David on electricity and computers)
  - Impacts takes time

Economic Evidence on management is limited

"*No potential driving factor of productivity has seen a higher ratio of speculation to empirical study*".

Chad Syverson (2011, *Journal of Economic Literature*)

WORLD MANAGEMENT SURVEY (WMS); BLOOM & VAN REENEN (2007)

1) Developing management questions

- Scorecard for 18 monitoring (e.g. lean), targets & people (e.g. pay, promotions, retention and hiring). ≈45 minute phone interview of manufacturing plant managers

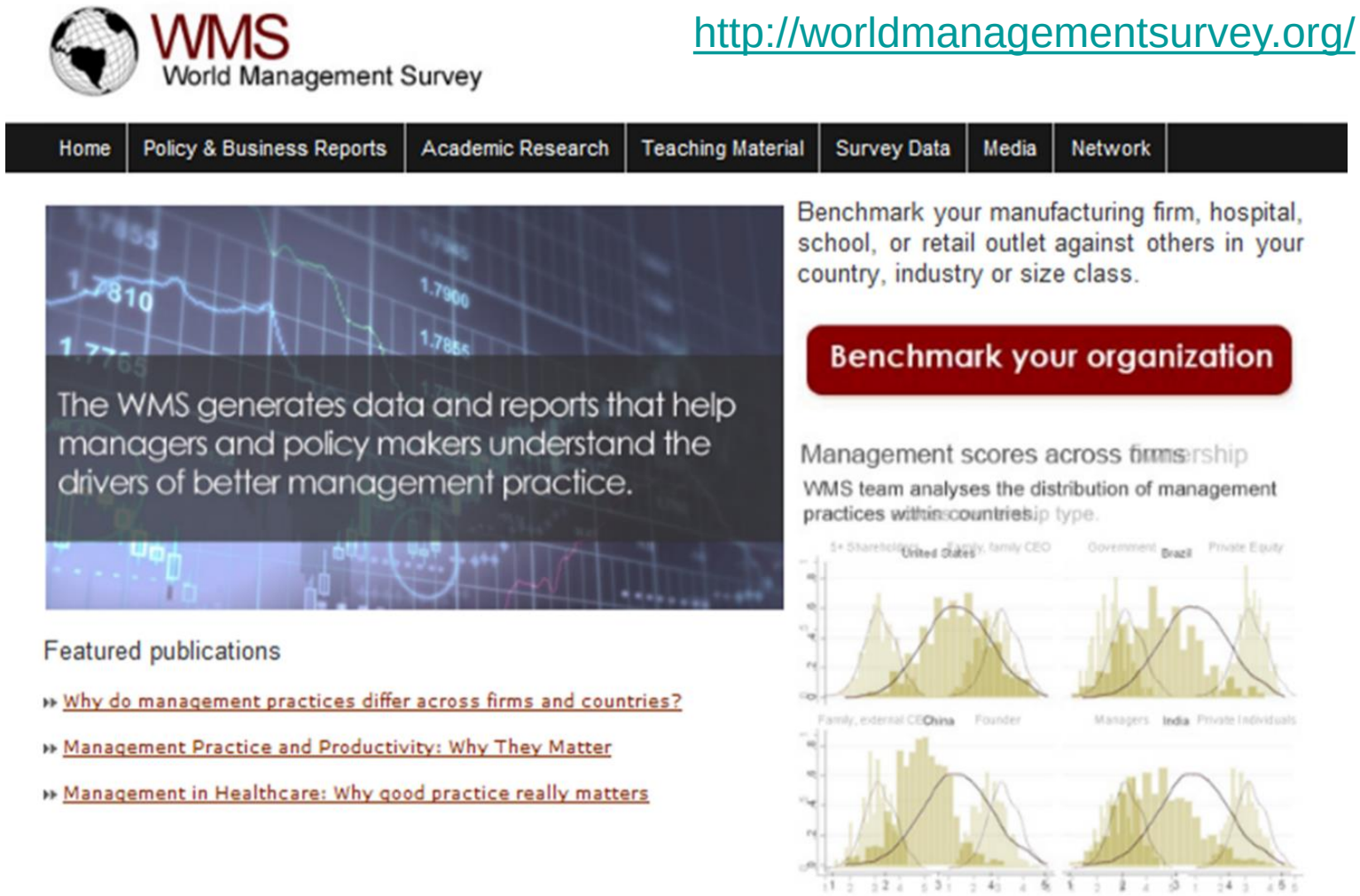
2) Obtaining unbiased comparable responses (“Double-blind”)

- Interviewers do not know the company’s performance
- Managers are not informed (in advance) they are scored

3) Getting firms to participate in the interview

- Official Endorsement: Bundesbank, Bank of England, RBI, etc.
- Run by 200 MBA types (loud, assertive & business experience)

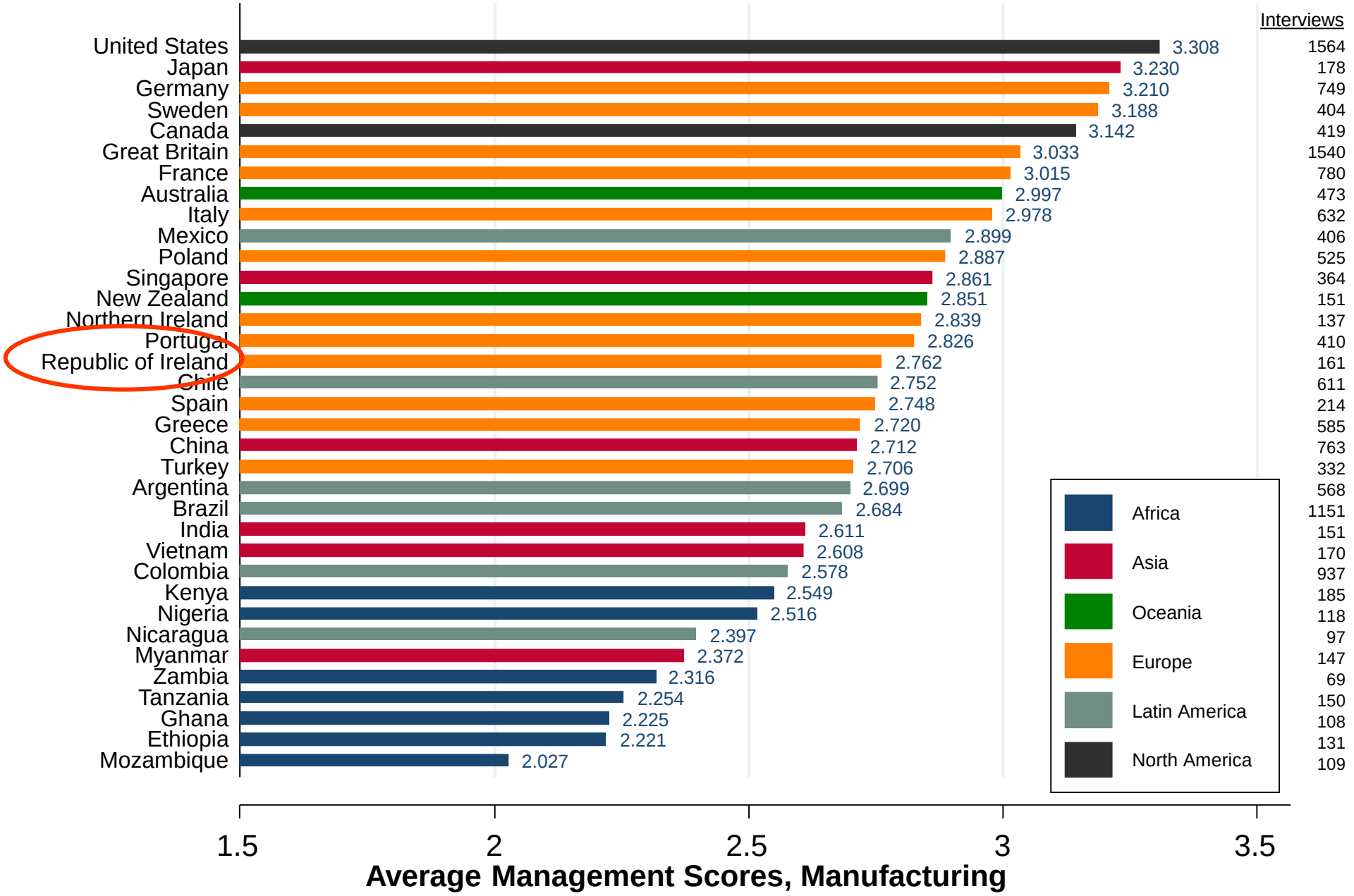
World Management Survey (~12,000 firms, ~20k managers in 4 major waves: 2004, 2006, 2009, 2014; 34 countries)



Medium sized manufacturing firms(50-5,000 workers, median≈250)

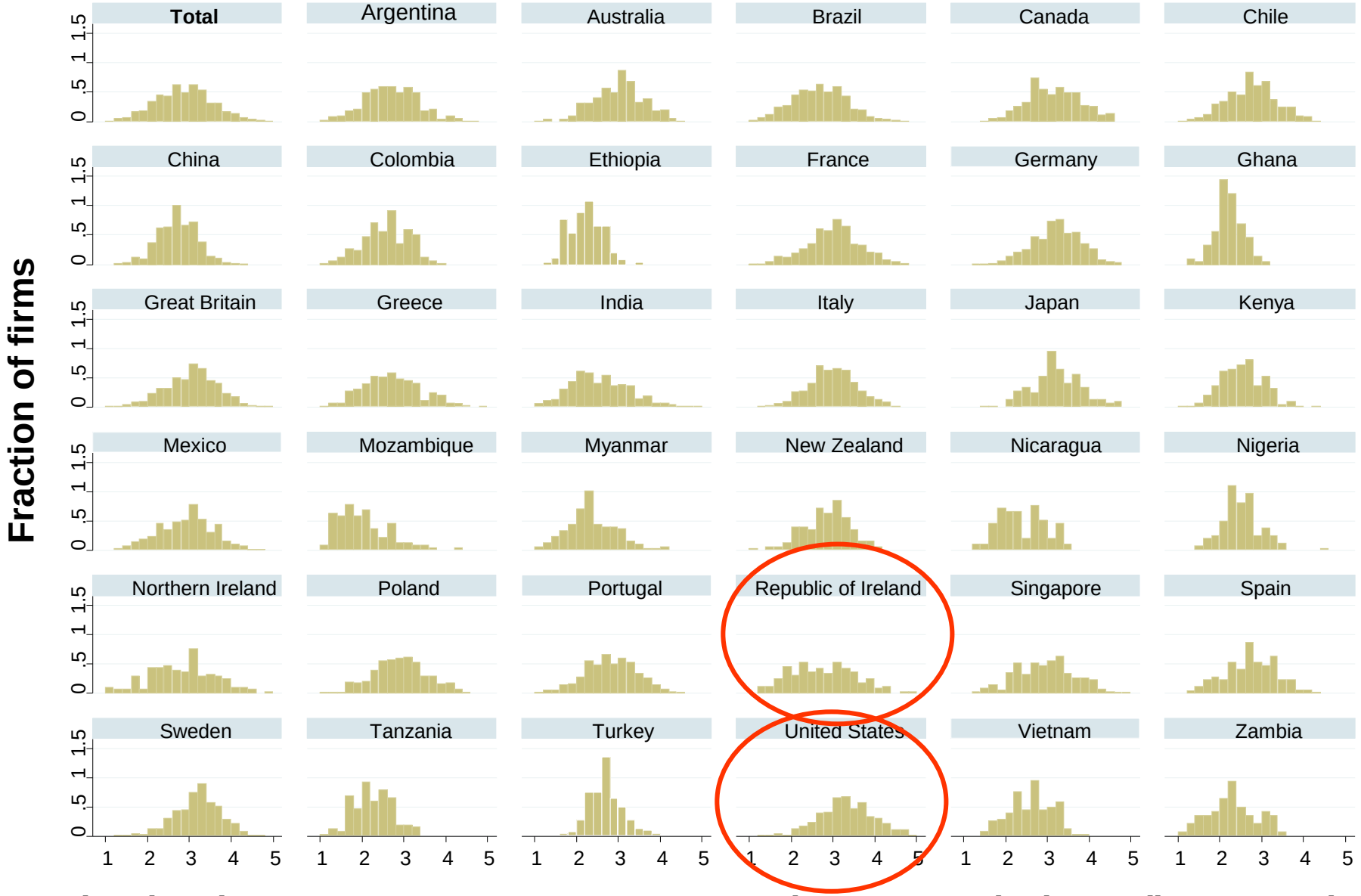
Now extended to Hospitals, Retail, Schools, etc.

Average Management Scores by Country



Note: Unweighted average management scores; # interviews in right column (total = 15,489); all waves pooled (2004-2014)

Management also varies heavily within countries



"Americans do I.T. better" (Bloom, Sadun and Van Reenen, AER, 2012)

- Use management data + IT data (ONS & Harte-Hanks)
- What happens to establishment productivity after changes in IT investment?

- Firms with better people management, don't just spend more on IT, but enjoy bigger productivity boost from each € of IT spent
  - Well managed firms get **double** the productivity boost from IT compared to poorly managed
  - Accounted for half of the faster productivity growth in US compared to Europe in decade since mid 1990s

- Similar findings on more recent data (e.g. Pelligrino & Zingales, 2018; Schmitz & Schivardi, 2018)

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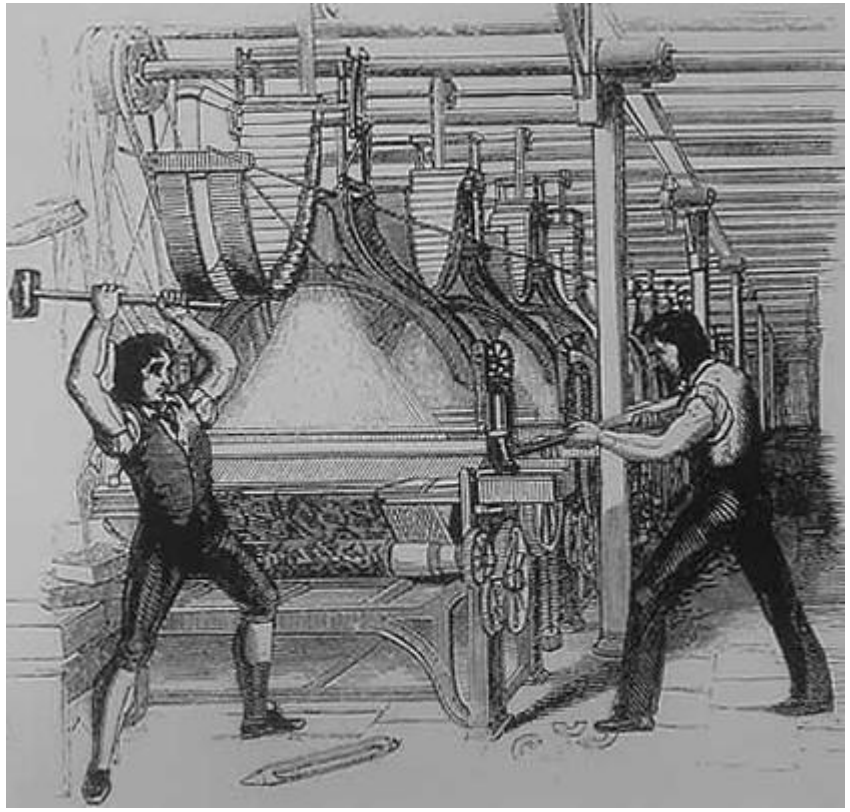
Will new technology make our working lives better?

Or is it “Robo-calypse Now?”

Déjà vu all over again…

AUTOMATION IN BRITAIN STIRS UNREST IN LABOR

Workers See 'Robot Revolution' Depriving Them of Jobs



THE NEW YORK TIMES, SUNDAY, FEBRUARY 26, 1928. XX 3

MARCH OF THE MACHINE MAKES IDLE HANDS

Prevalence of Unemployment With Greatly Increased Industrial Output Points to the Influence of Labor-Saving Devices as an Underlying Cause

By EVANS CLARK.

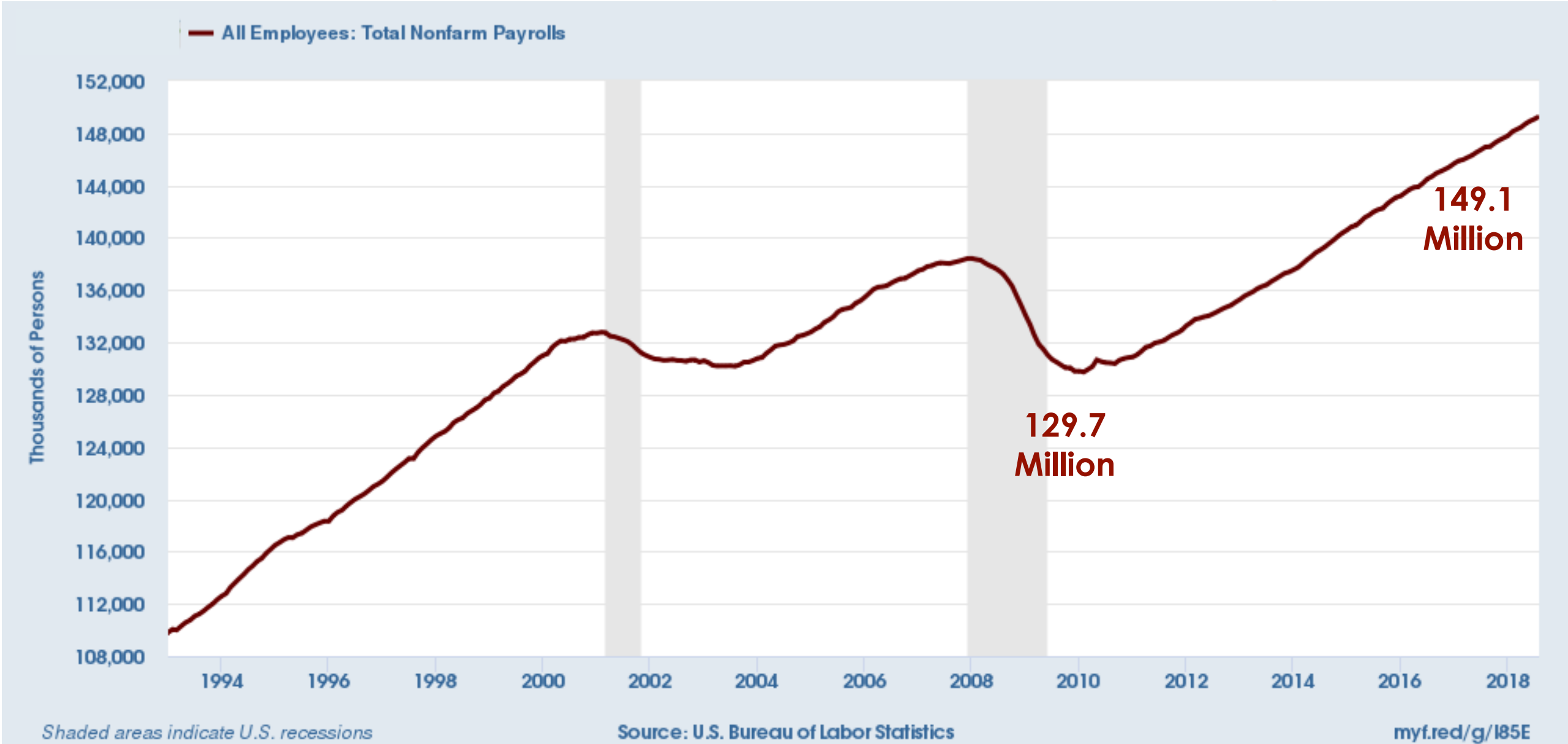
A FEW days ago the General Motors Corporation reported the largest peace-time earnings ever made by a single concern in the history of America. Three days later Governor Smith made public a report from the New York Industrial Commissioner which called public attention to serious unemployment throughout the State: not since the depression of 1921, it was disclosed, have conditions been as bad.

The people of the United States—in the shadow of a Presidential election—are presented with a social

have gone far to make construction a machine industry instead of a collection of hand trades. One gasoline crane takes the place of ten or twelve laborers. The hod-carrier has disappeared before the invasion of the material hoist. In concrete construction building materials are mixed, like dough, in a machine and literally poured into place without the touch of a human hand. The Ohio figures record these results: with 15 per cent. fewer men employed, contractors put up 11 per cent. more square feet of finished buildings last year than in 1923.

Coal Mined by Machines.

Not Running out of Jobs – U.S. Added 19.4 Million Jobs Between Jan 2010 – Sep 2018



Is Automation Labor Displacing?

Four countervailing forces against the employment-reducing effect of automation

1. **Uber effects**
2. **Walmart effects**
3. **Business-to-Business effects**
4. **Creation of new work / new tasks**

‘Uber’ Effects – Produce a Cheaper, Better Product, and Employment May Rise,

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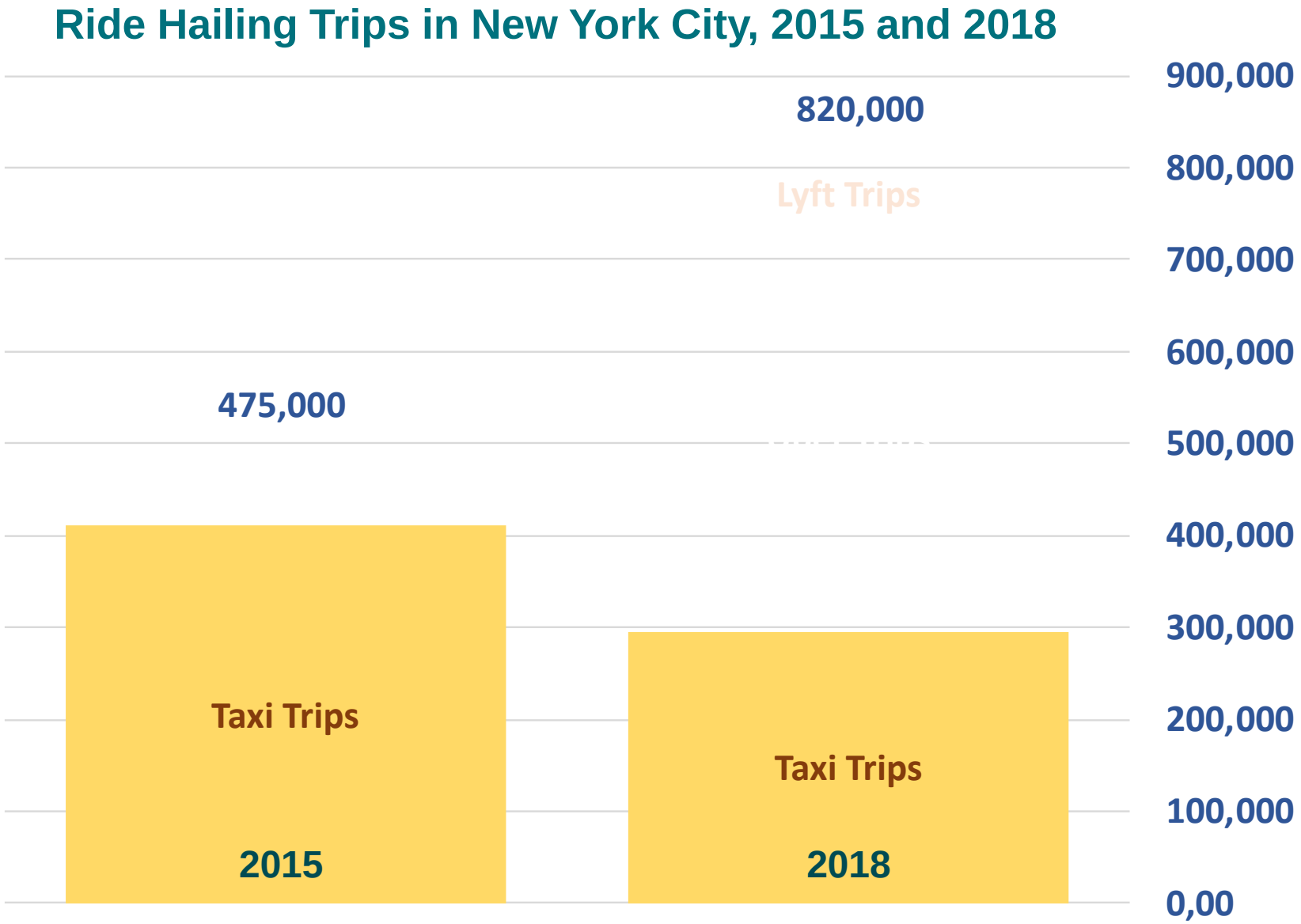
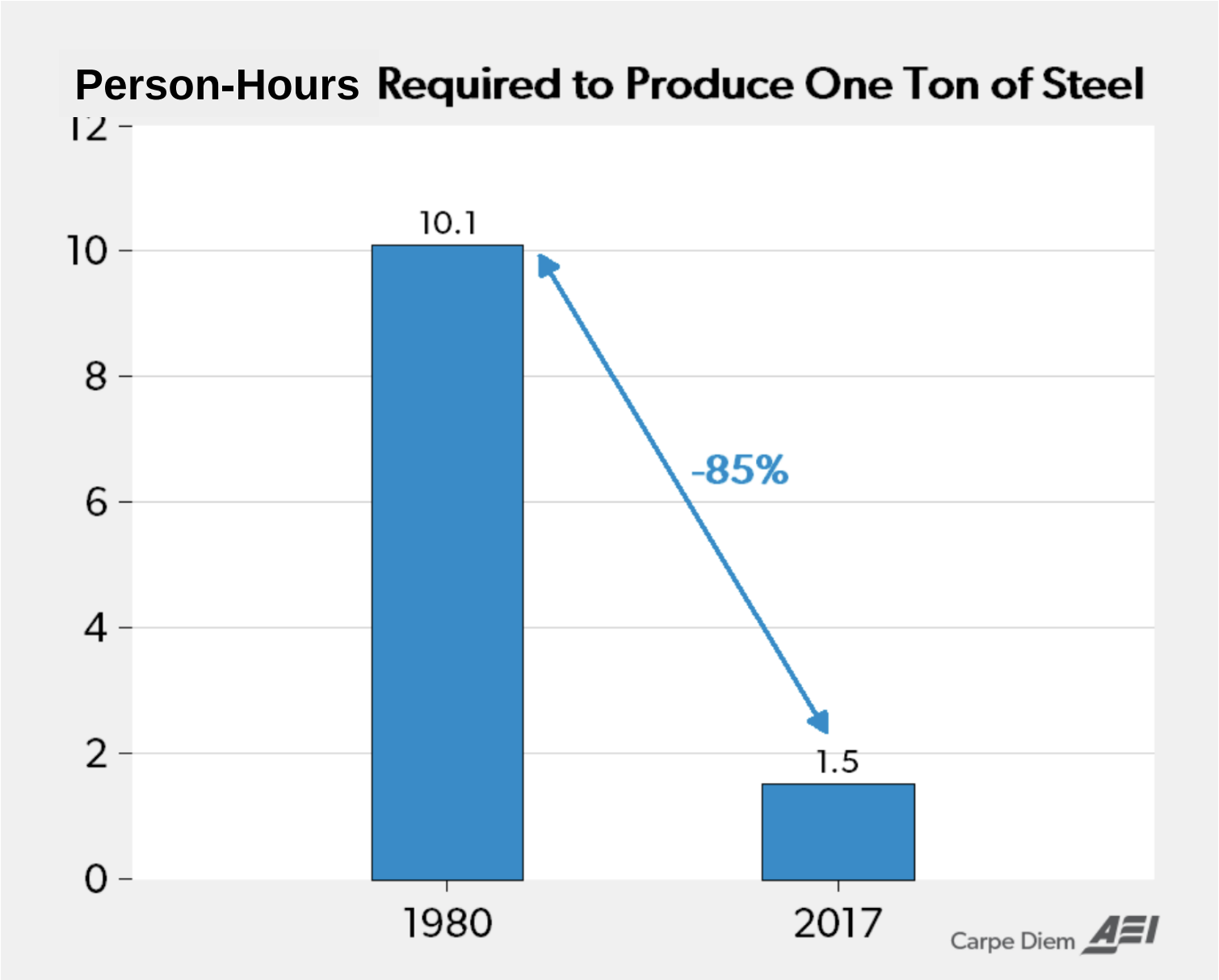
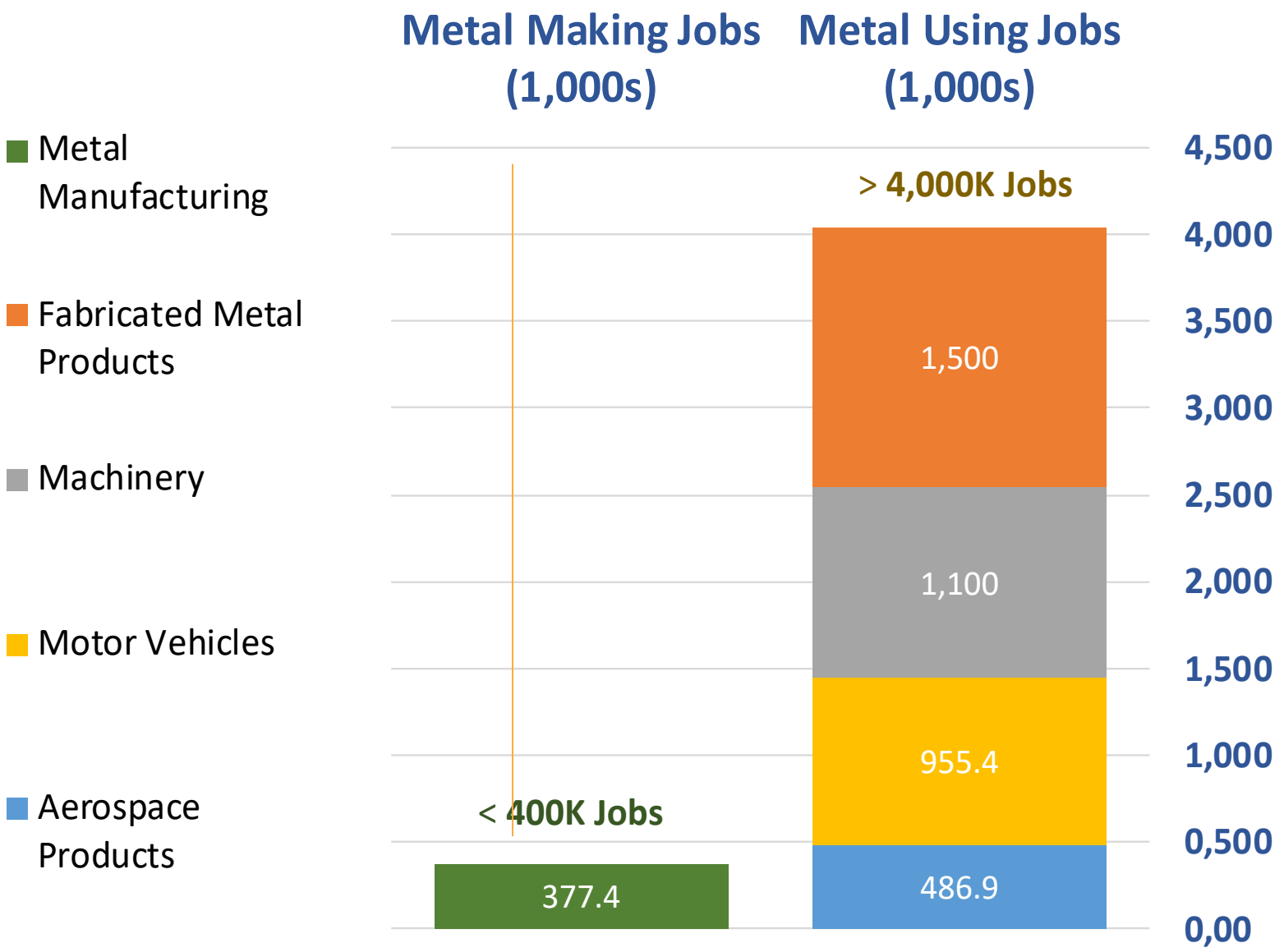


Walmart Effects – A Fall In the Cost of Necessities Frees Income for Luxuries

Business-to-Business Effects – There's Been a Lot of Productivity Growth in Steel!



Business-to-Business Effects –



New technology destroys old tasks, but creates new tasks

- Acemoglu and Restrepo (2017,2018)
  - Automation technologies can reduce overall labor demand.
  - But “reinstatement effect” generated by new tasks counterbalances automation

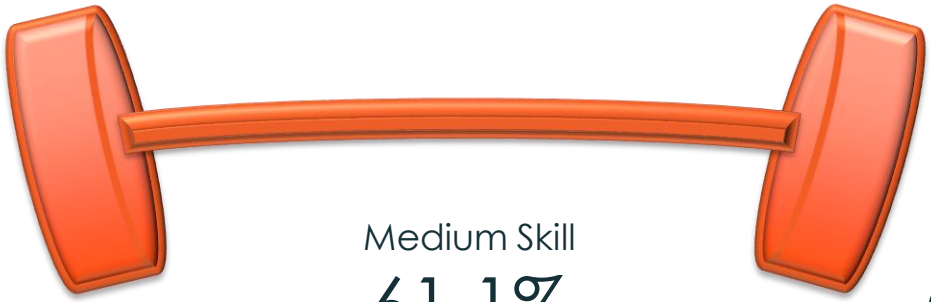
- No trend in unemployment in long-run (but hours worked have fallen)

- A bigger problem than the number of jobs is the quality of jobs. Wages and other aspects of the desirability of work

Biased Technical Change → Shrinking Middle: The 'Barbell' Labor Market ("Job Polarization")

1979

Low Skill
13.7%



Medium Skill
61.1%

High Skill
25.2%

2016

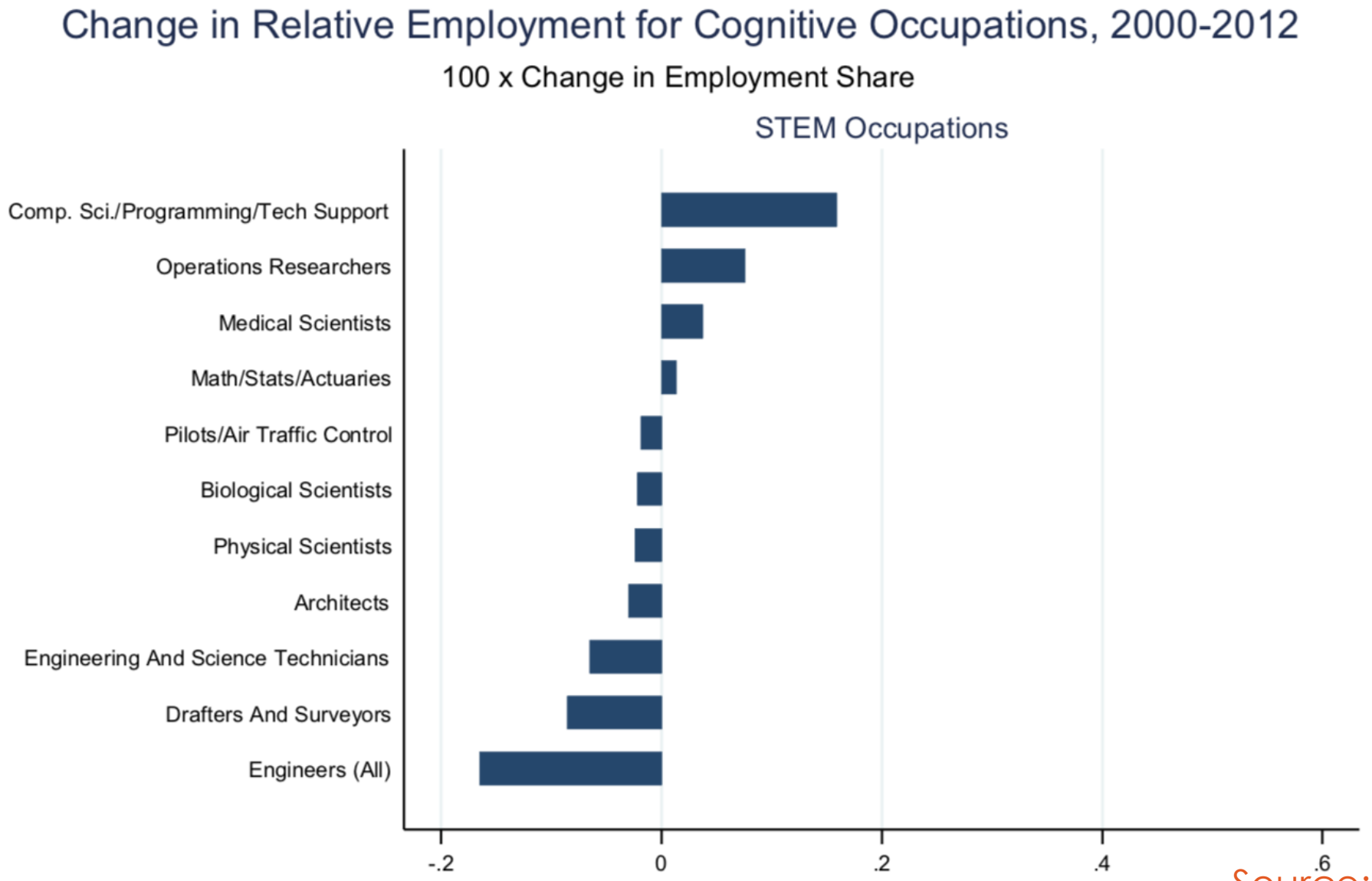
Low Skill
18.2%

Medium Skill
43.2%

High Skill
38.6%

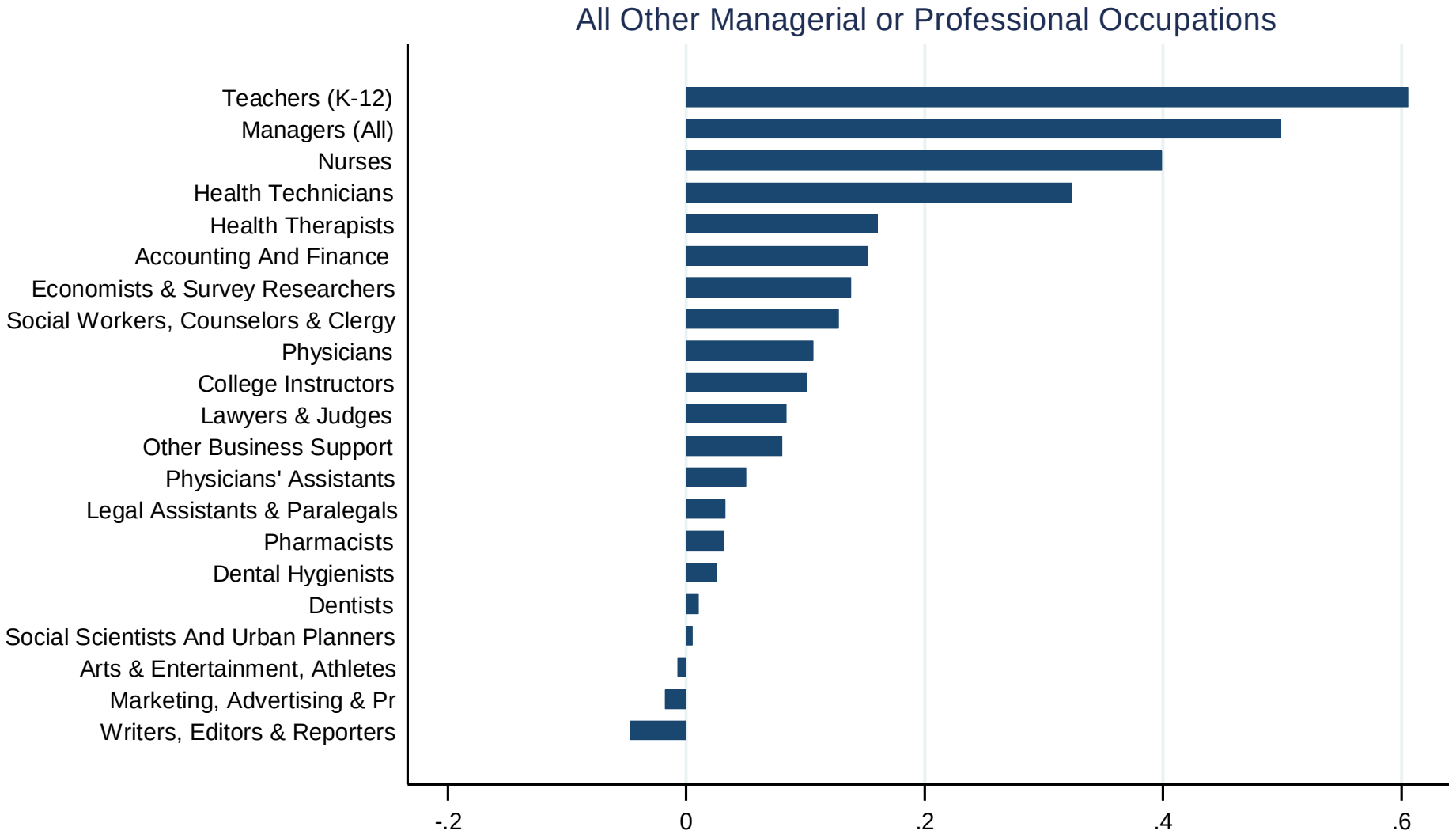
Source: US data Autor (2018)

New Jobs are Not Primarily STEM! (US 2012 – 2000)



Source: Deming (2018)

Many Growing Occupations Combine Interpersonal with Technical Skills



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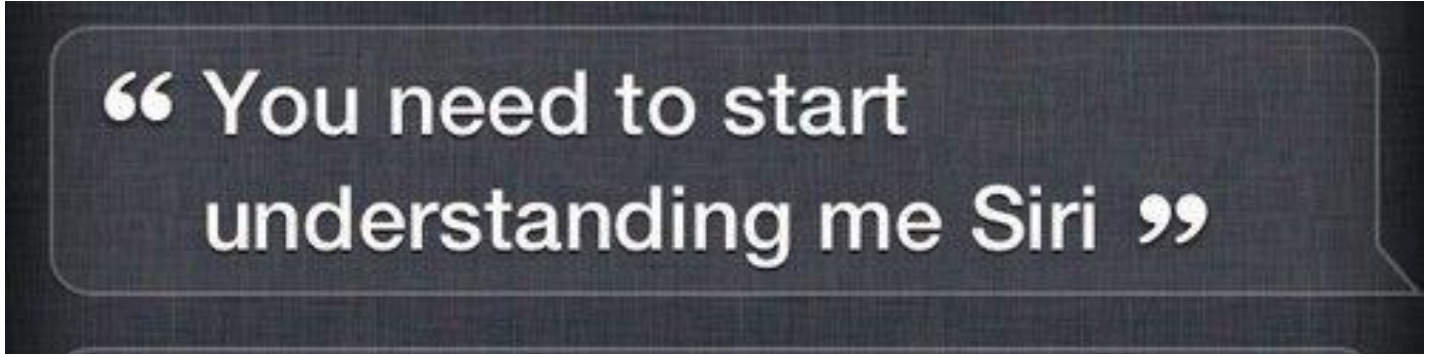
“ You need to start
understanding me Siri ”


“ You need to start understanding me Siri ”
I’ll make a note of that.
“ Yeah you better make a note of that ”
Got it:
Of that

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Workers getting smaller share of Economic pie: Falling Labor Share of Corporate Value added

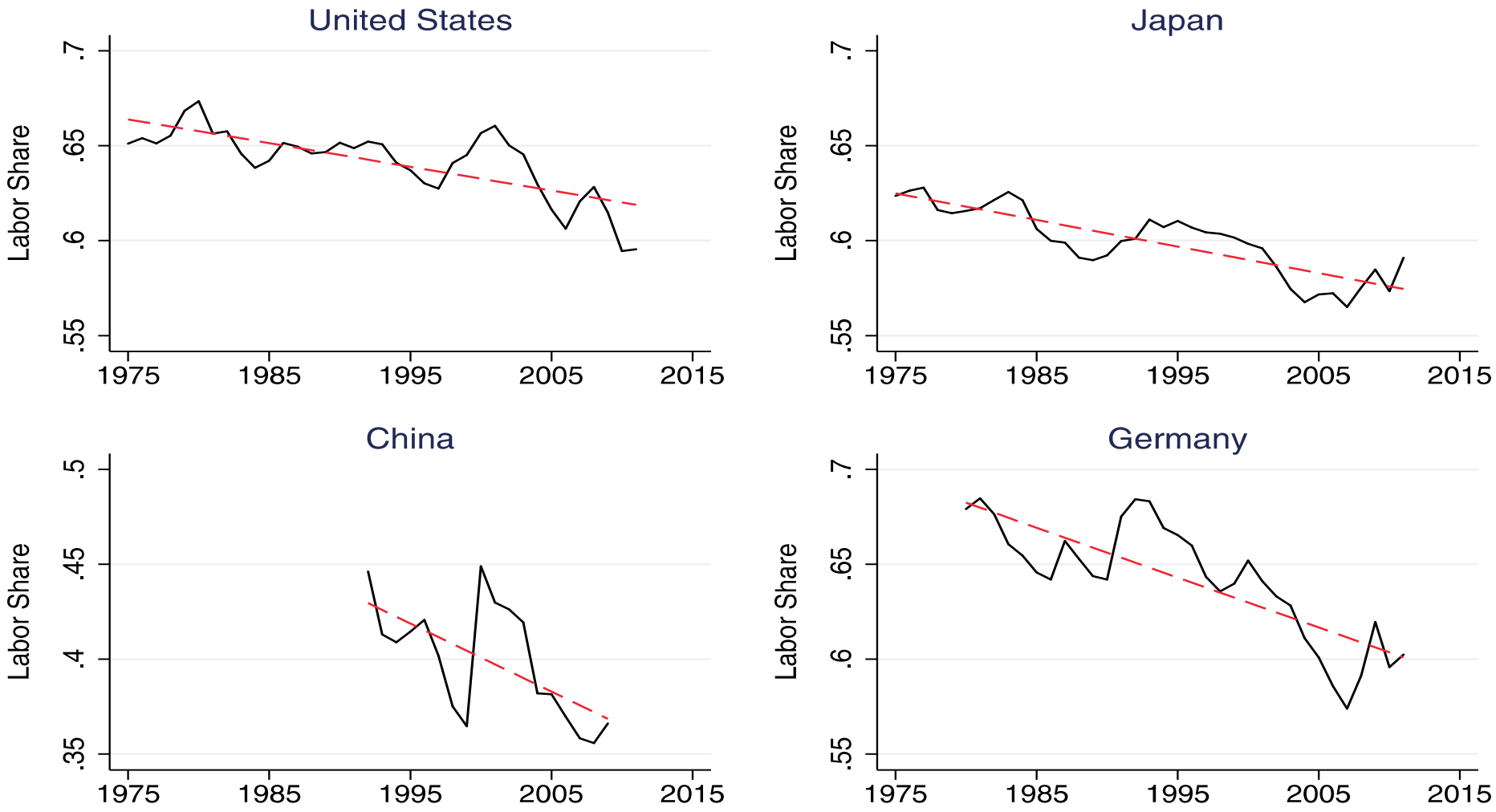

FIGURE II

Declining Labor Share for the Largest Countries

Karabarbounis and Neiman, 2014

Why has labor share fallen?

'Superstar Firms' hypothesis (Autor, Dorn, Katz, Patterson & Van Reenen, 2017, 2019)

- Large firms tend to have lower labor shares
- Rising prevalence of "winner take most" competition
- Small set of large firms capture increasing share of market, aggregate labor share falls due to reallocation

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Some Implications for business leaders & policy-makers

- New technologies create **challenges** and **opportunities** but making the most of these opportunities not automatic
  - To make most of new technologies requires complementary changes in organizational & management
- How to improving management?
  - **Optimistic story:** it's within the power of business leaders to improve management (multinationals example)
  - **Government policies:** Information provision (esp. for SMEs); Education/training; Ownership/governance; Competition.
- Policy moving in **wrong** direction in many countries right now
  - Strong anti-globalization and populism
  - Retreat to protectionism in US; Brexit pushes up trade and mobility costs

THANKS!