MIT work OF THE FUTURE

Building Better Jobs in an Age of Intelligent Machines

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Centre for the Governance of Ai @fhioxford
January 20, 2021

MIT Task Force on the Work of the Future

The MIT Task Force on the Work of the Future launched by MIT President Reif in 2018

1. How are emerging technologies changing the nature of human work and the skills required?

2. How we can design and leverage technological innovations for the benefit of everyone in society?

workofthefuture.mit.edu
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The Task Force comprised

~20 faculty members from across all five schools
~20 graduate students
~34 person Advisory Board and Research Advisory Board

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The Work of the Future:

Building Better Jobs in an Age of Intelligent Machines

2020

The New York Times

Don't Fear the Robots, and Other Lessons From a Study of the Digital Economy

A task force assembled by M.I.T. examined how technology has changed, and will change, the work force.

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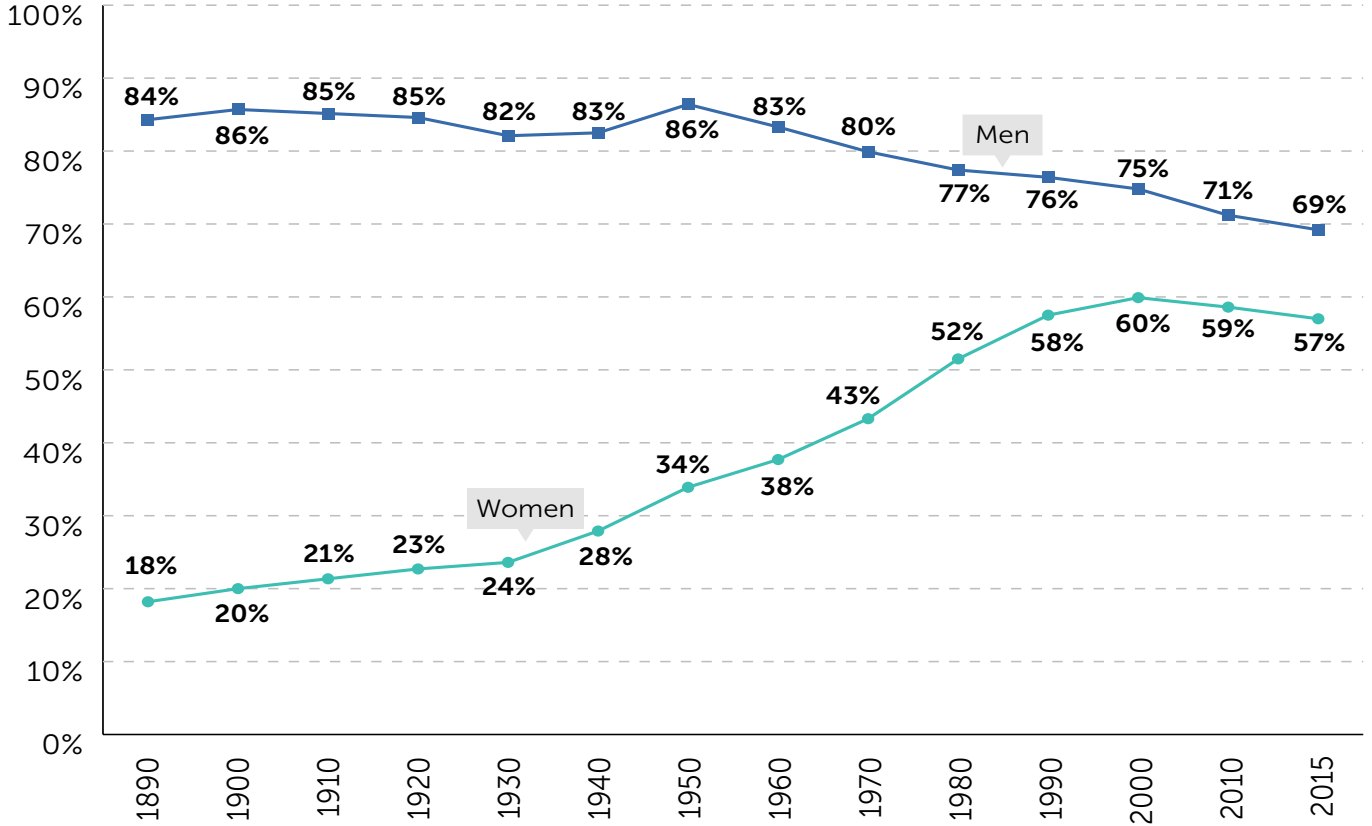
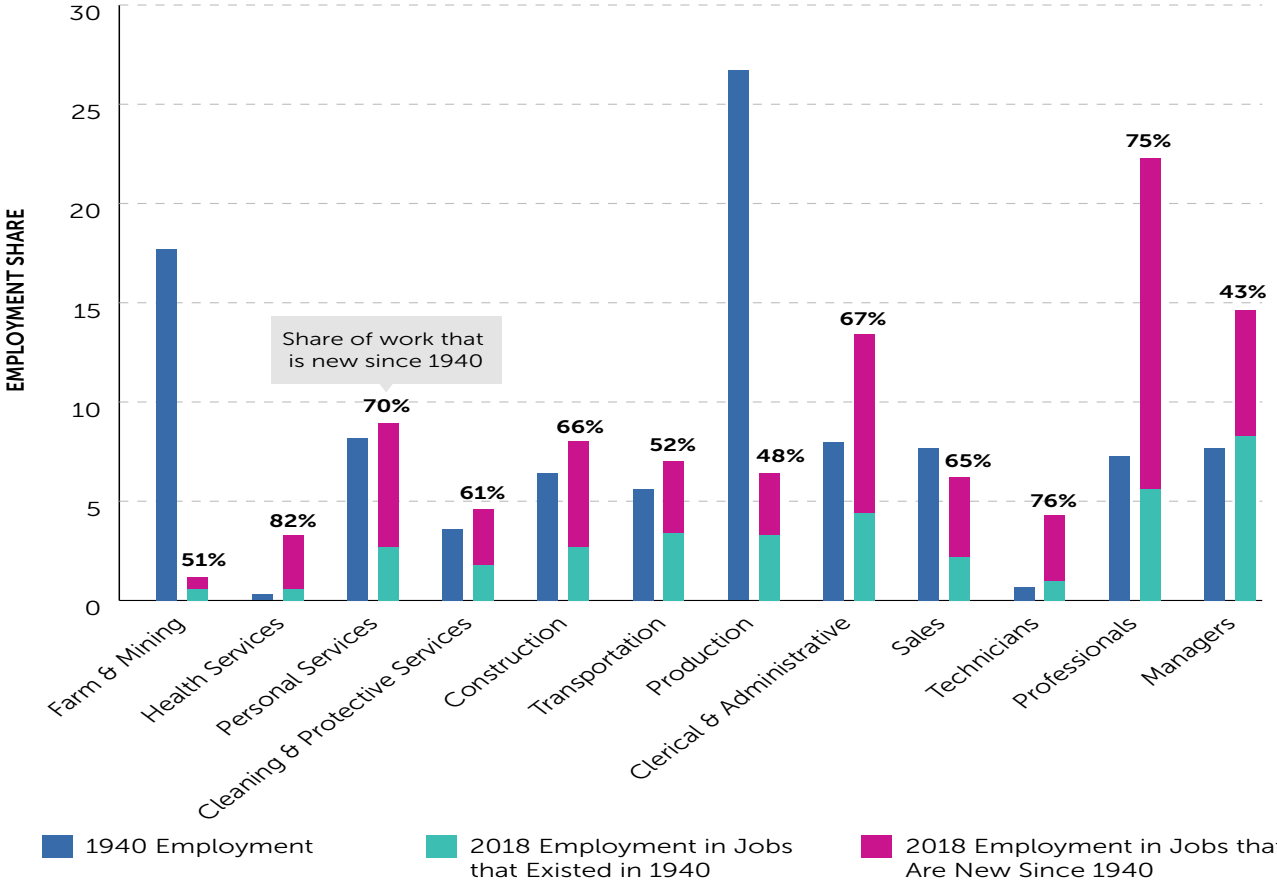
I. Economic Context

After a Century of Automation, Why Are There Still So Many Jobs?

Employment to Population Ratio of U.S. Adults, 1890 - 2015



More than 60 Percent of Work Performed in 2018 Had Not Yet Been 'Invented' as of 1940



Autor, Salomons, and Seegmiller 2020

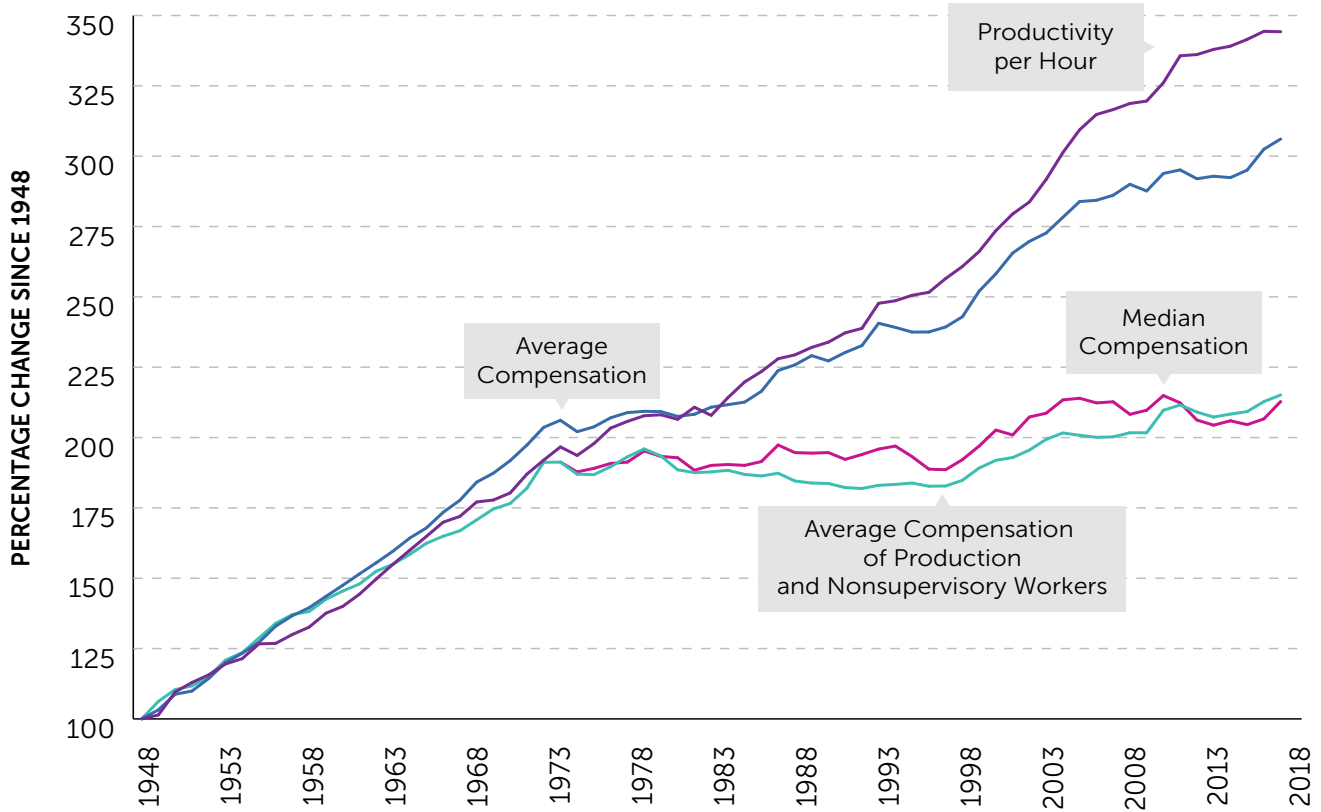
Examples of New Occupations Added to the U.S. Census Between 1920 and 2018

YEAR	EXAMPLE TITLES ADDED	
1940	Automatic welding machine operator	Gambling dealer
1950	Airplane designer	Beautician
1960	Textile chemist	Pageants director
1970	Engineer computer application	Mental-health counselor
1980	Controller, remotely piloted vehicle	Hypnotherapist
1990	Certified medical technician	Conference planner
2000	Artificial intelligence specialist	Chat room host/monitor
2010	Wind turbine technician	Sommelier
2018	Pediatric vascular surgeon	Drama therapist

Source: Autor, Salomons, and Seegmiller, 2020

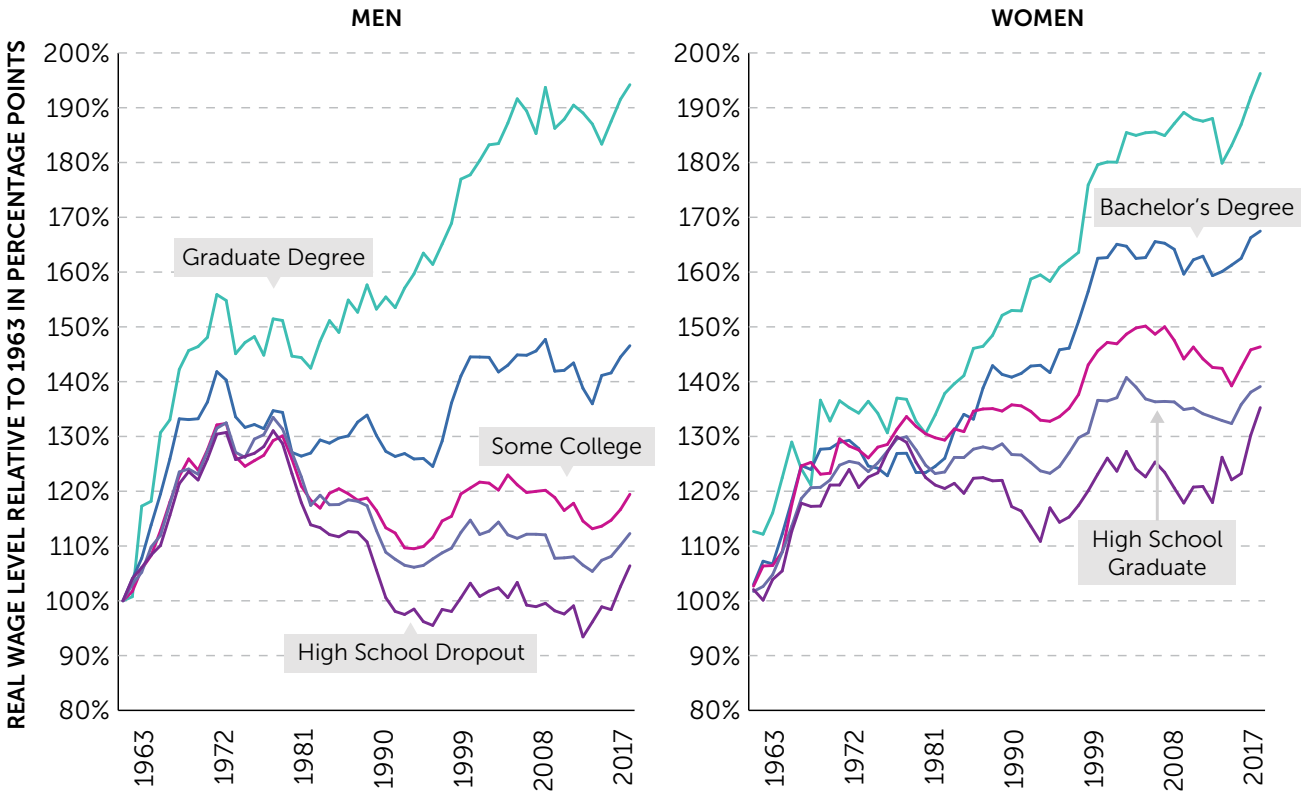
The U.S. Has Gotten Much More Productive since 1975, but Most Workers Have Benefited Little

U.S. Productivity and Compensation Growth, 1948 – 2018



Real Wages Have Risen for U.S. College Graduates and Fallen for Workers with High School Degree or Less Since 1980

CUMULATIVE CHANGE IN REAL WEEKLY EARNINGS OF WORKING-AGE ADULTS AGES 18–64, 1963–2017



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II. What are the Causes?

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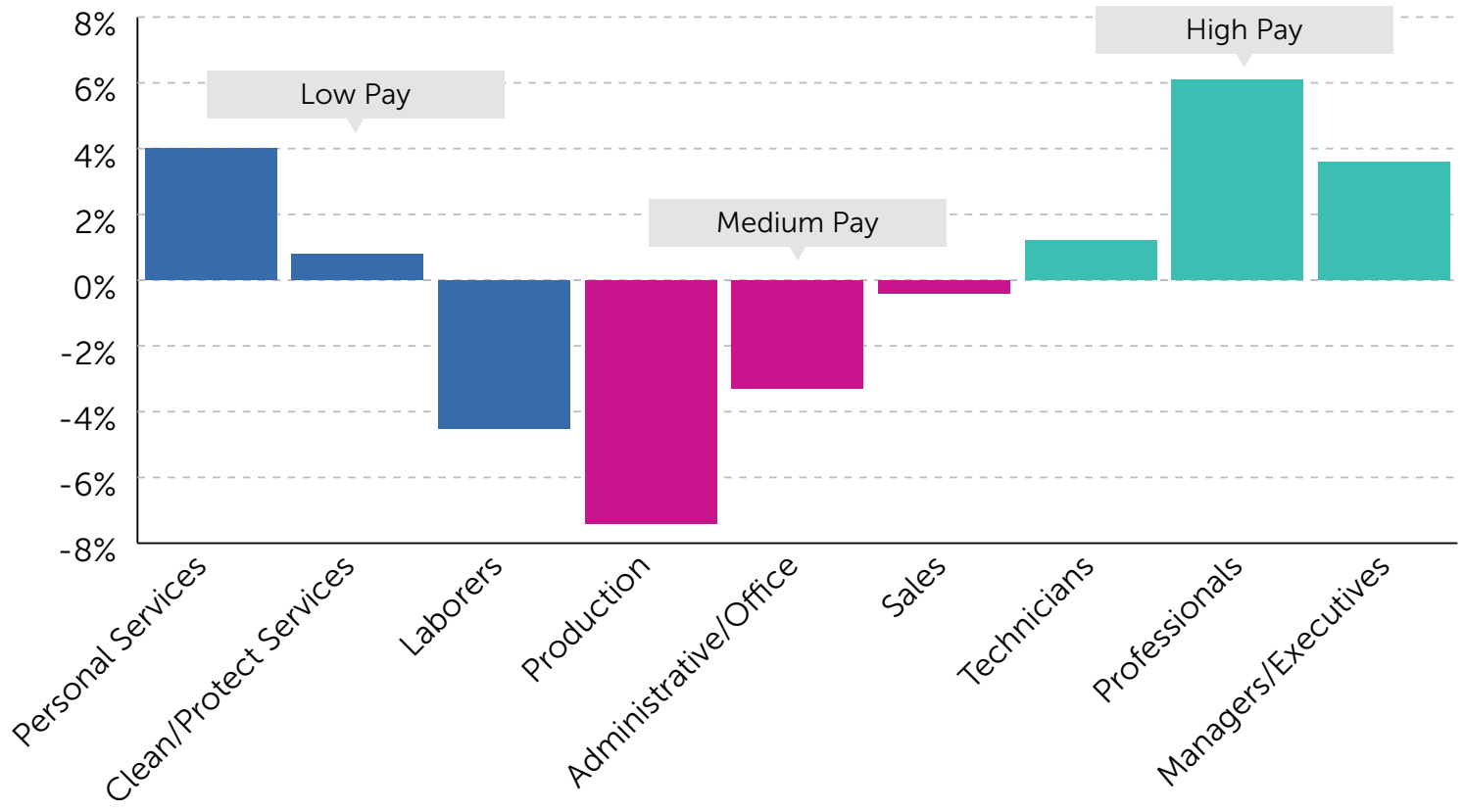
1. **Technology**: Digitalization of work made highly-educated workers more productive, made less-educated workers easier to replace with machinery

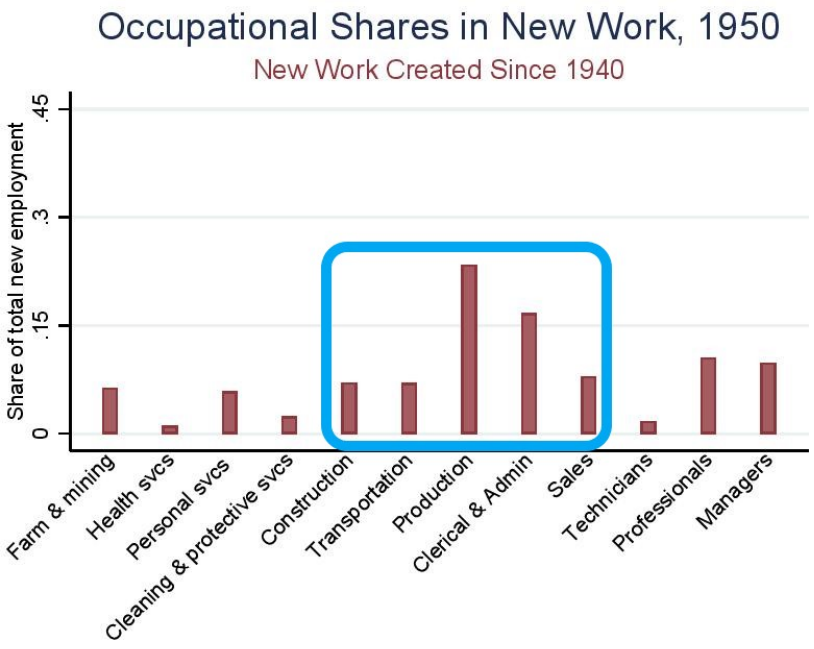
The U.S. Occupational Structure has 'Polarized', 1980 – 2015

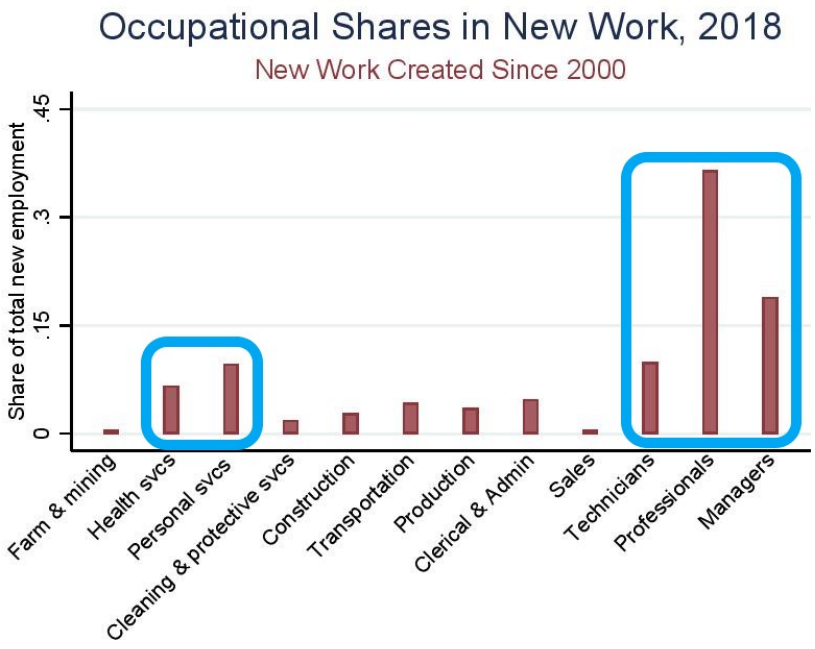
Changes in Employment in Low, Medium, & High Paying Occupations



As Innovation has Shifted Towards Information and Electronics, Locus of New Work Creation Has Polarized

In the 1940s, New Work Creation Concentrated in Middle-Paid Occupations
In the 2000s, New Work Creation Concentrated in High- or Low-Paid Occs

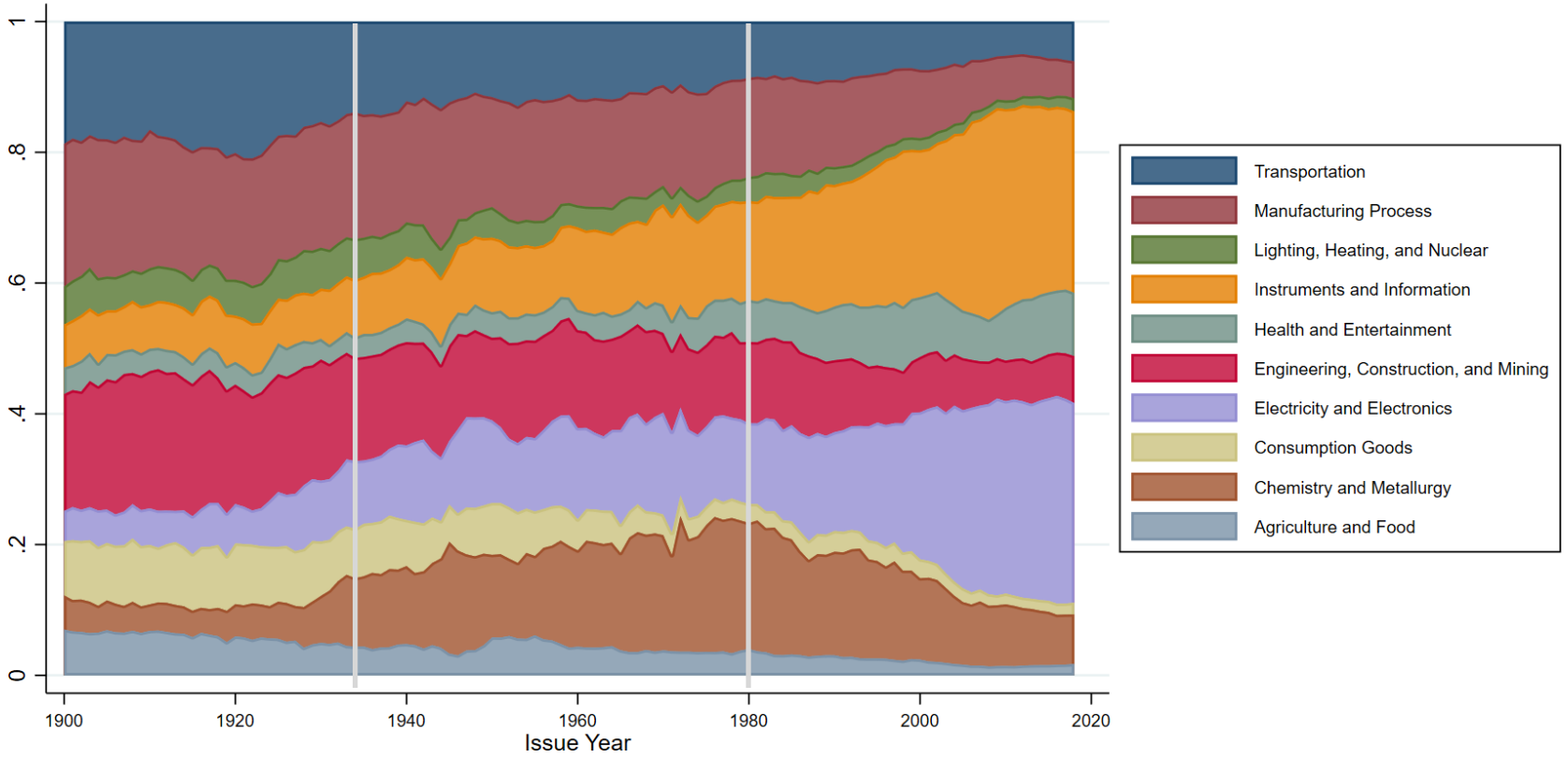




Autor, Salomons, and Seegmiller 2020

The Locus of Innovation Has Shifted Across the 20th Century

Shift of Patenting Activity: from Manufacturing and Transportation, to Chemicals and Electricity, to Electronics and Information



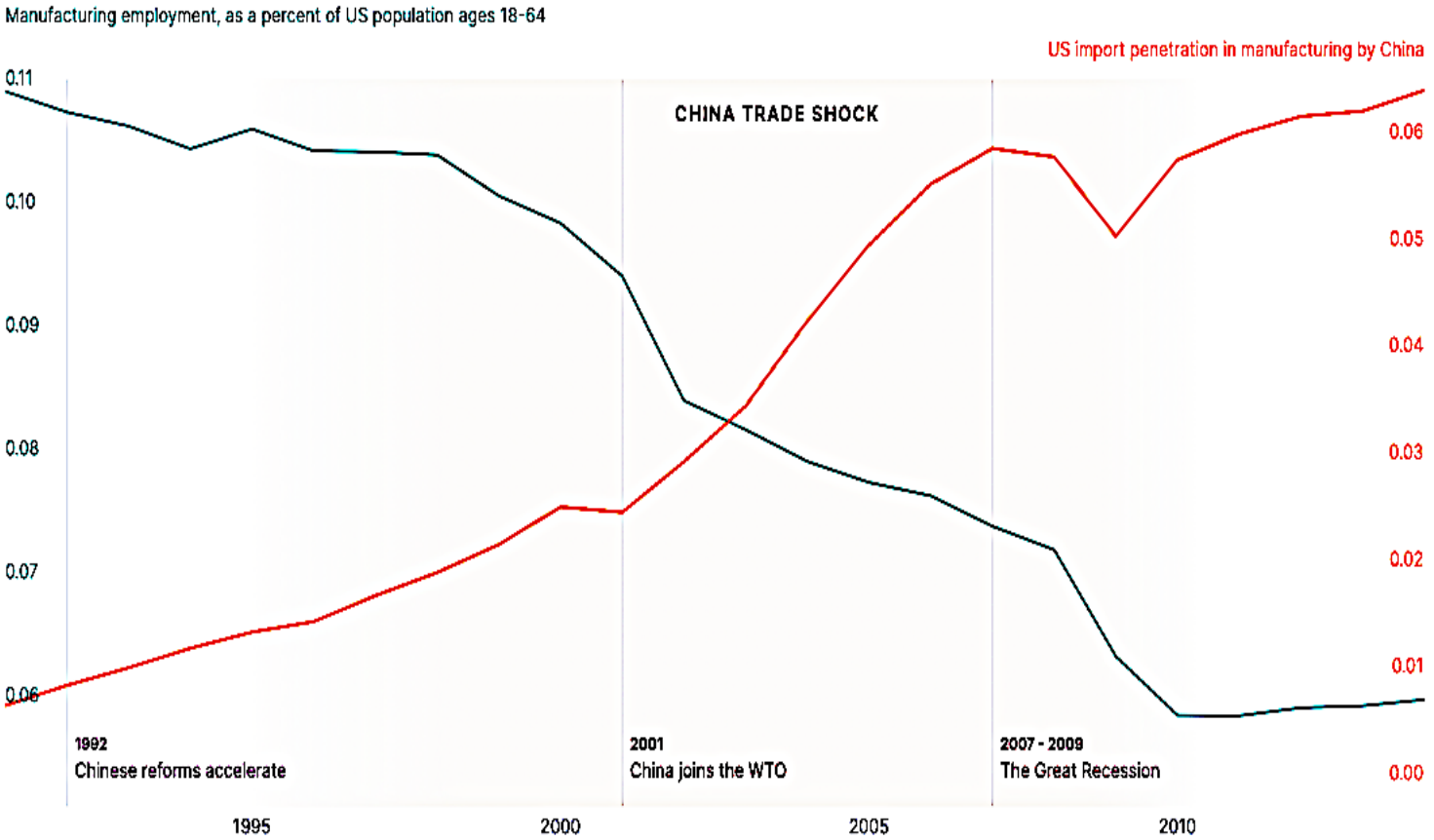
Autor, Salomons, and Seegmiller 2020

What Are the Causes?

1. **Technology**: Digitalization of work made highly-educated workers more productive, made less-educated workers easier to replace with machinery

2. **Globalization**: Trade has been a huge positive for world welfare but has placed pressure on manufacturing jobs and manufacturing-intensive communities

U.S. Manufacturing Employment Dropped Sharply After China Joined the World Trade Organization in 2001



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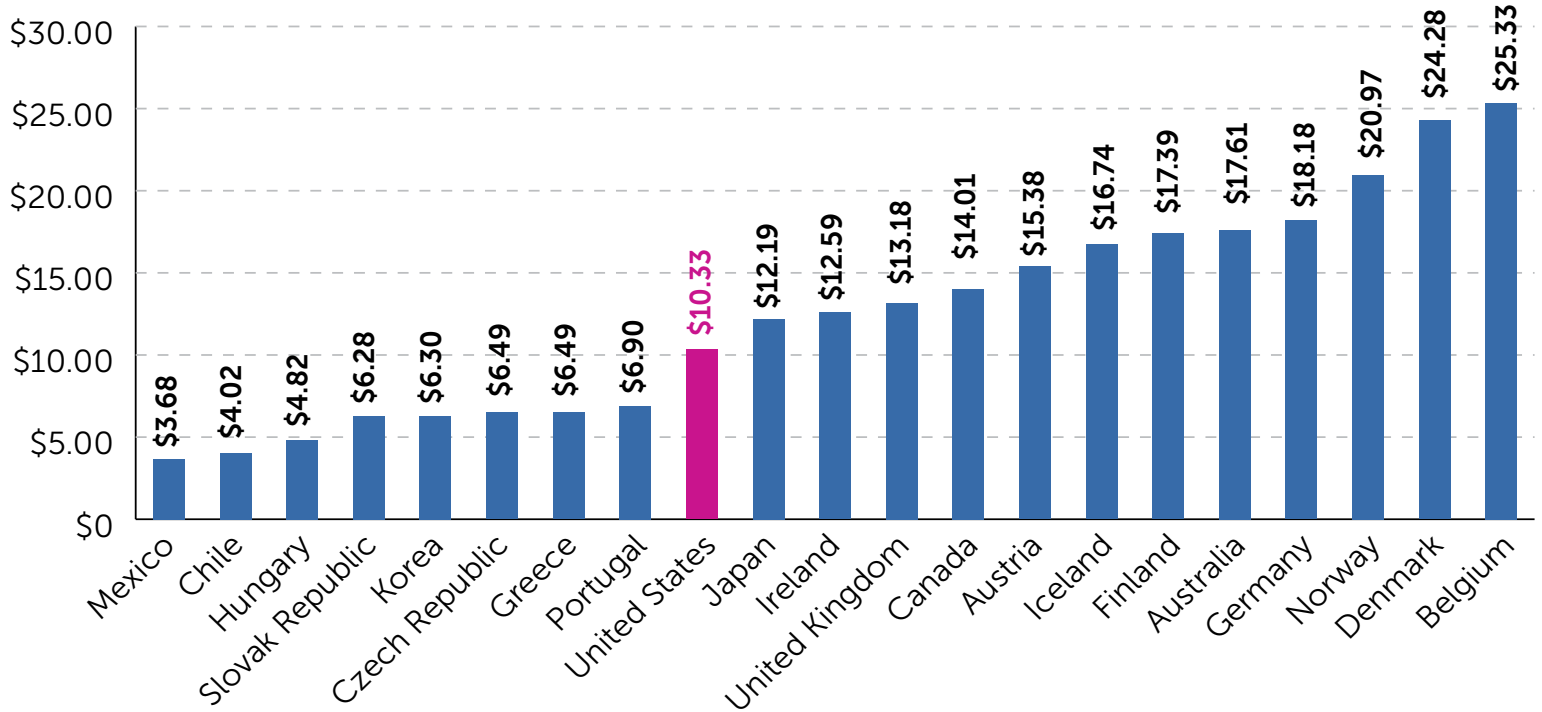
2. **Globalization**: Trade has been a huge positive for world welfare but has placed pressure on manufacturing jobs and manufacturing-intensive communities

3. **Institutions**: Weakened labor unions, historically low minimum wage, and outdated employment regulations have harmed rank and file workers

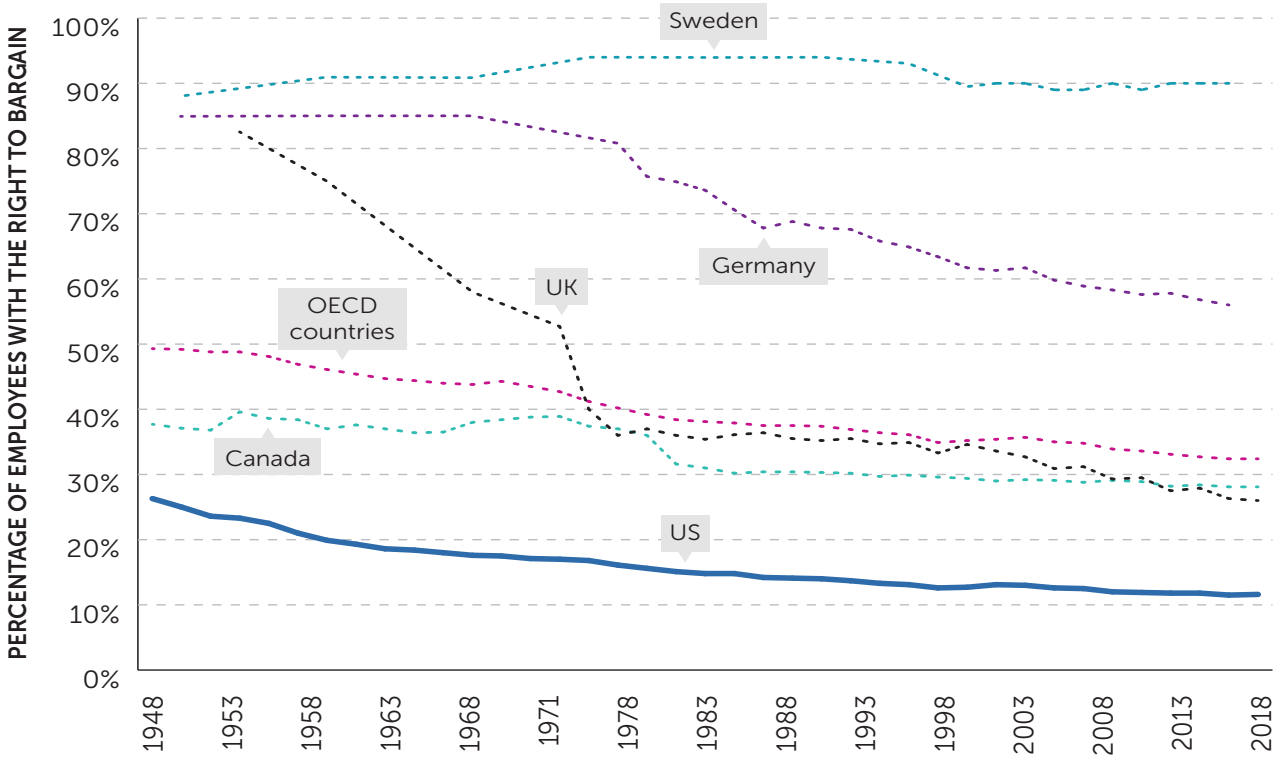
Less-Educated Workers in the U.S. Receive Lower Pay Than in Other Industrialized Countries

Purchasing Power-Adjusted Hourly Earnings of Low-Education Workers in 2015



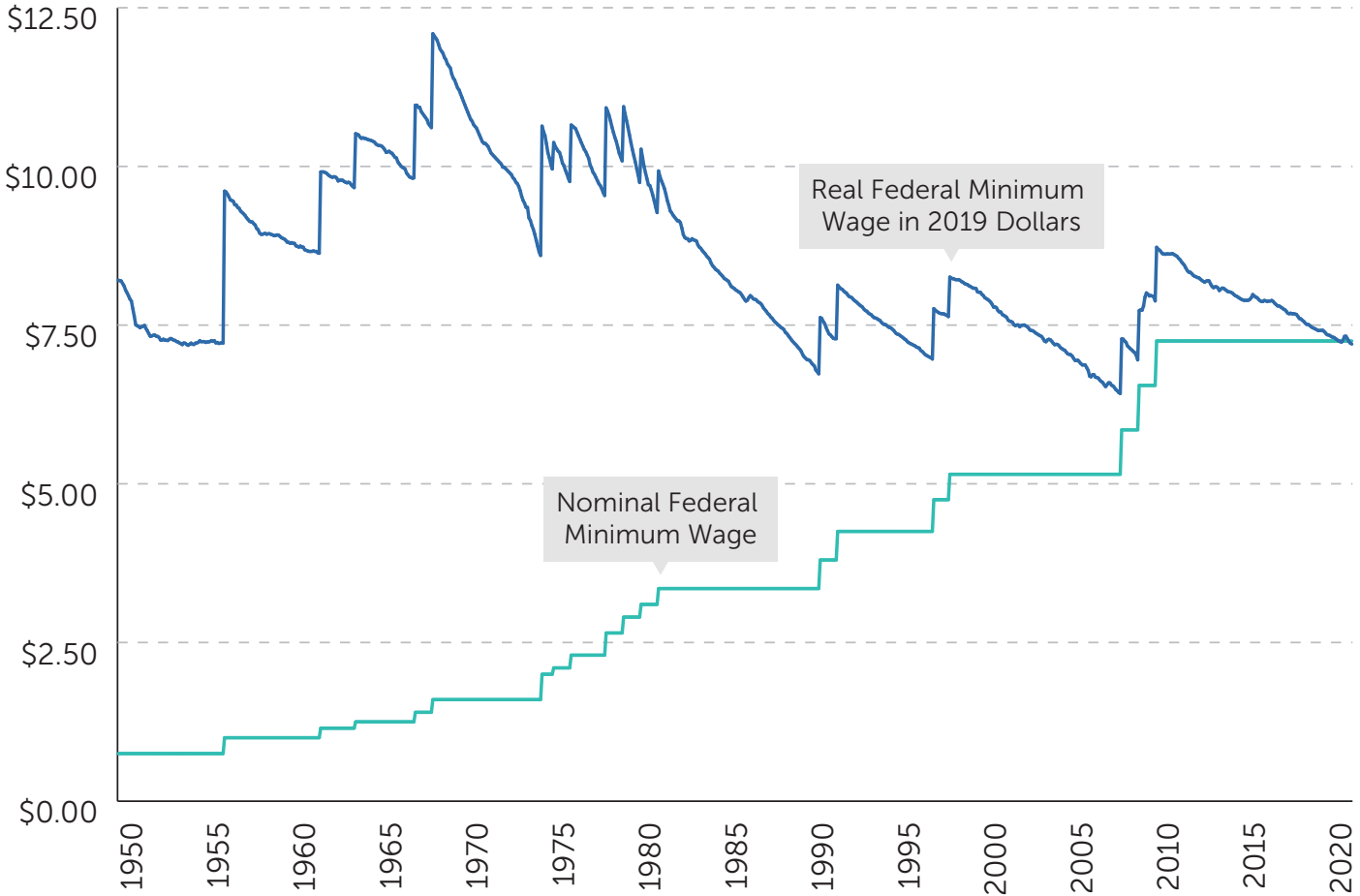
Collective Bargaining is Declining in Many Industrialized Countries

U.S. and U.K. are Outliers



Source: OECD.Stat: Collective bargaining coverage. ICTWSS database version 6.0 (June 2019).

Real U.S. Federal Minimum Wage Has Fallen to Near Irrelevance



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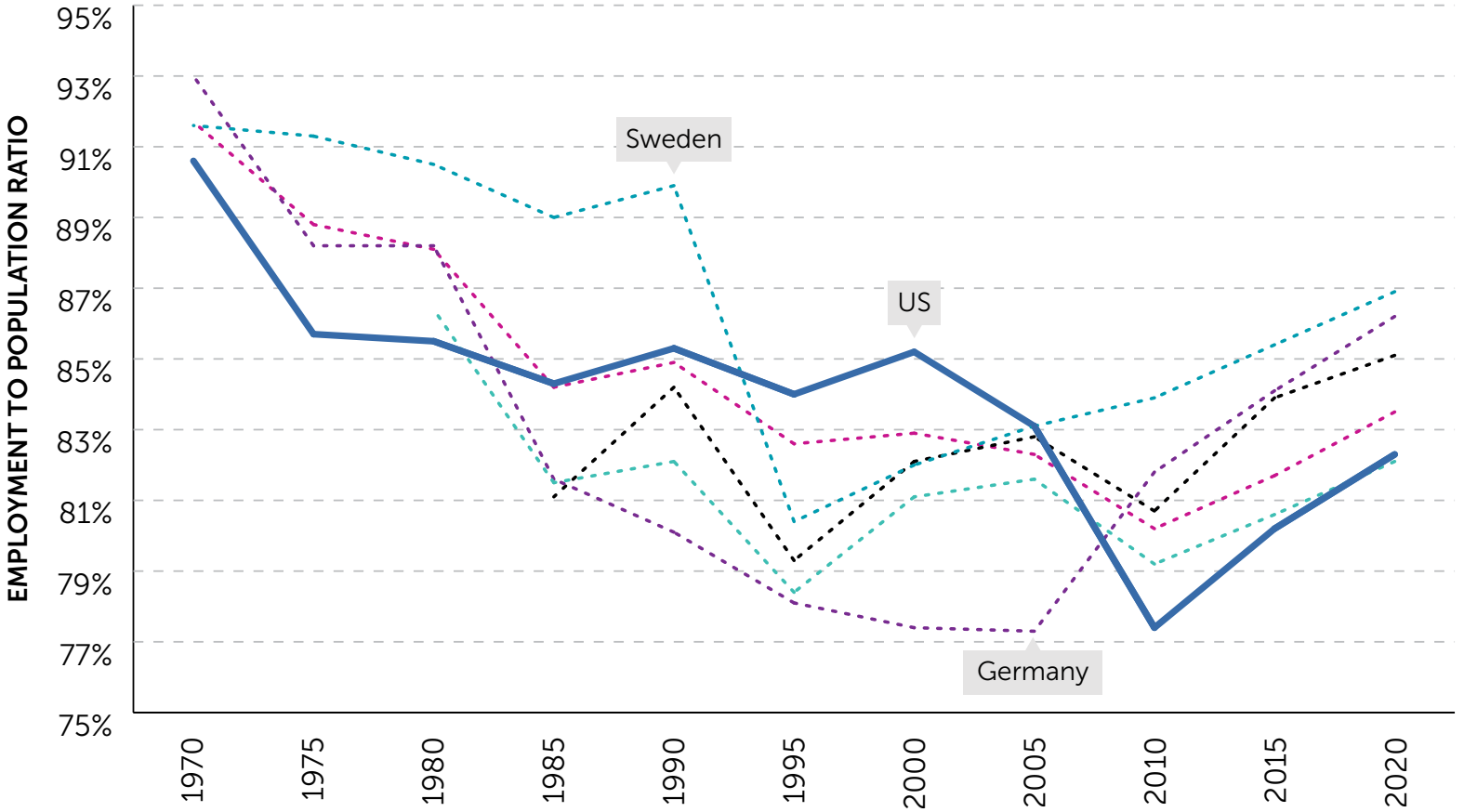
III. Are We Getting a Positive 'Return' on Inequality?

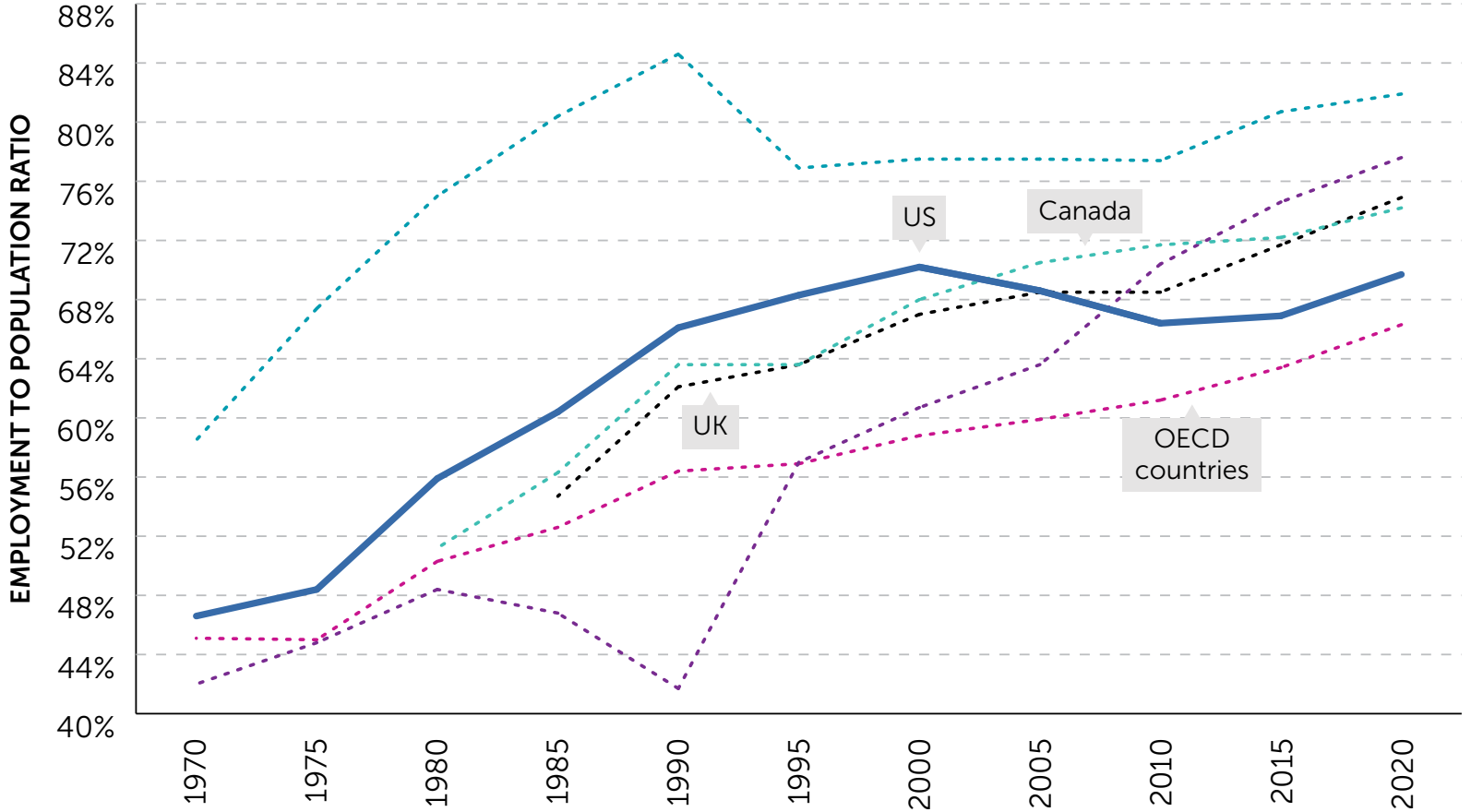
Are We Getting a Positive 'Return' on Inequality?

1. Labor Force Participation
2. Economic Mobility
3. Economic Growth

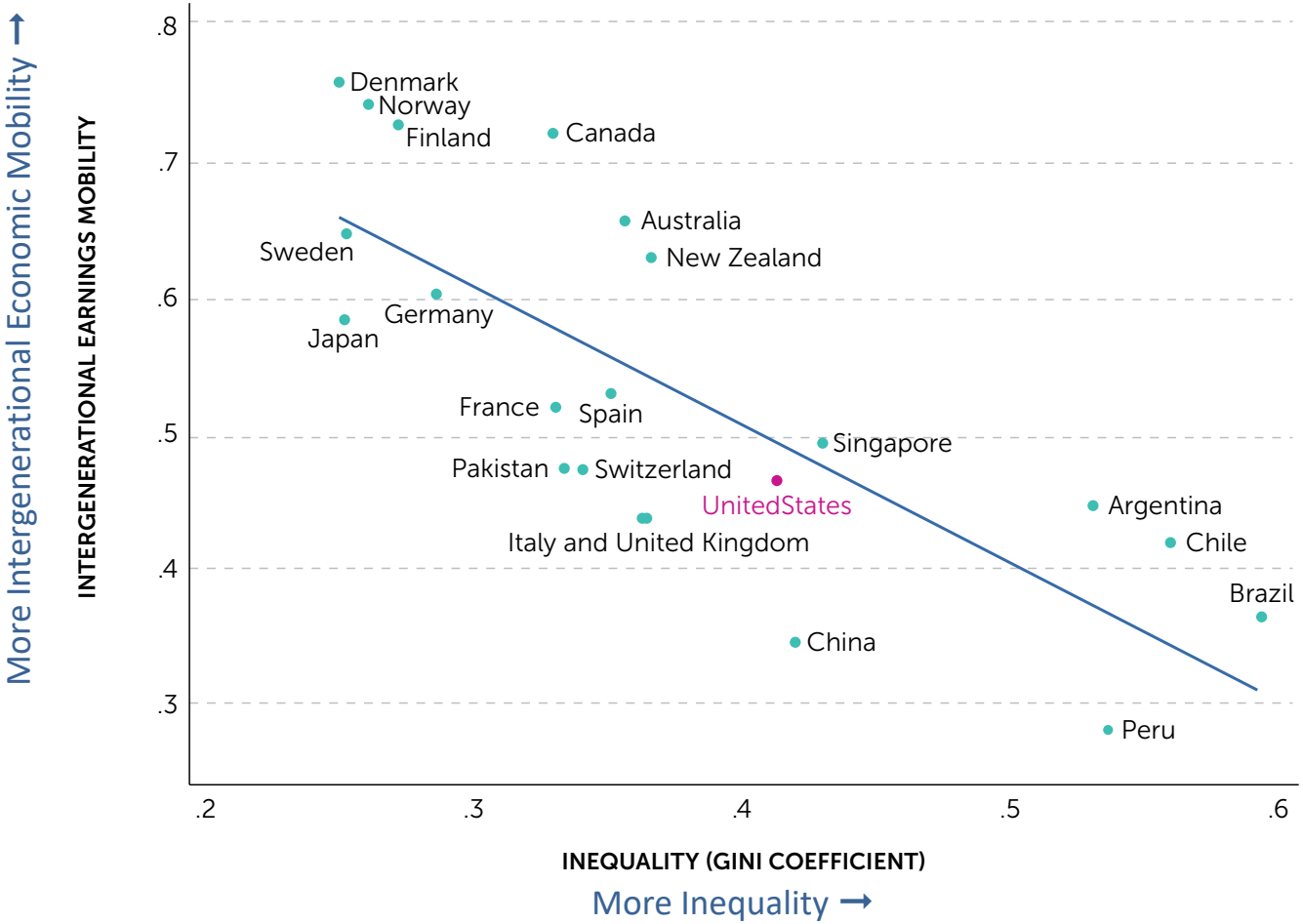
Employment to Population Rates are Not Higher in More Unequal Countries: Men



Employment to Population Rates are Not Higher in More Unequal Countries: Women



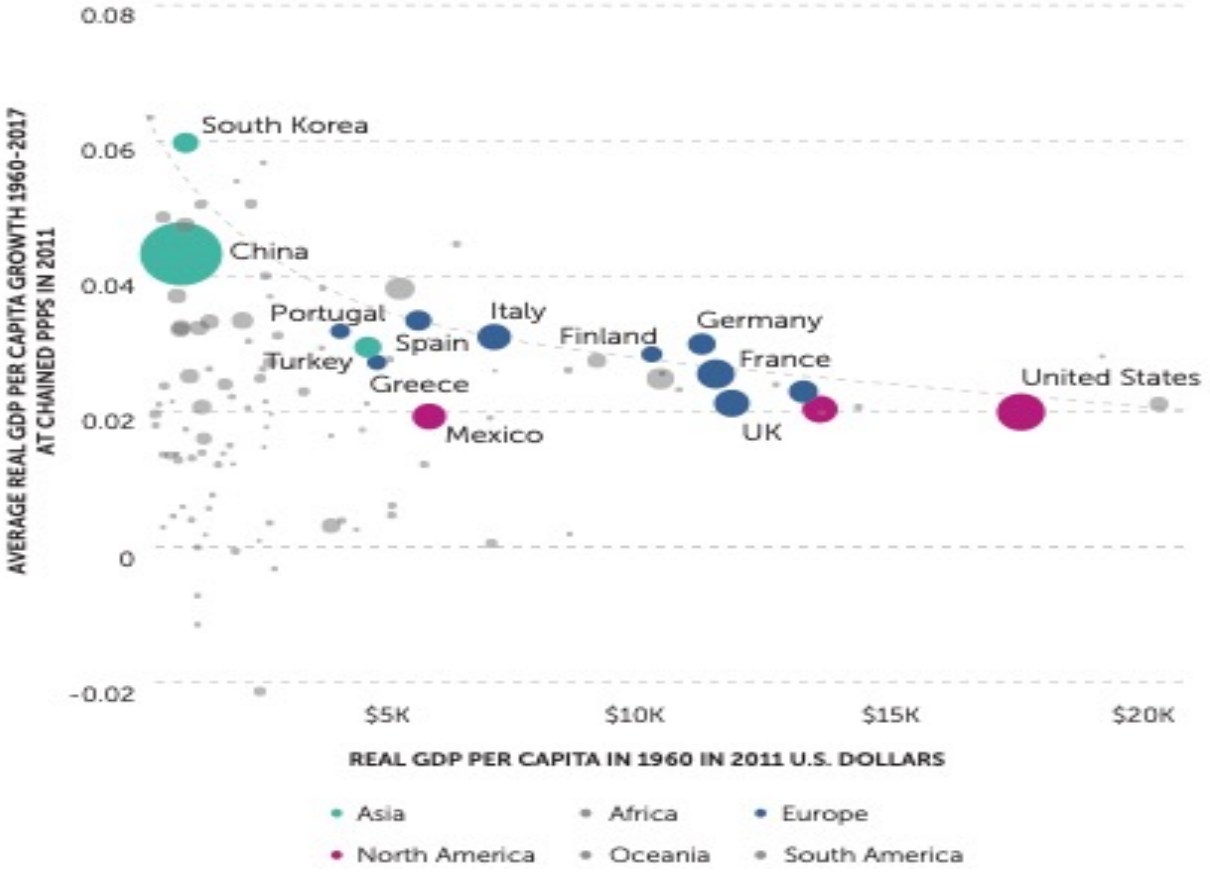
Inequality Does Not Appear to Promote Intergenerational Mobility



Corak 2013

High Inequality and Low Taxes Do Not Predict Faster Growth

Average GDP Growth Rate 1960 – 2011 vs. GDP per Capita in 1960



Sources: Feenstra et al. (2015): Penn World Tables 9.1, Population (Gapminder, HYDE (2016) & UN (2019))

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IV. Technological Context

The Momentous Impacts of Technological Change are Unfolding Gradually

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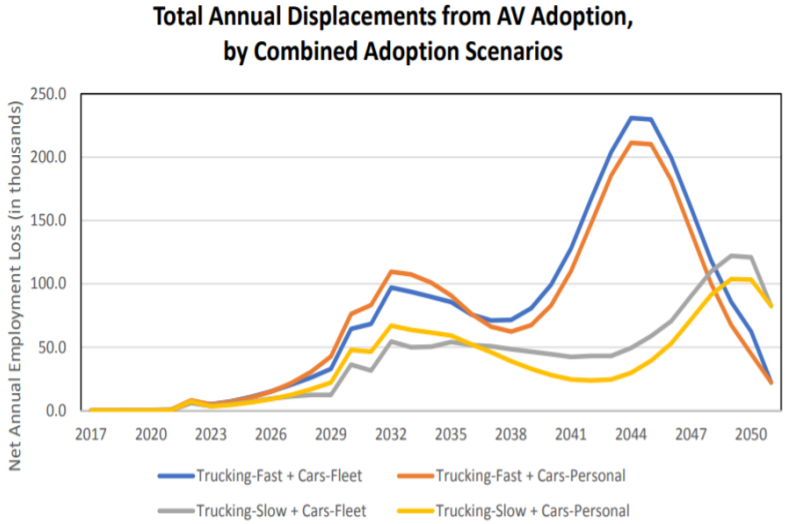
1. Autonomous vehicles
2. Industrial robotics
3. Intelligent supply chains
4. Additive manufacturing
5. Artificial intelligence

AVs Estimated to Displace 1.3 – 2.3m U.S. Workers

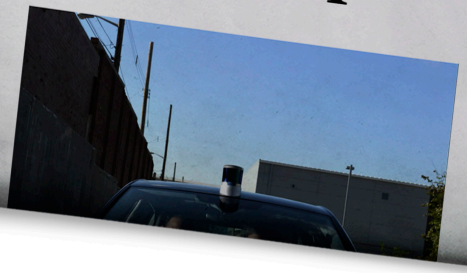
- Size similar to recent China trade shock – but slower moving
- Regional disparities – esp. hard on South
- Potential increase in workers' commuting range—OR increased congestion, collapse of public transit



The Washington Post

The Switch

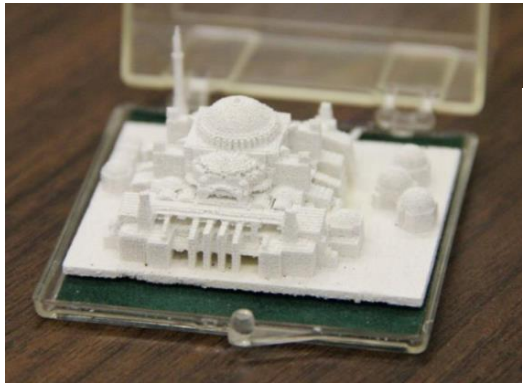
Shaken by hype, self-driving leaders adopt new strategy: Shutting up



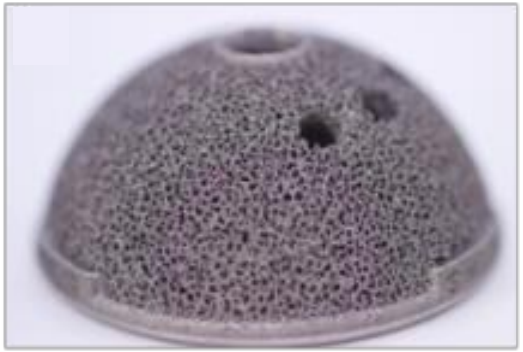
OCTOBER 18, 2018

Three former executives at Google, Tesla and Uber who once raced to be the first to develop self-driving cars have adopted a new strategy: Slow down. And shut up.

Additive Manufacturing has Transformative Potential



MIT Dome



Metal Hip Implant

Aircraft Fuel Nozzle

Faucet

Orthodontic Retainer

The Momentous Impacts of Technological Change are Unfolding Gradually

1. AI and robotic applications take time (decades) to develop and deploy, especially into safety- and production-critical applications. While they are coming, they are not as close as some would fear, offering some time for preparation

2. The largest labor-market effects of technology we're seeing still stem from maturing IT like internet, mobile computing, EHR and e-commerce

3. We can see glimpses of the future today; it will take time to fully distribute. This time window offers opportunity

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V. The Work of the Future

Institutional Innovation
Must Complement Technological Innovation

1. **Invest and innovate in skills and training**
2. Ensure productivity gains translate into better quality jobs
3. Expand and shape innovation

Invest and Innovate in Skills and Training at Scale

- **Develop and field-testing innovative methods and tools** for delivering training including online and hybrid models
- **Foster private sector investment in training** to facilitate upward mobility among lower-wage, less-educated and minority workers
- **+ Federal funding for training programs** that lead to middle-class jobs without four-year degrees. Competitive funds for **community colleges and labor market intermediaries**
- **Policies to raise degree completion rate at community colleges**
- **Require, and fully fund, RCTs** of training programs to gauge efficacy in achieving employment and earnings outcomes
- **Improve labor market information for workers seeking jobs and jobs seeking workers**

Institutional Innovation
Must Complement Technological Innovation

1. Invest and innovate in skills and training

2. **Ensure productivity gains translate into better quality jobs**

3. Expand and shape innovation

Improve Job Quality

- **Modernize the Unemployment Insurance System**
- **Restore the real value of the federal minimum wage** to at least 40 percent of the national median wage and **index this value** to inflation
- **Strengthen and adapt labor laws**
  - Enforce existing protections and processes for workers to gain access to collective bargaining
  - Open up labor law to allow innovation in new forms of representation in workplace and corporate decision-making and governance
  - Build legal protections for organizing w/o retaliation in non-traditional realms: domestic + home-care workers, independent contractors, farmworkers, etc.

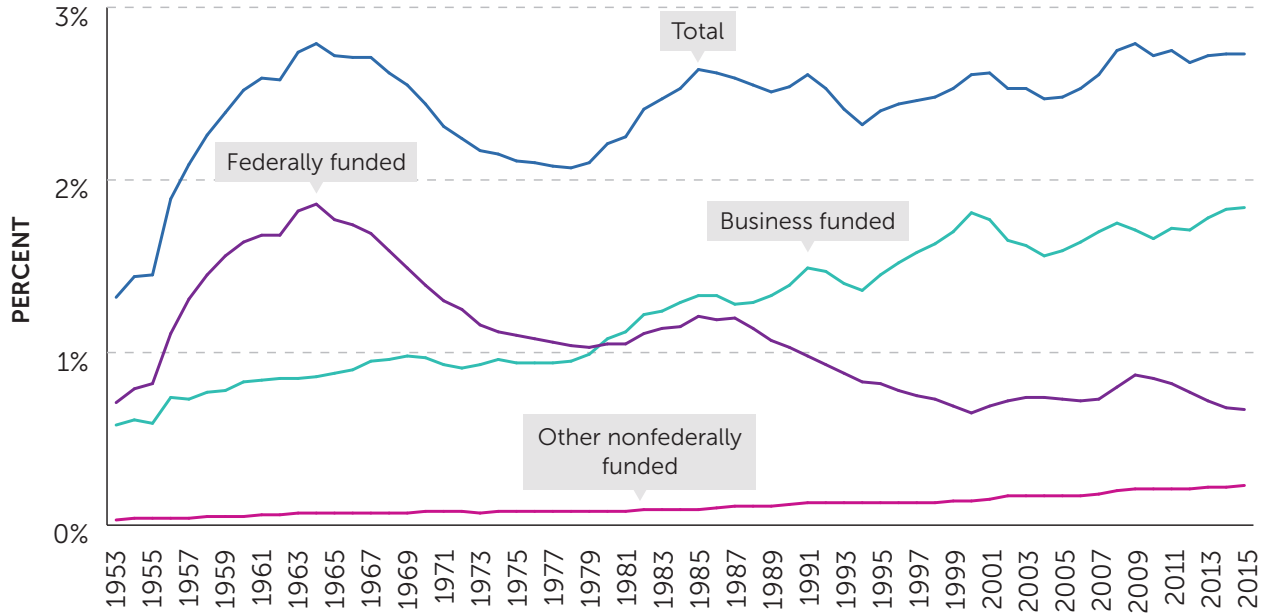
Institutional Innovation
Must Complement Technological Innovation

1. Invest and innovate in skills and training

2. Ensure productivity gains translate into better quality jobs

3. **Expand and shape innovation**

Public investment share of R&D has fallen from approximately 40% in 1985 to approximately 25% in 2015



Source: This figure displays data from figure 4-3 of National Science Board (2018), chap. 4. The original data are drawn from the National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

Notes: The figure shows how spending on R&D performed in the United States, presented as a share of GDP, has evolved over time from 1953 to 2015, in total and broken down by source of R&D funding.

Expand and Shape Innovation

- **Increase federal research spending** and **use it to set the agenda**
- **Expand the geography of innovation in the U.S.** Spread the benefits of innovation to a broader set of regions
- **Rebalance taxes on capital and labor** by altering the ways the tax code currently unduly favors investments in capital
  - Eliminate accelerated depreciation allowances
  - Apply corporate income tax equally to all corporations
  - Maintain federal R&D tax credit but enact an employer training tax credit

The Work of the Future is Ours to Invent

1. There is a palpable fear of the future – a consequence of divergence between innovation and labor market opportunity
2. If we deploy new technologies into existing labor systems, we will get the same problematic results
3. We should reject false tradeoffs between economic growth and strong labor markets
4. The majority of today's jobs had yet to be invented a century ago. The job of the present is to build the work of the future