

# Technological Disruption, the Labor Market, and Appropriate Policy Responses

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June 27, 2017



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# About ITIF

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- One of the world's top science and tech policy think tanks
- Formulates and promotes policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress
- Focuses on a host of issues at the intersection of technological innovation and public policy:
  - Innovation processes, policy, and metrics
  - Science policy related to economic growth
  - E-commerce, e-government, e-voting, e-health
  - IT and economic productivity
  - Innovation and trade policy

# Today's Presentation

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- 1 Claims Regarding Tech & Work
- 2 A Historical Perspective
- 3 Will the Future Be Different?
- 4 What Should Policymakers Do?

# Prognosticators Say Tech Will Transform Everything

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A few recent books:

- *The Singularity*
- *The Second Machine Age*
- *The Third Wave*
- *The Fourth Industrial Revolution*
- *The Fifth Technology Revolution*
- *The Sixth Wave*
- *Infinite Progress*



# Moore's Law is Speeding Up

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- “We are entering the second half of the “exponential chess board.”
  - Erik Brynjolfsson
- “Information technology ... progresses exponentially.”
  - Ray Kurzweil



# Leading to Unprecedented Change

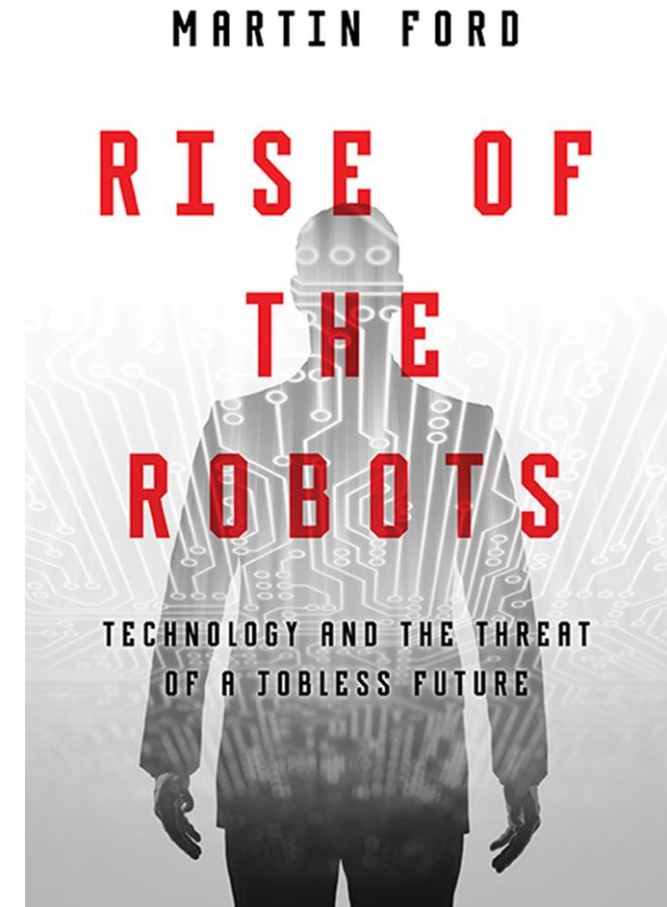
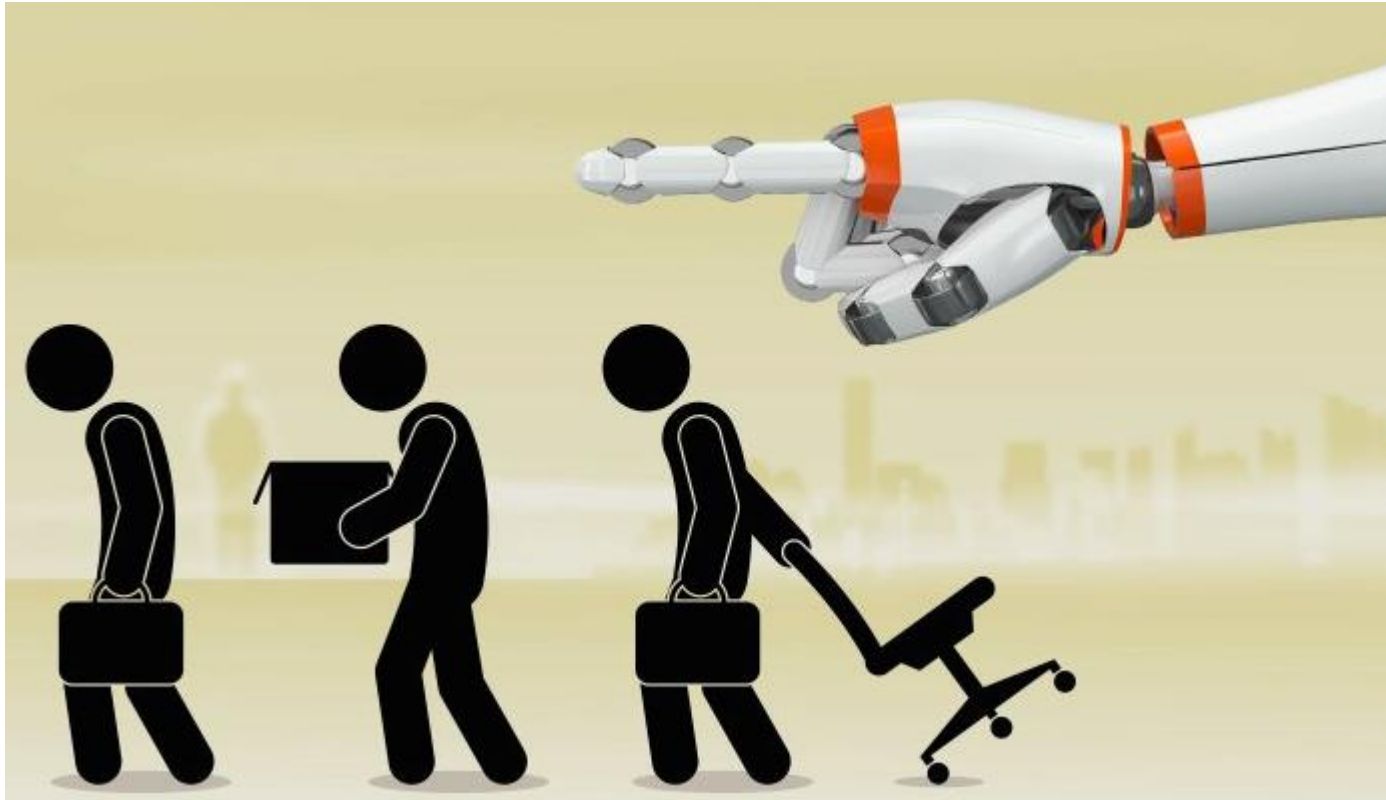
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- “We are entering into an era in which the pace of innovation is growing exponentially.” – Peter Diamandis and Steve Kotler
- “We’re in a world of exponential transformational change.” – Daniel Burrus
- “Explosive and exponential advances.” – Joseph Jaffe



# Leading to Unprecedented Job Destruction

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# Leading to Unprecedented Job Destruction

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- “...half the jobs ... might be eliminated by innovations such as self-driving vehicles, automatic checkout machines and expert systems. (Larry Summers)
- “Highly educated workers are as likely as less educated workers to find themselves displaced.” (Paul Krugman)
- “Brain work may be going the way of manual work.” (*The Economist*)
- “75% unemployment by 2100,” (Martin Ford, *The Rise of the Robots*)
- 47% of U.S. jobs eliminated by 2035 (Osborne and Frey).
- 80 to 90% of U.S. jobs eliminated in 10 to 15 years (Vivek Wadhwa)

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# Historical Patterns: Methodology

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- Two occupational data sets from Minnesota Population Center, which used Census's American Community Survey with BLS classifications:
  - One data set using 1950 occupational classifications to examine change from 1850 (the earliest year of data collection) to 2015
  - Another data set using 2010 classifications covering 1950 to 2015.
- Researchers estimated employment by occupation at the national level by weighting the individual responses of a census.
- Because occupational categories change from decade to decade, they harmonize historical occupational categories to occupation codes in either 1950 or 2010.

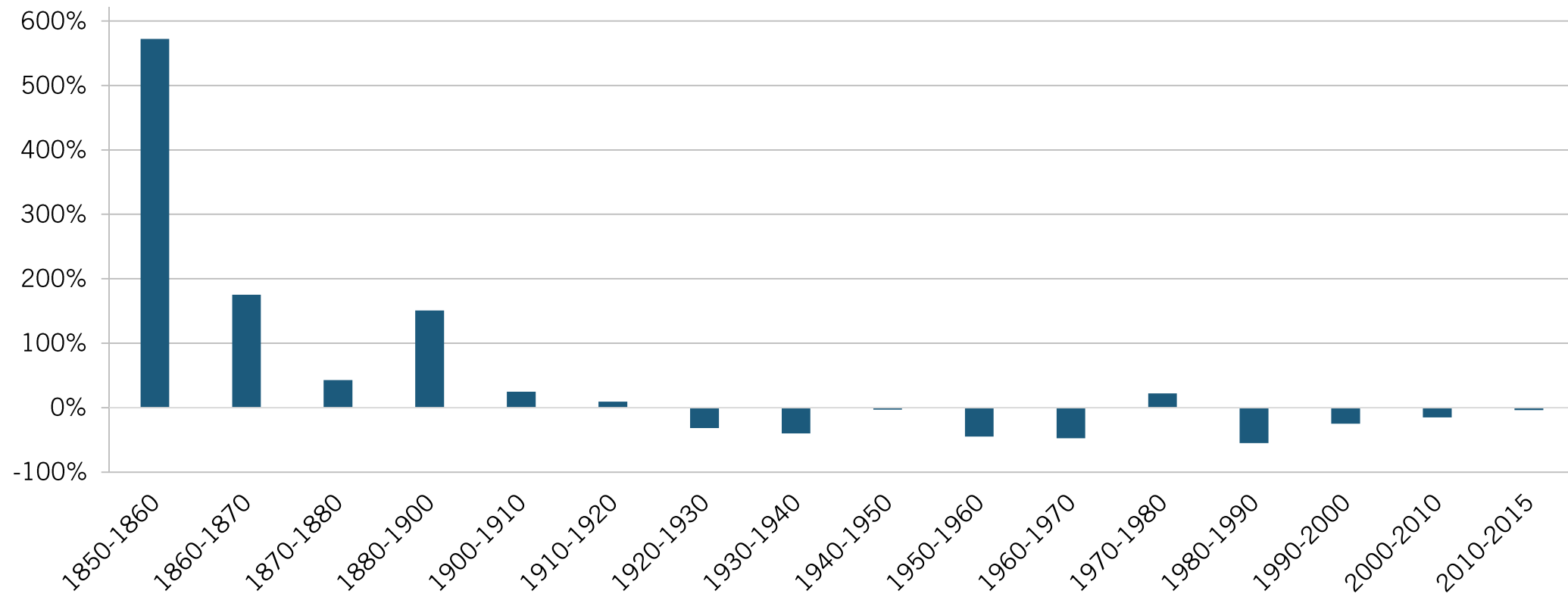
# Historical Patterns: Methodology

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- Method 1: Absolute change in each occupation relative to overall change.
  - If an occupation didn't grow as fast as the overall labor market, then the delta between that growth and overall labor force growth would be calculated as churn.
- Method 2: Excludes occupations that grew less than average.
  - For declining occupations, only includes a sum of occupational changes where there was an absolute loss in jobs.
  - On the growth side, only includes occupations that grew faster than national average.
- There was robust correlation between these two measures (0.92 for 1950 occupation codes and 0.90 for 2010 occupation codes respectively).

# Examples of Technology-Driven Change in Occupations

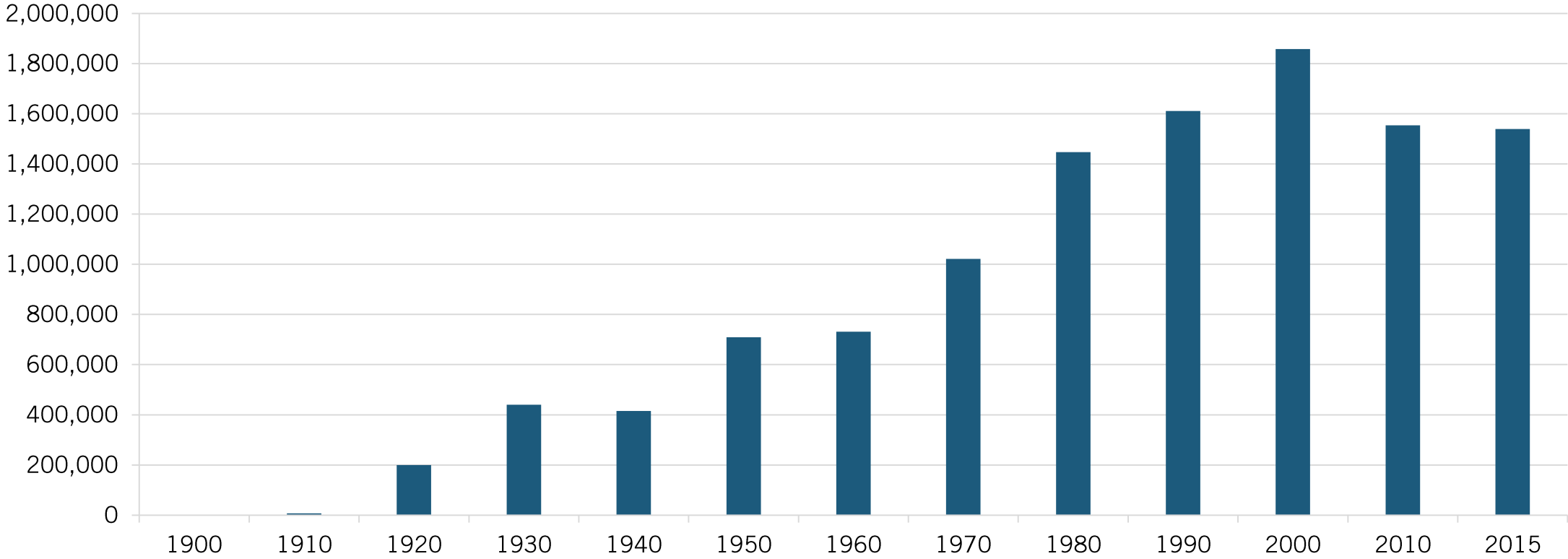
## Locomotive Engineers, Railroad Conductors, and Railroad Brakemen



Source: ITIF analysis of IPUMS occupation data.

# Examples of Technology-Driven Change in Occupations

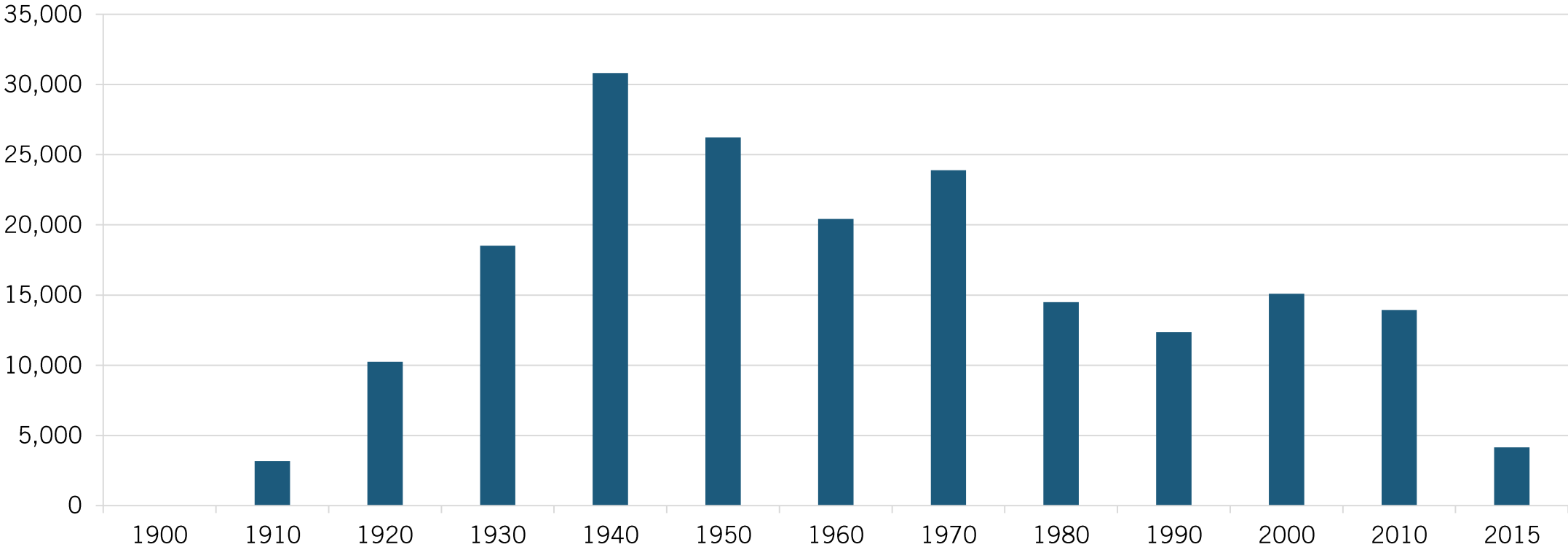
## Mechanics and Repairmen, Automobile



Source: ITIF analysis of IPUMS occupation data.

# Examples of Technology-Driven Change in Occupations

## Motion Picture Projectionists



Source: ITIF analysis of IPUMS occupation data.

# Examples of Technology-Driven Change in Occupations

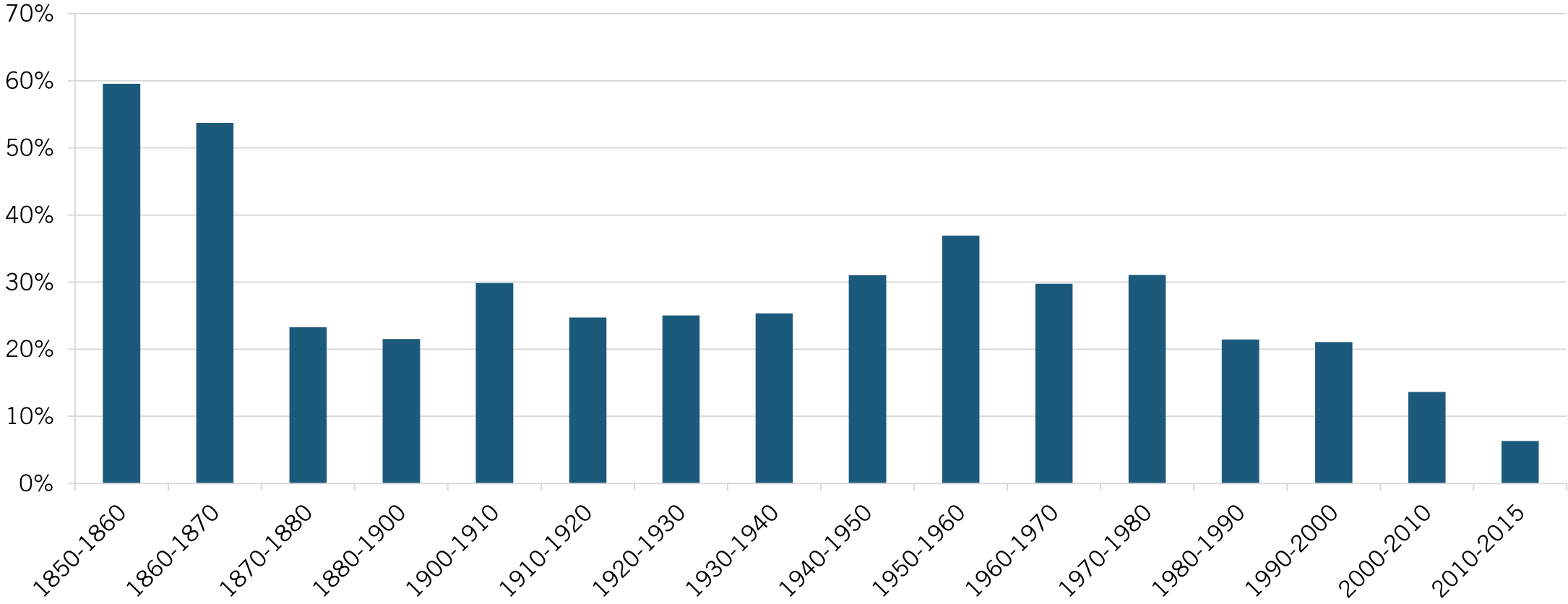
Growth of Computer Occupations Relative to Overall Employment Growth



Source: ITIF analysis of IPUMS occupation data.

# Examples of Technology-Driven Change in Occupations

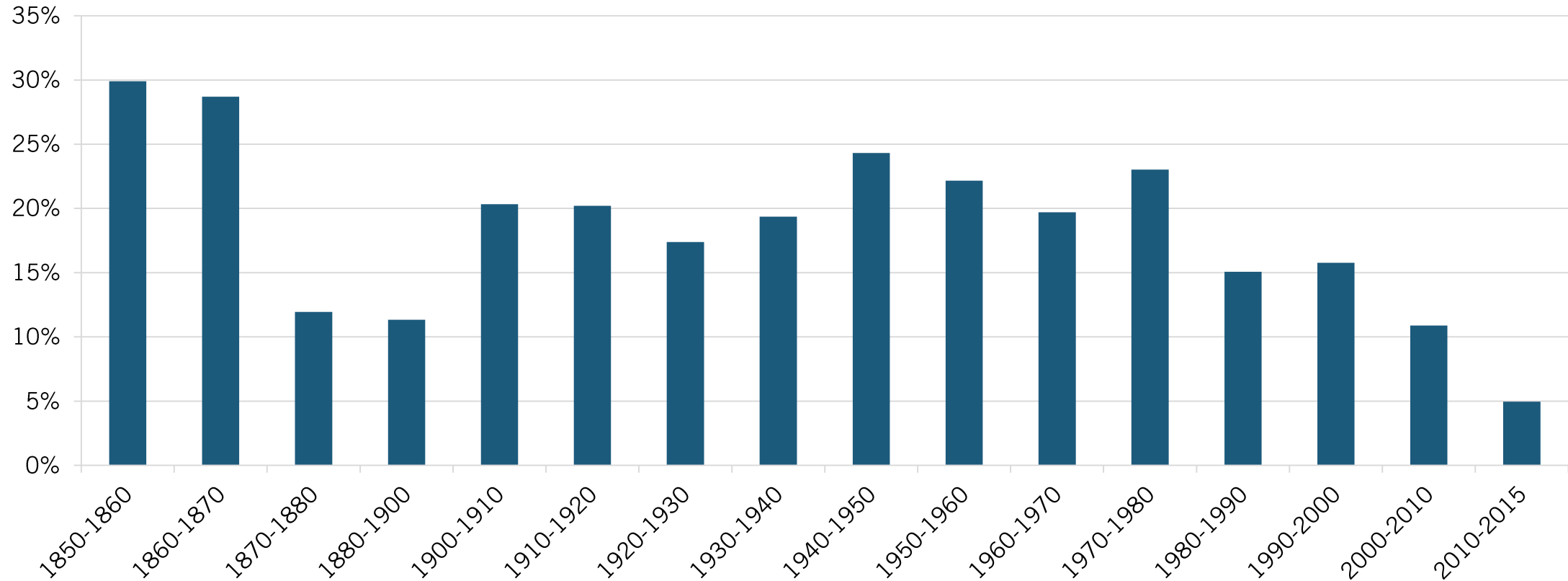
Rate of Occupational Change by Decade (1950 Categories, Method One)



Source: ITIF analysis of IPUMS occupation data.

# Examples of Technology-Driven Change in Occupations

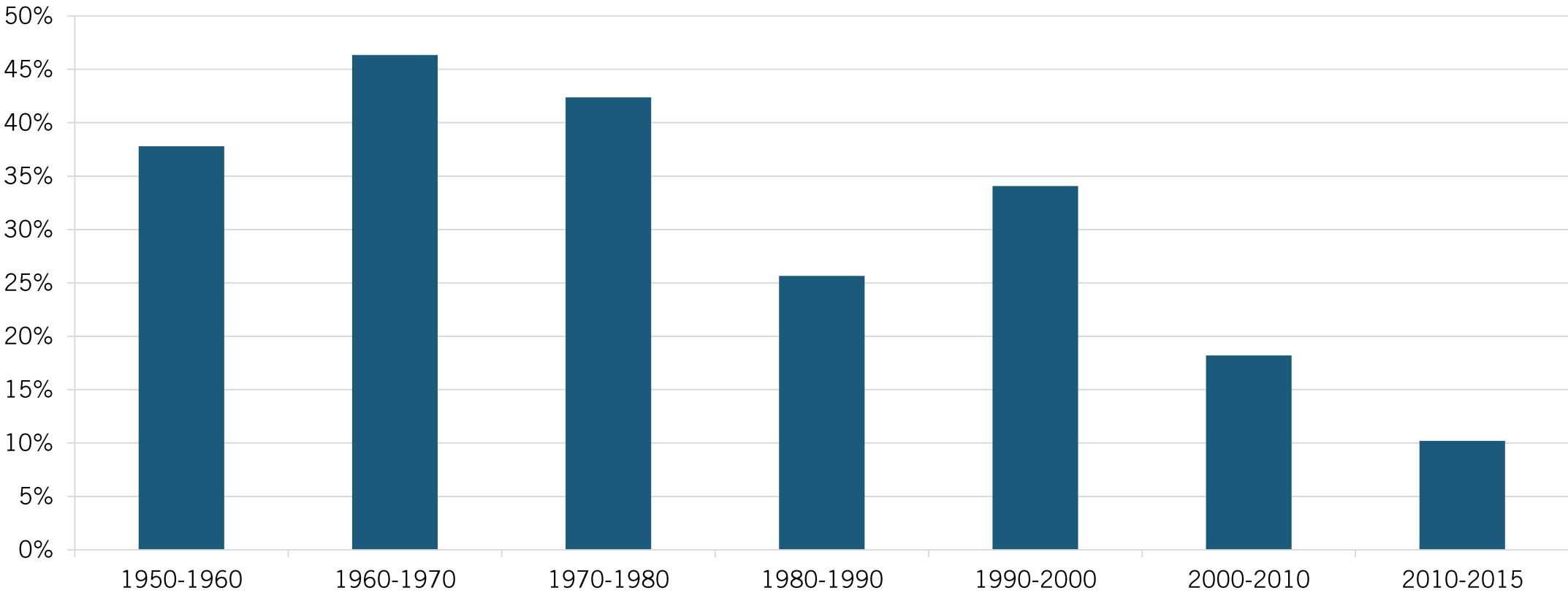
Rate of Occupational Change by Decade (1950 Categories, Method Two)



Source: ITIF analysis of IPUMS occupation data.

# Examples of Technology-Driven Change in Occupations

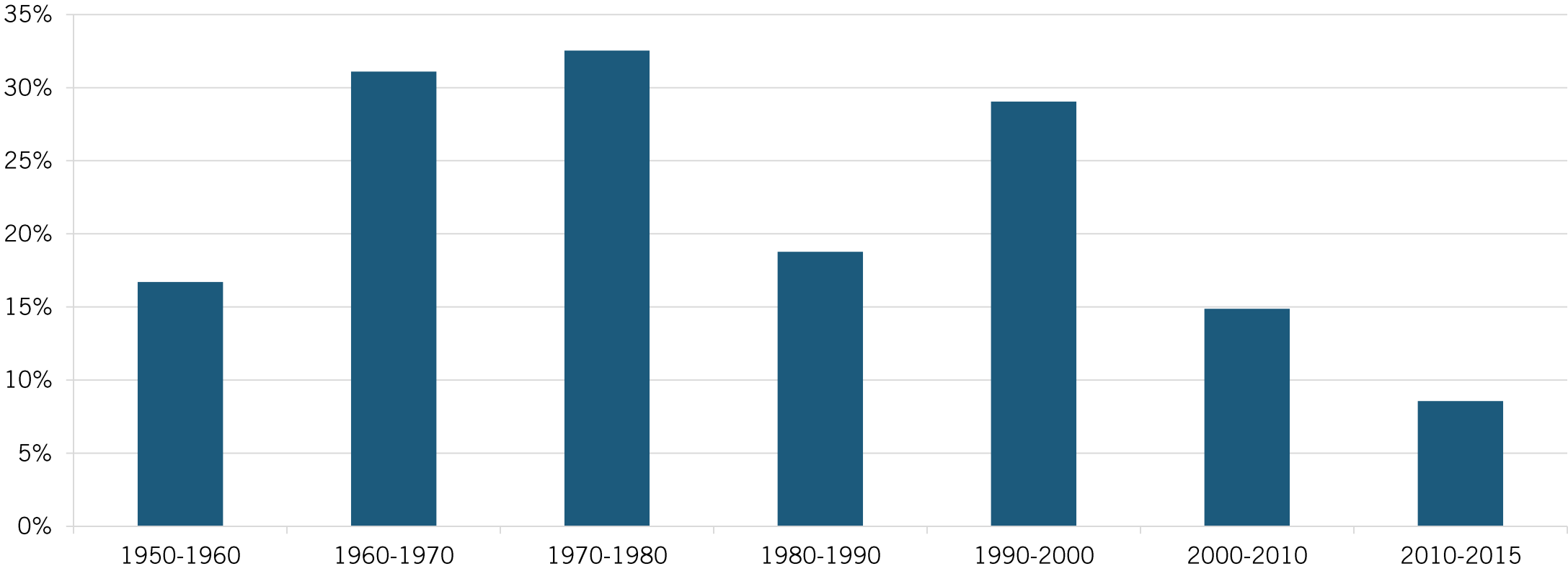
Rate of Occupational Change by Decade (2010 Categories, Method One)



Source: ITIF analysis of IPUMS occupation data.

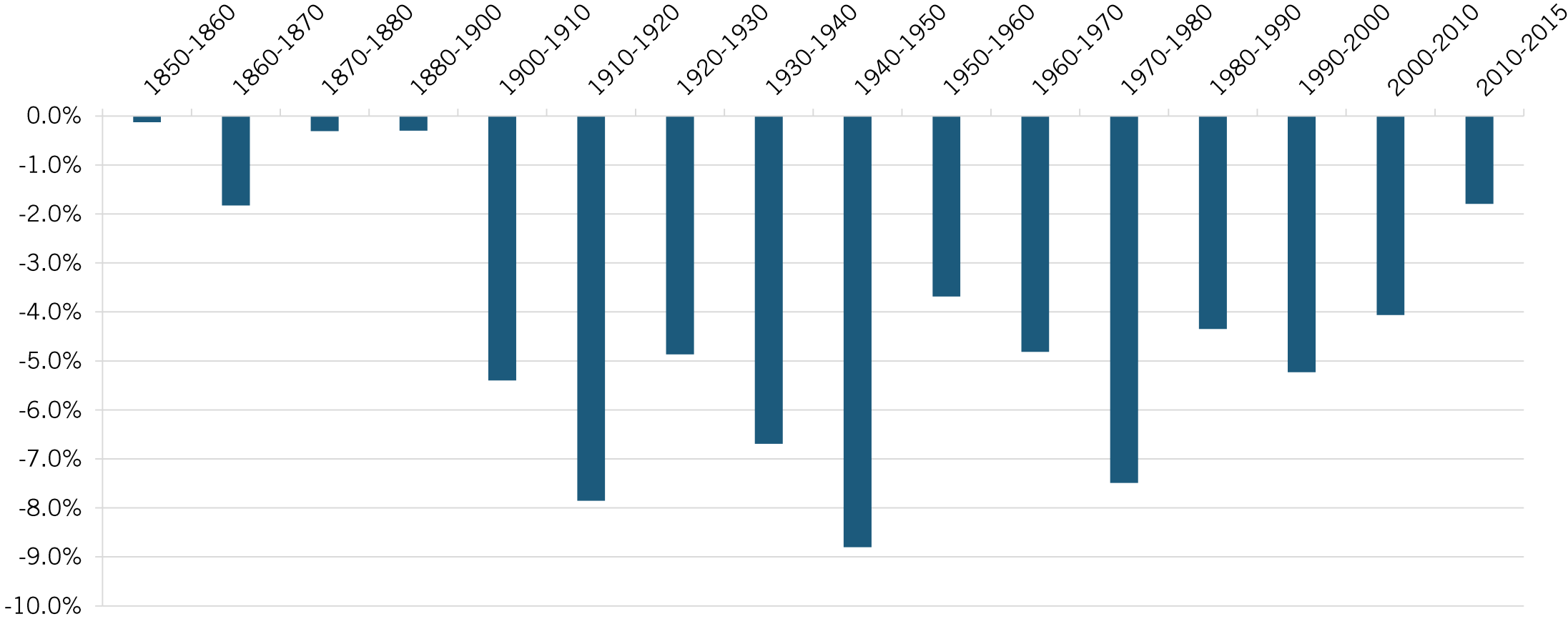
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Rate of Occupational Change by Decade (2010 Categories, Method Two)



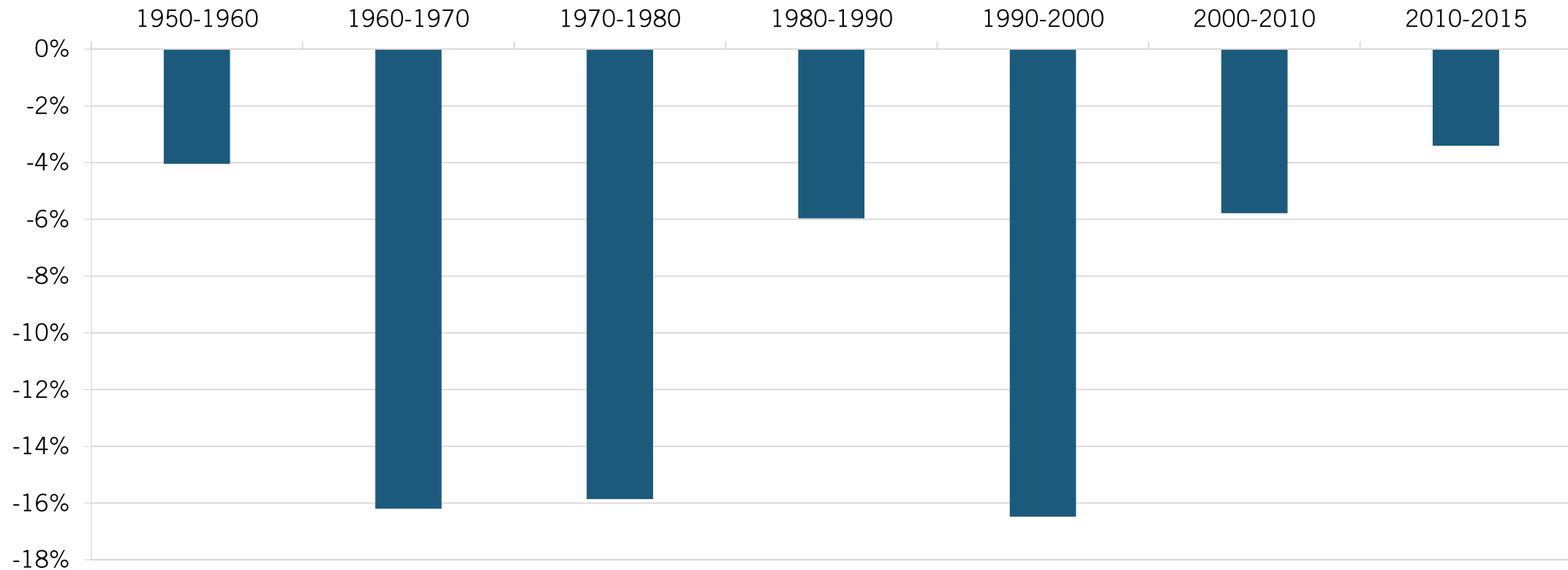
Source: ITIF analysis of IPUMS occupation data.

# Absolute Losses in Occupations, 1850–2015 (1950s Categories)



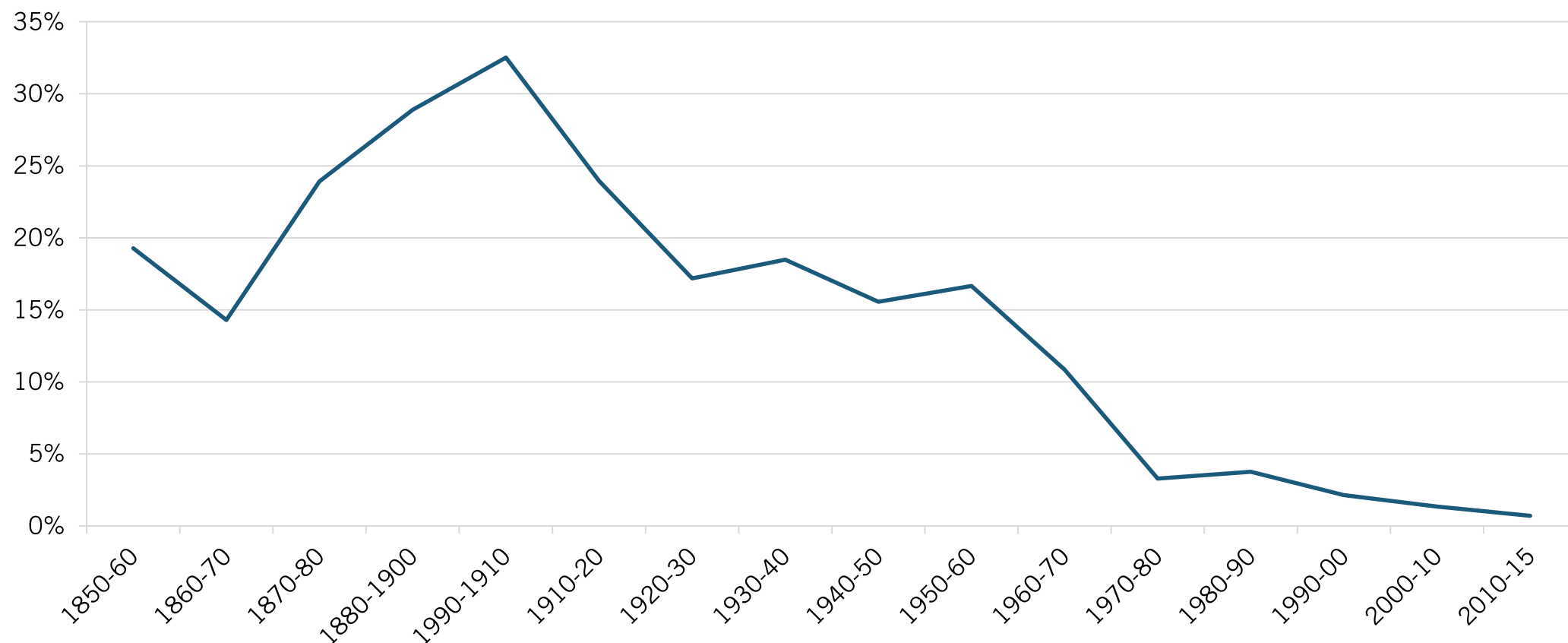
Source: ITIF analysis of IPUMS occupation data.

# Absolute Losses in Occupations, 1950–2015 (2010 Categories)



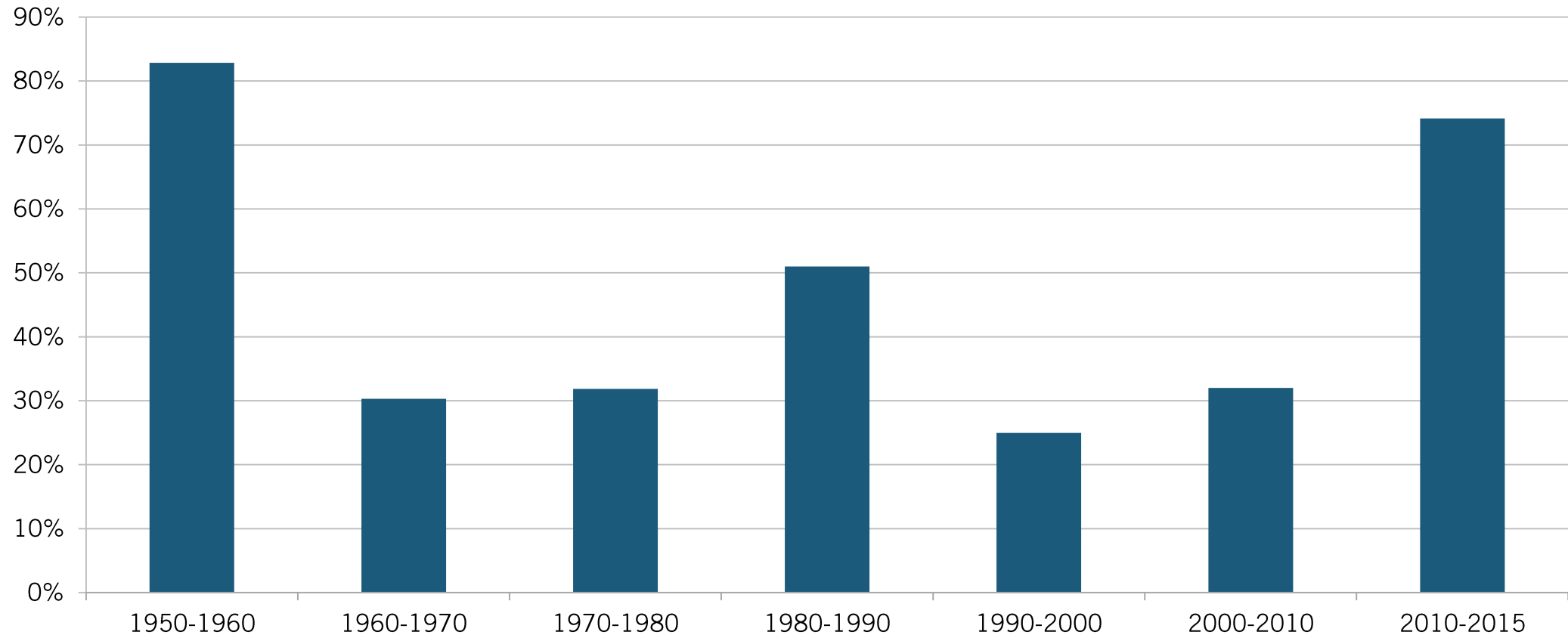
Source: ITIF analysis of IPUMS occupation data.

## Farm Employment Churn as a Share of Total Occupational Churn, by Decade



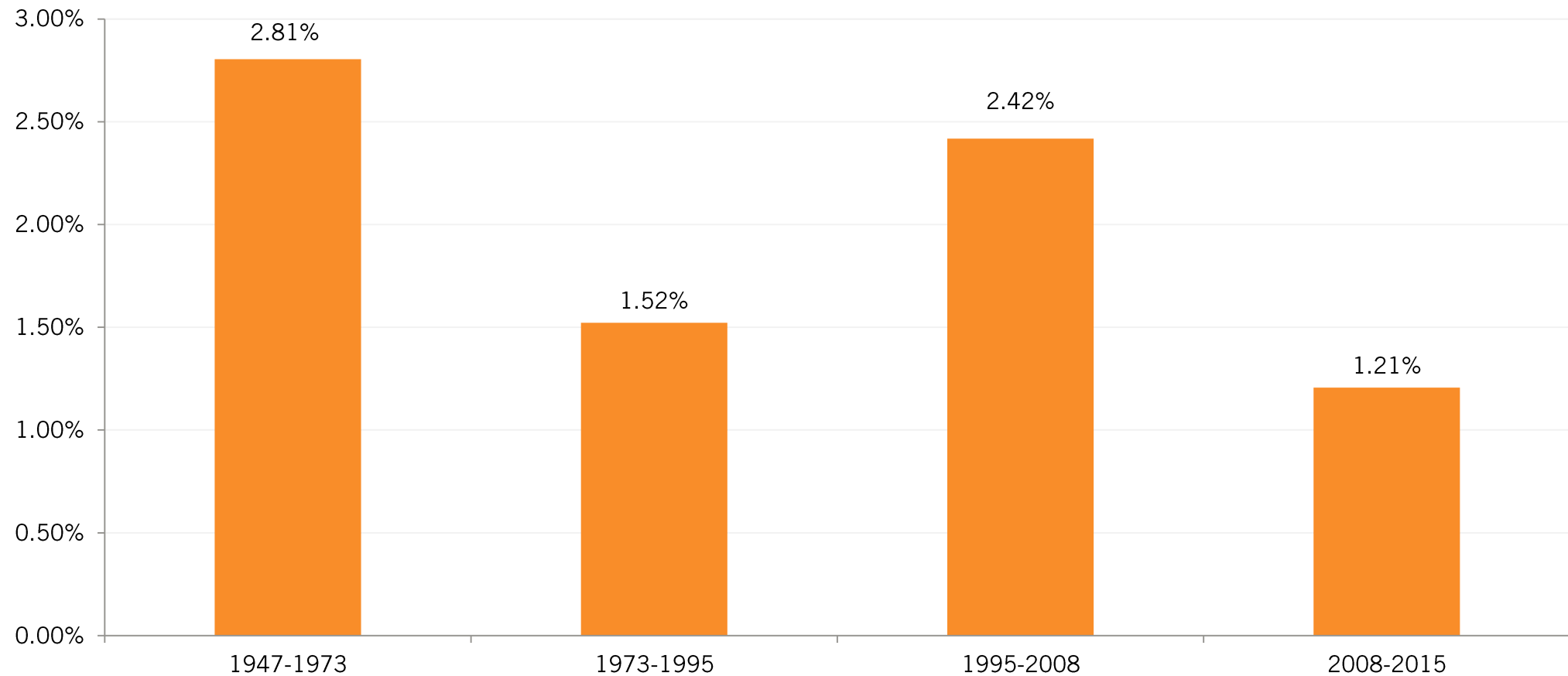
Source: ITIF analysis of IPUMS occupation data.

# Technology Creating New Jobs/Technology Eliminating Jobs



Source: ITIF analysis of IPUMS occupation data.

# U.S. is in a Productivity Rut



Source: U.S. Bureau of Labor Statistics, "Labor Productivity and Costs (Business, Labor Productivity, Index, base year = 100)"

# Past Predictions of Employment Doom Have Been Wrong

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- Marvin Minsky (1970): “in from 3 to 8 years we will have a machine with the general intelligence of an average human being.”
- Gail Garfield Schwartz (1982): “perhaps as much as 20% of the work force will be out of work in a generation.”
- Nil Nilson (1984): “We must convince our leaders that they should give up the notion of full employment. The pace of technical change is accelerating.”



# Today's Presentation

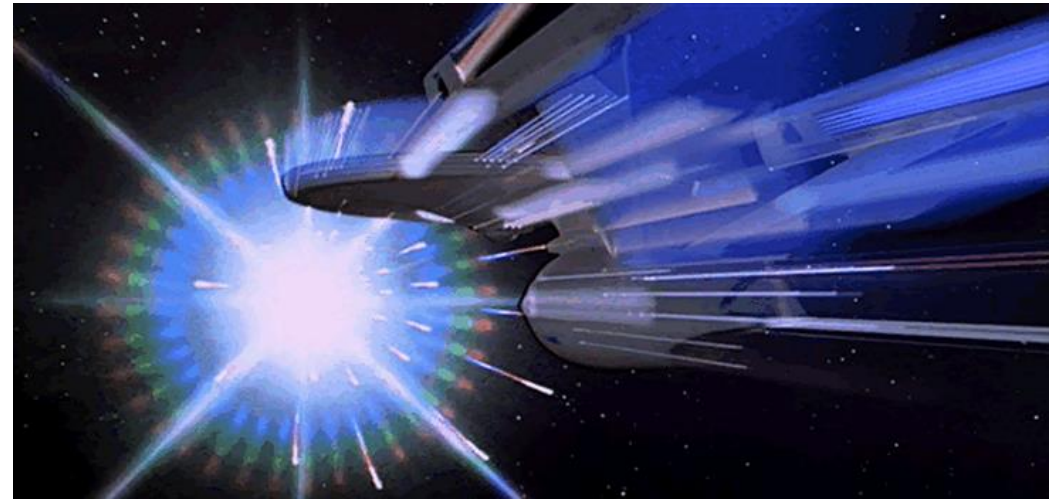
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# Technological Change Has Always Been Gradual

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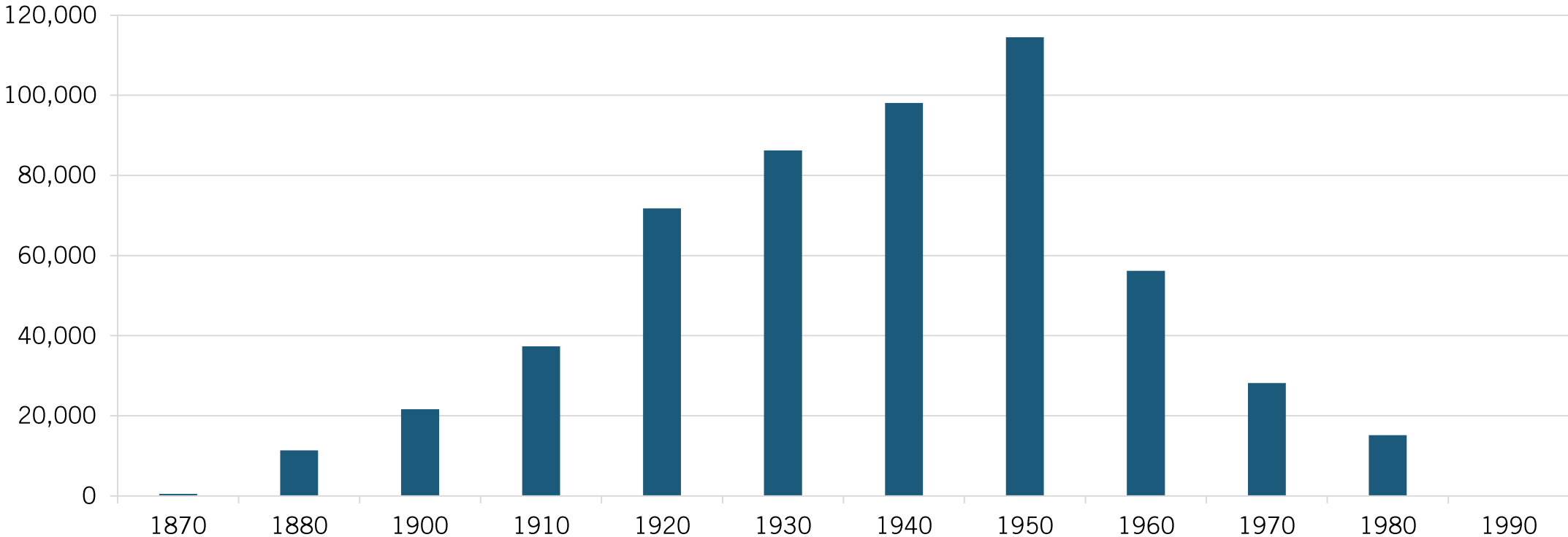
- “Misled by suitcase words, people are making category errors in fungibility of capabilities—category errors comparable to seeing the rise of more efficient internal combustion engines and jumping to the conclusion that warp drives are just around the corner.”



— (Rodney Brooks, MIT)

# Examples of Technology-Driven Change in Occupations

Number of Elevator Operators, 1870–1990



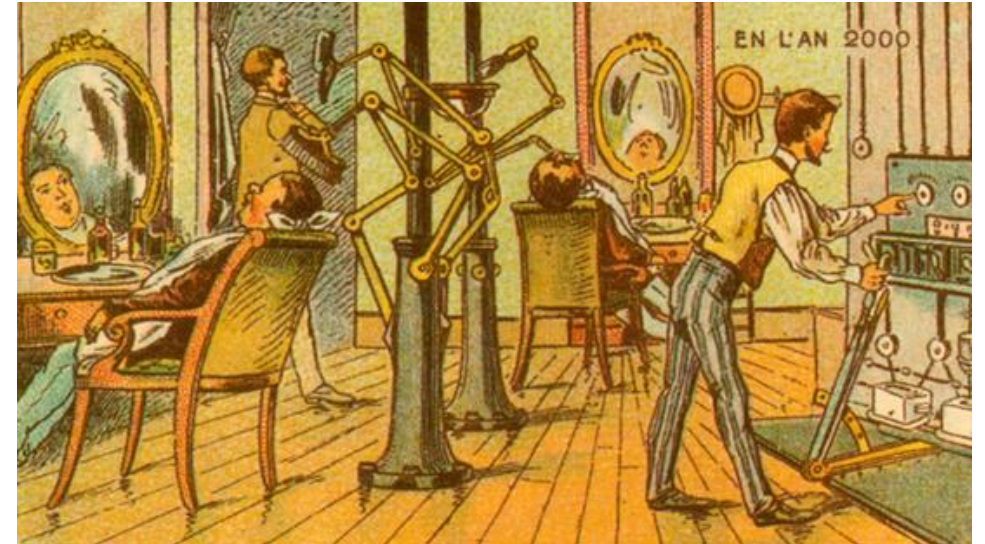
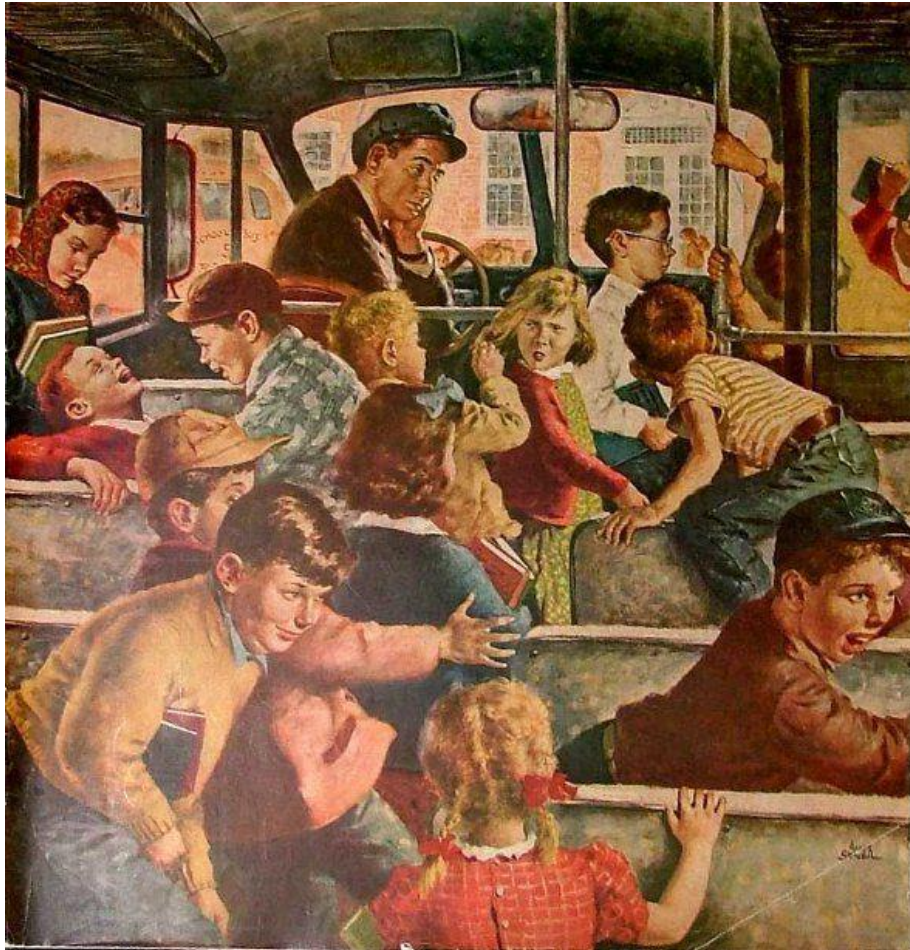
Source: ITIF analysis of IPUMS occupation data.

# Occupations at High Risk According to Frey and Osborne

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- Dental technicians
- Models
- Manicurists and pedicurists
- Bicycle Repairers
- Radio and Cellular Tower Installers and Repairers
- Fence Erectors
- Electrical and Electronics Installers
- School Bus Drivers
- Terrazo Workers and Finishers
- Carpet Installers
- Veterinary Assistants and Laboratory Animal Caretakers
- Insulation Workers
- Property, Real Estate and Community Association Managers
- Barbers
- Shoppers
- Drywall and Ceiling Tile Installers
- Aircraft Mechanics

# Occupations at High Risk According to Frey and Osborne



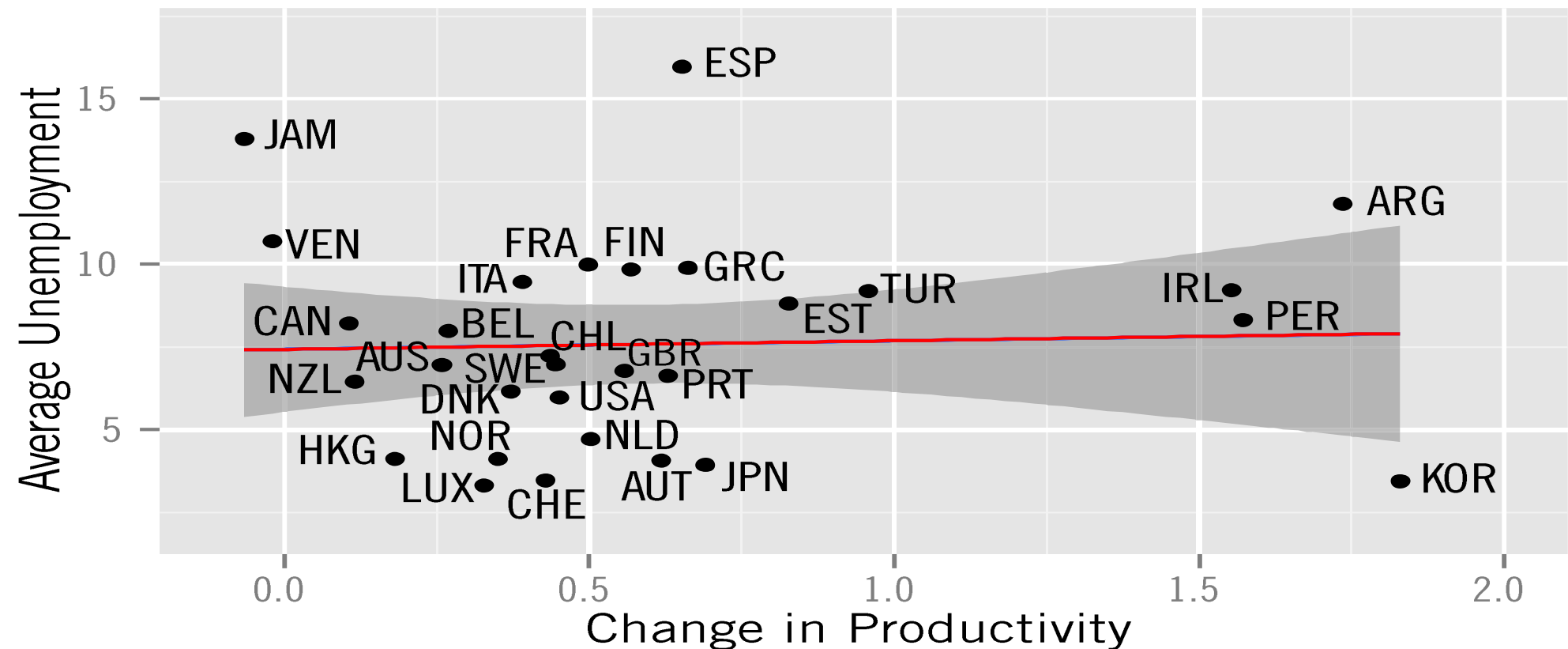
# Most Occupations Are Hard to Automate

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- Brick masons and block masons
- Machinists
- Cartographers and photogrammetrists
- Dental laboratory technicians
- Social science research assistants
- Firefighters
- Pre-school teachers
- (Randomly selected U.S. occupations)



# No Correlation Between Productivity Growth and Unemployment



Average unemployment rate and total change in productivity in select nations, 1990-2011 (%) (World Bank and Penn World Tables)

# Increased Productivity Creates Jobs

- Automation lowers prices which increases demand. (BLS)

Savings are spent



Spending creates demand



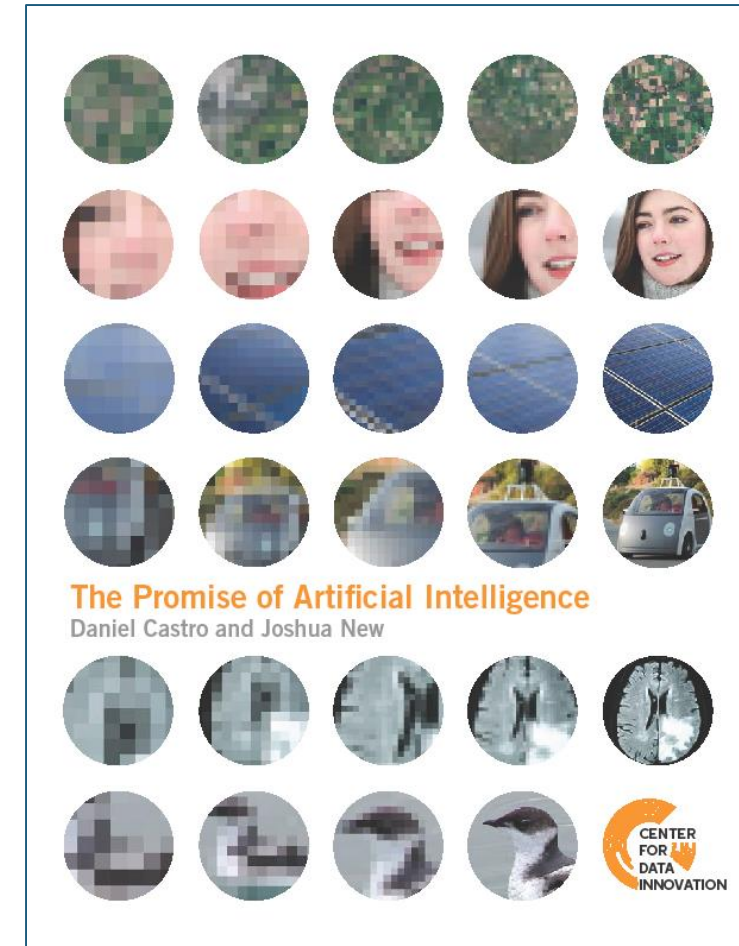
Demand creates jobs



# Much of AI Will Boost Quality, Not Eliminate Jobs

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- Health care diagnosis
- Fraud prevention
- Student feedback
- Disability access
- Reduced human trafficking



# Human Wants and Needs Are Far From Being Satisfied



# Today's Presentation

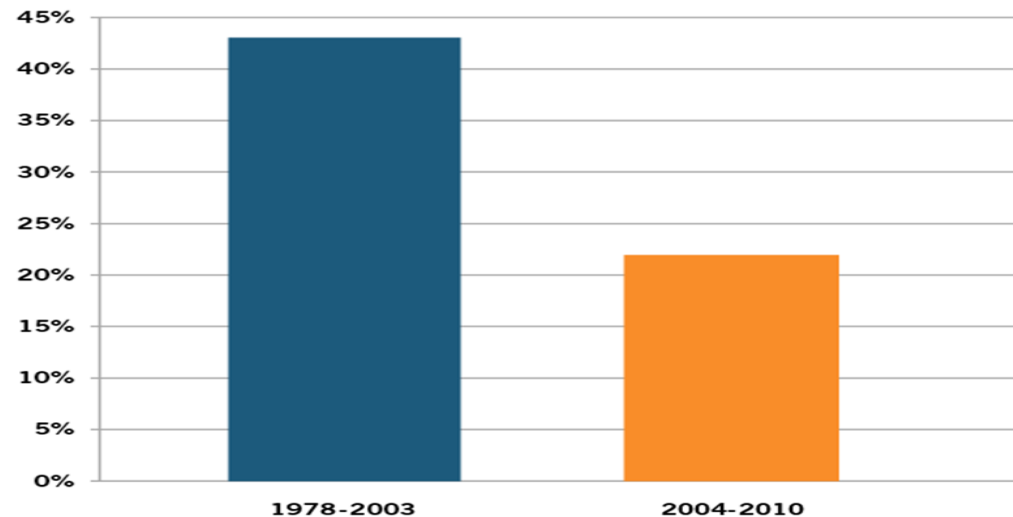
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# Not Yet: Moore's Law is Slowing Down

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- Speed increases are slowing, while transistors per dollar are decreasing.
- Even Gordon Moore says his law “can't continue forever. The nature of exponentials is that you push them out and eventually disaster happens.”



Annual % change in processor speed

# What Should Policymakers *Not* Do?

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- Panic
- Slow the rate of innovation and automation (e.g., robot tax)
- Put in place Universal Basic Income



# What Should Policymakers Do?

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- Speed the rate of innovation and automation
- Reduce the risk from job loss (e.g., universal health coverage, higher federal floor for unemployment insurance)
- Fundamentally restructure higher education to separate education and credentialing.
- Improve worker training (e.g., worker training tax credit, require states to allow unemployed workers to collect UI while in training, industry-led skills alliances)

# Thank You!

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