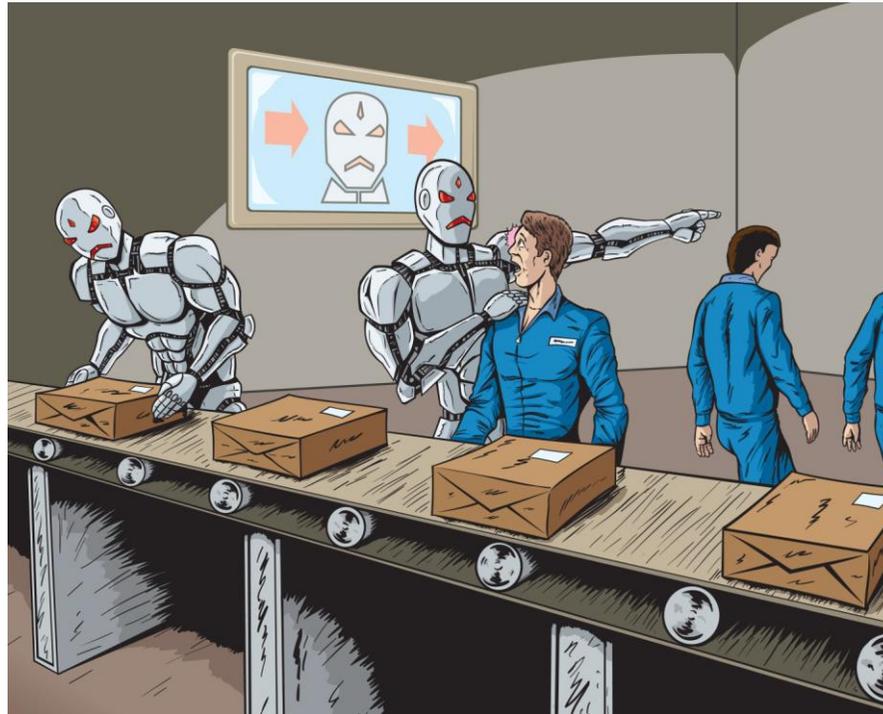


# Will there still be jobs? Explaining the shape of employment growth

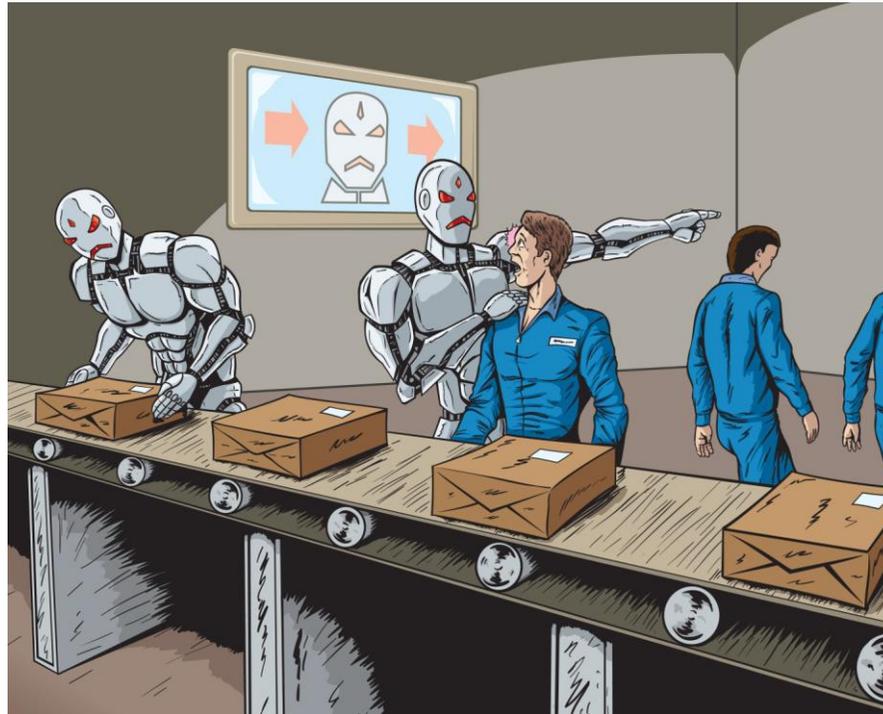
Morten Olsen, University of Copenhagen



Source: techcrunch.com

# Why are there still any jobs? Explaining the shape of employment growth

Morten Olsen, University of Copenhagen

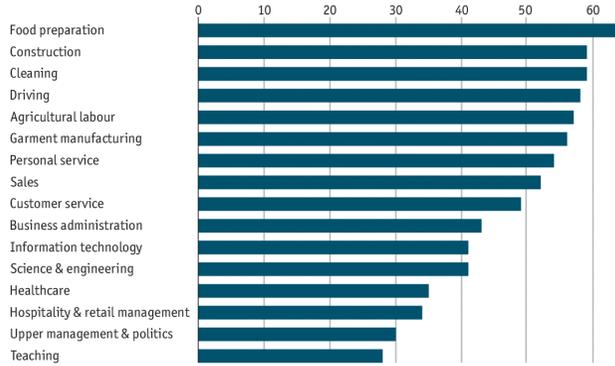


Source: techcrunch.com

# Age-old question

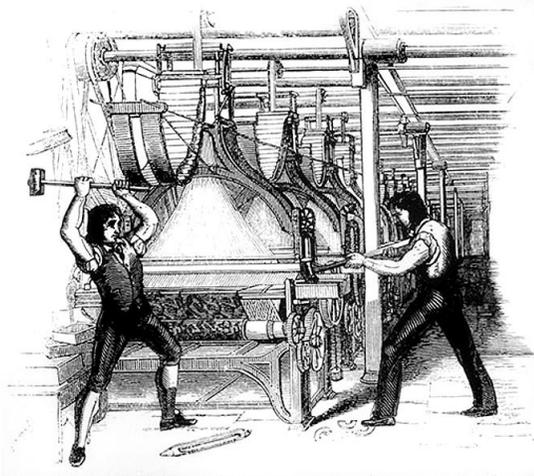
## The Economist, 2018

**Automated for the people**  
Automation risk by job type, %

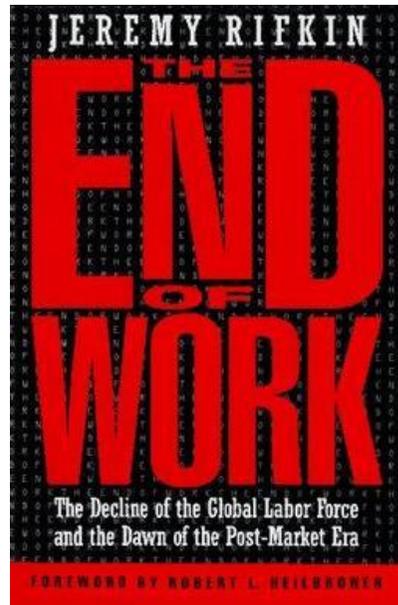


Source: OECD

Economist.com



Luddites, 19<sup>th</sup> century



Rifkin, 1995

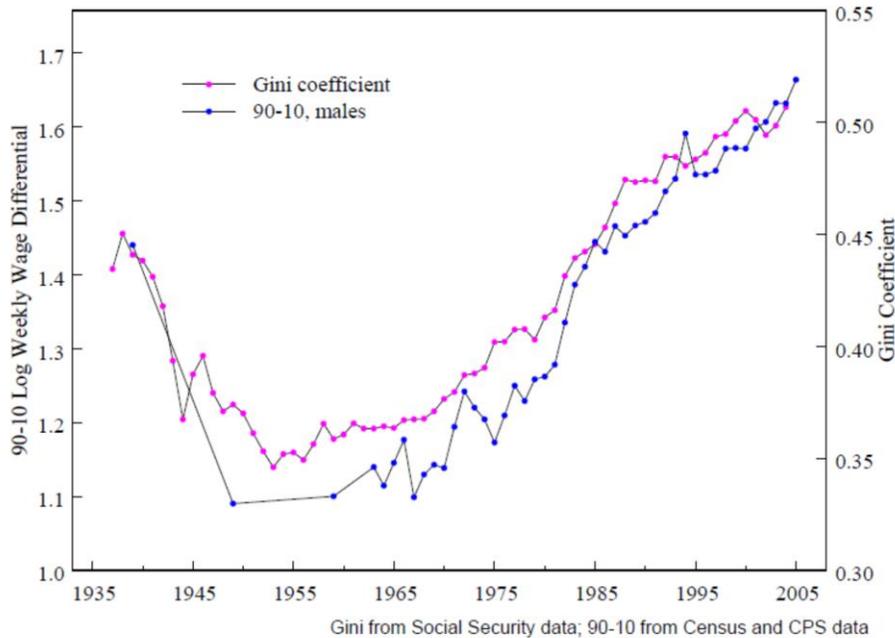
Time Magazine, 1961  
 “The number of jobs lost to more efficient machines is only part of the problem. What worries many job experts more is that automation may prevent the economy from creating enough new jobs . . . Many of the losses in factory jobs have been countered by an increase in the service industries or in office jobs. But automation is beginning to move in and eliminate office jobs too.”

## Not loss of job, but increases in income inequality

- Unemployment has shown no upward trend if anything employment higher today (due to women joining work force)
  - Agricultural employment has gone from 50-80 per cent to less than 5 in most advanced economies.
- Income inequality has been generally rising in the advanced economies
- Picture much less clear in developing countries.
- What does past automation (computers) teach us about future innovation (Artificial Intelligence and Robots)?

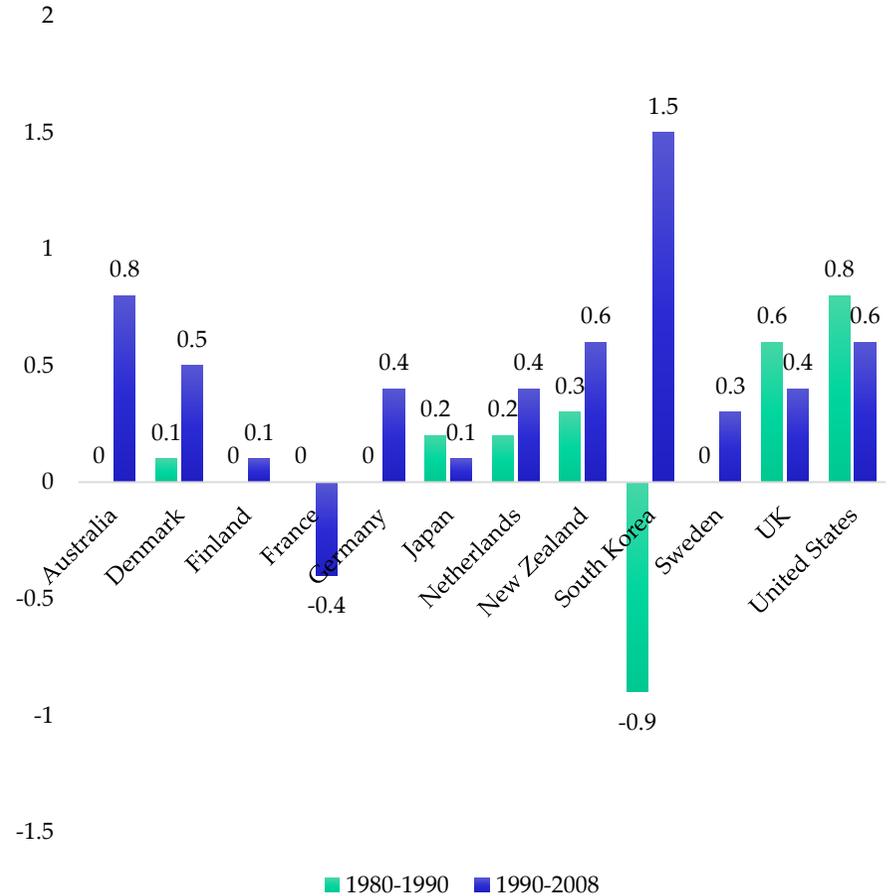
# Income Inequality in Advanced Economies

## Change in income inequality US



Source: Van Reenen (2011) using data from Goldin and Katz (2008)

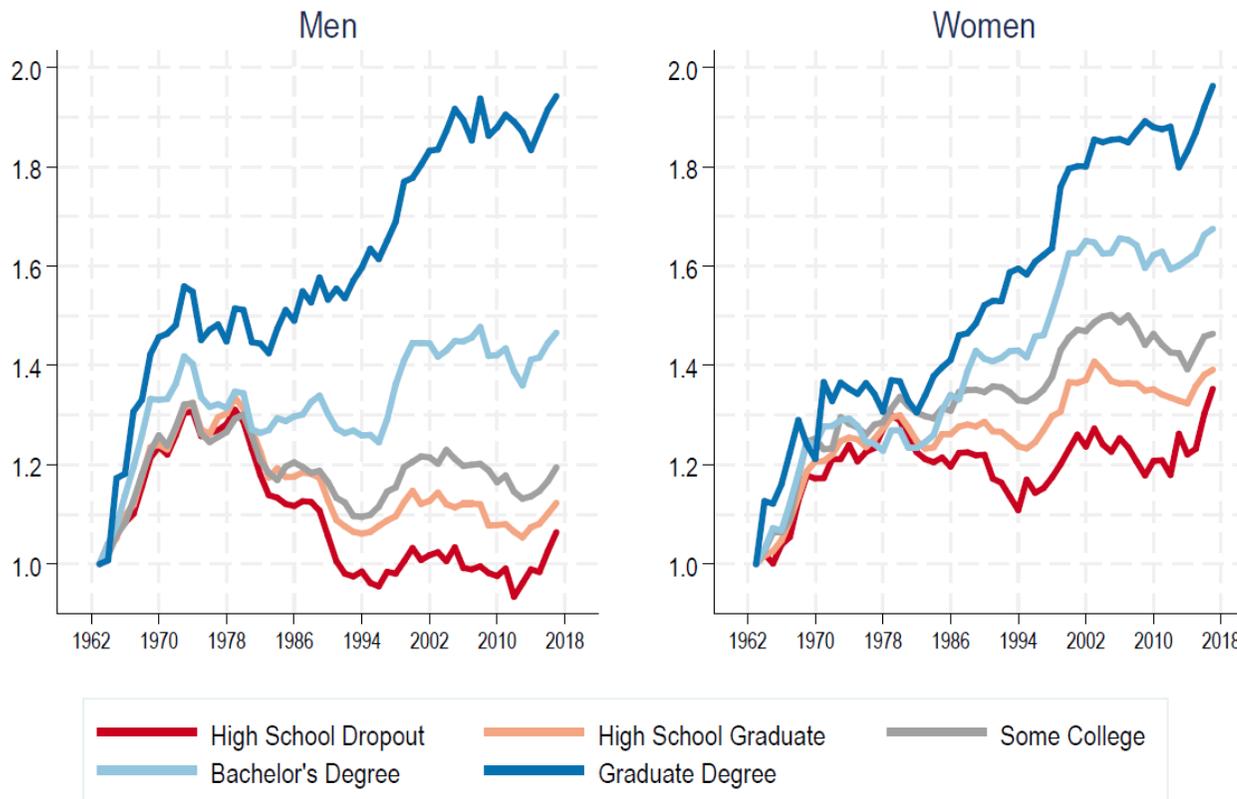
## Change in male wage inequality other countries (90/10)



Source: OECD / own calculations

# Inequality often comes from Rising Return to Education

Cumulative Change in Real Weekly Earnings 1963 - 2017  
Working Age Adults, Ages 18 - 64



- Rising returns to education
- Most pronounced in the U.S. but is general pattern in Europe as well
- Puzzling fact:
  - Returns to schooling ↑
  - While uni. graduates ↑
- Clearly the changing economy has disproportionately benefitted educated workers.
- But why?

## Whom do Computers Replace?

### - A Task Model of Work – Jobs 1990 years ago

#### **Surgeon tasks**

- Surgeries
- Examine patient
- Examine patient medical history
- Conduct research to improve treatment

#### **Secretary tasks**

- Answer telephones
- Maintain calendar
- Create/maintain electronic or paper filing systems
- Type letters etc.
- Book travel

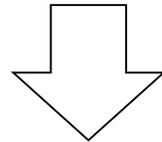
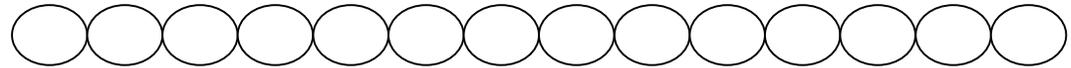
#### **Gardener tasks**

- Gather and remove litter
- Water lawns, trees or plants,
- Prune and trim trees and flowers

# The Task Model of Work

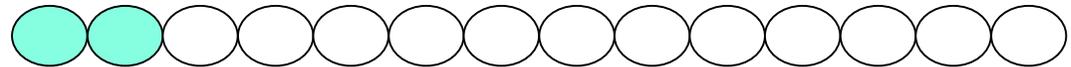
## - Tasks not Automated are *Complemented*

Set of (non-automated) tasks in 1980



Computers (1980-2019)

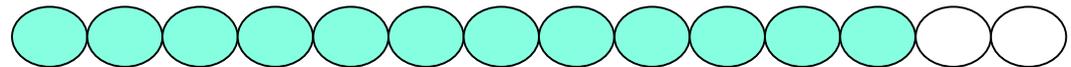
Job with some tasks automated



Remaining tasks are complemented by automation: Workers become more productive might command higher wages

Or?

Job with many tasks automated



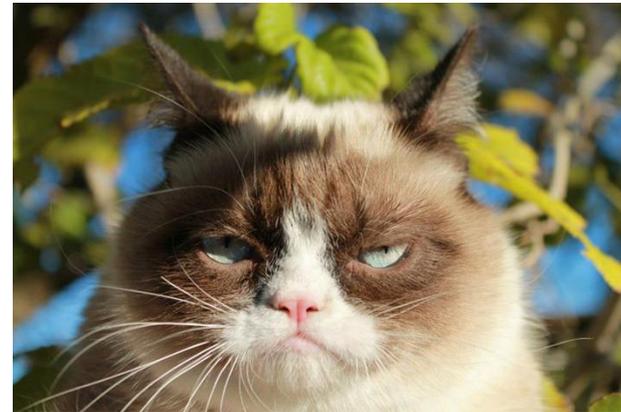
Workers become (almost) redundant. Demand for their services falls

# What Tasks do Computers Replace

- Computers perform routine, codifiable tasks that are “fully understood”
- Computers cannot do adaptability, creativity, flexibility or common sense
- Polanyi’s Paradox: “We know more than we can tell”

$$\begin{array}{r} 2000 \\ +4000 \\ \hline =6000 \end{array}$$

“Easy” to explain to a computer



“How can you tell that’s a cat?”

# The 2 by 2 Table of Computer Comparative Advatnage

	Manual	Cognitive / Non-manual
Routine	Assembly work	Secretary, accountant
Non-routine	Gardener, truck-driving	Physician, CEO, selling

First wave of automation: mid 20<sup>th</sup> century: Automated factory work (Manual/routine)

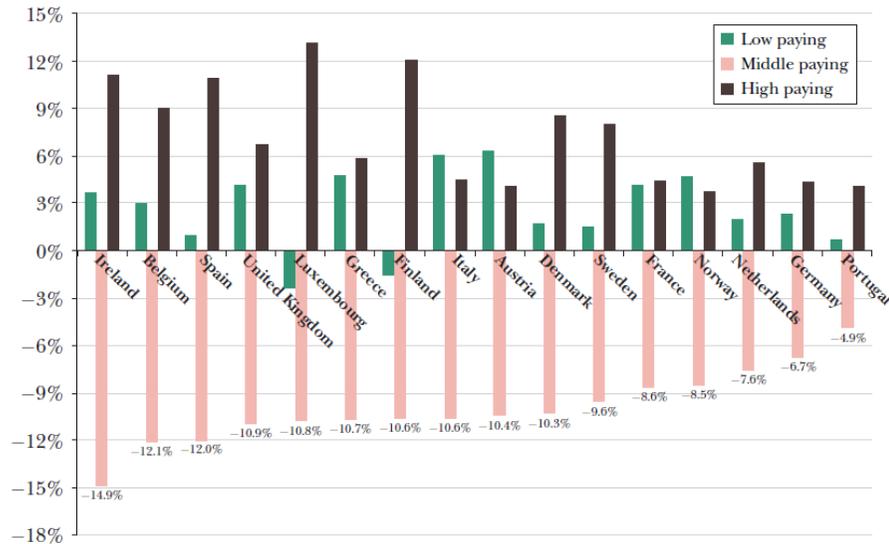
Second wave of automation: End of 20<sup>th</sup> century: Computers (Cognitive/routine)

Source: Adopted from Autor, Levy, Murnane (2003)

# But those are the Jobs in the Middle!

## ● Job Polarization

Change in Occupational Employment Shares in Low, Middle, and High-Wage Occupations in 16 EU Countries, 1993–2010



Source: Autor using Goos, Manning, and Salomons (2014)

## ● Wage Polarization



Source: Acemoglu and Autor (2011)

## The ABC of Benefits from Automation

- **Complementarity to Automation:** Are the tasks you perform complemented by computers / automation? Secretaries versus physicians.
- **Boost to demand from higher income:** Does higher income in society increase demand for your services? restaurants, yoga instructors, tourist guides, sommeliers, medical professionals
- **Adjustments to labor supply:** Do you possess skills in limited supply or will any increase in demand lead to more workers in the field? Contrast physicians with waiters

Many jobs in the bottom of the income distribution benefit from Boost to demand, but just see inflow of new workers.

# Boost to Demand from Better Technology

## ● Directly (frontier technology jobs)

### Swarm Drone Expert

Algorithma ★★★★★ 2 reviews

Abu Dhabi

Uncertainty, swarm robotics, and/or human-robot interaction. In Computer Science, Robotics, Electrical Engineering, Mathematics or...

### Mechanical Design Engineer (Mechatronics/Robotics)

PAL Group of Companies ★★★★★ 5 reviews

Abu Dhabi

Within PAL Robotics. Experience in robotics desirable. Experienced in the design and development of precision electro-mechanical assemblies and equipment...

### Artificial Intelligence (AI / ML) Engineer

Affaan Technologies

Dubai

We are looking for highly passionate and enthusiastic players for solving problems in medical data analysis by building and implementing algorithms for image...

30+ days ago [save job](#) [more...](#)

## ● Indirectly (higher wealth jobs)

### Barista Maestro

Empower projects

Abu Dhabi

**AED2,200 - AED2,500 a month**

Must have previous experience as a barista. Previous experience as a Barista for at least 2 years. Looking for a Barista who is so talented in making all kinds...

### Spa Therapist - Female

Bricks Concept Development

Abu Dhabi

**AED2,000 - AED3,500 a month**

Spa Therapist job description template | Workable. We are looking for a qualified spa therapist to provide professional and engaging wellness therapies and...

### Shisha Sommelier

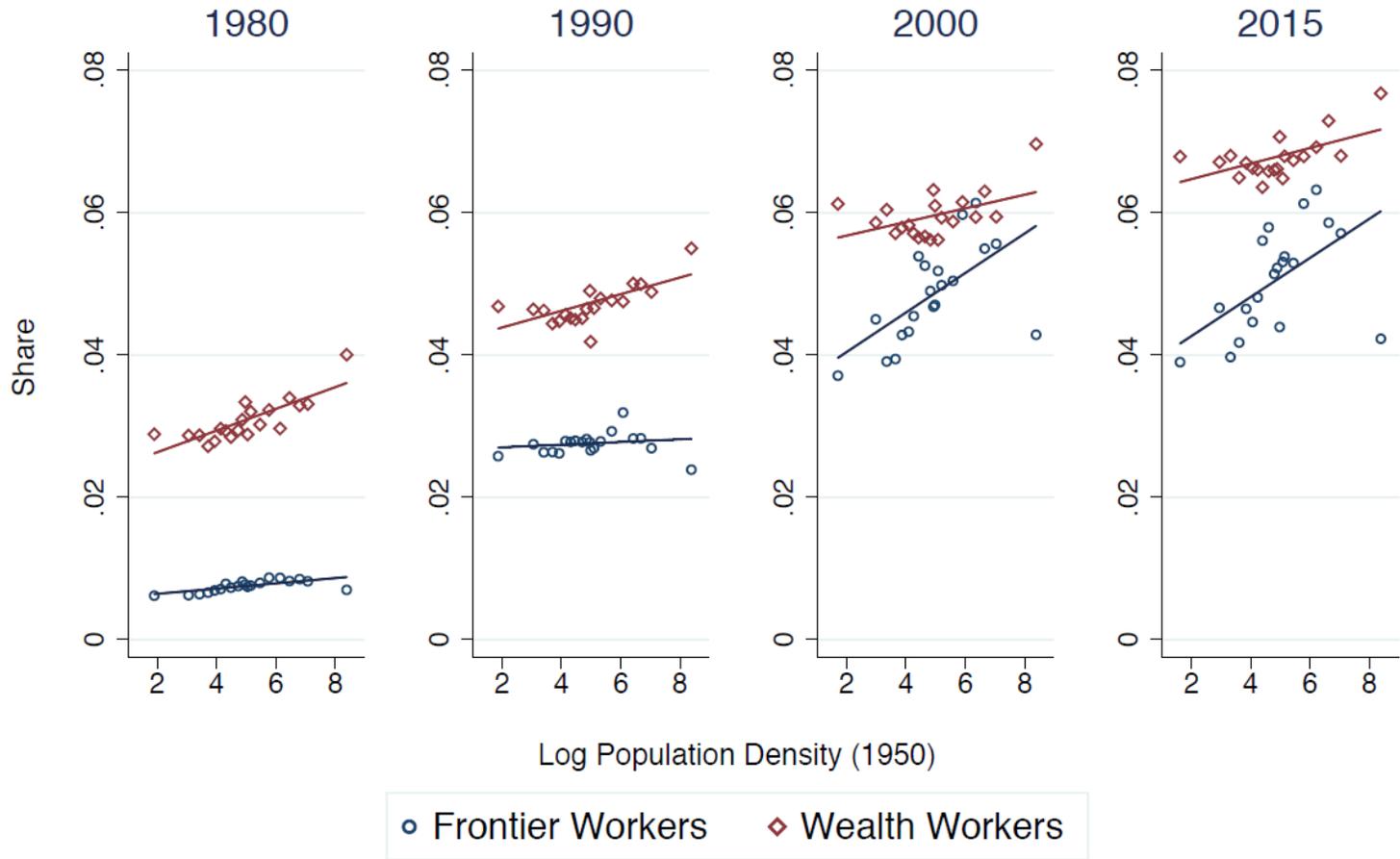
Fairmont The Palm, Dubai ★★★★★ 1,015 reviews

Dubai

The property will be positioned as a Luxury Hotel joining other internationally branded hotels on the 'island', which will generate tremendous anticipation both...

# Frontier Jobs and Wealth Jobs are Increasingly in Cities

Employment Shares in New Census Job Titles (Cumulative)  
Working Age Adults



# Stark differences between Frontier Jobs and Wealth Jobs

	All Jobs	Frontier Jobs	Wealth Work
Wage (\$2015)	18.78	26.89	18.49
Pct. Women	44%	28%	62%
Pct. College	35%	50%	41%
Pct. HS. Graduate	26%	16%	21%
Pct of Jobs	100%	5.1%	6.8%

Source: Autor (2019)

## Taking Stock

- Computers have automated some tasks and **Complemented** others
- At the same time new technology and a wealthier society has given a **Boost** to demand for some jobs
- Whether this increases employment or wages depends on the **Adjustment** of workers into these jobs.

# What's the difference between Computers and AI?

WIRED STAFF SCIENCE 06.26.12 11:15 AM

## GOOGLE'S ARTIFICIAL BRAIN LEARNS TO FIND CAT VIDEOS



By *Liat Clark*. *Wired UK*  
ANNALS OF TECHNOLOGY

## IBM computer Watson wins Jeopardy clash

Supercomputer outwits US quiz show champions in epic head-to-head drive battle



▲ Watson wins: Jeopardy host Alex Trebek, executive producer Harry Friedman and former champion Brad Rutter discuss the battle between man and machine. Photograph: Ben Hider/Getty

## Singapore Built a Dedicated Town for Self-Driving Buses

The city-state's secure test park gathers information about autonomous vehicles.

By **Kyunghee Park** and **Krystal Chia**

June 4, 2018, 11:00 PM GMT+2

From **Hyperdrive**

# HOW THE ARTIFICIAL-INTELLIGENCE PROGRAM ALPHAZERO MASTERED ITS GAMES

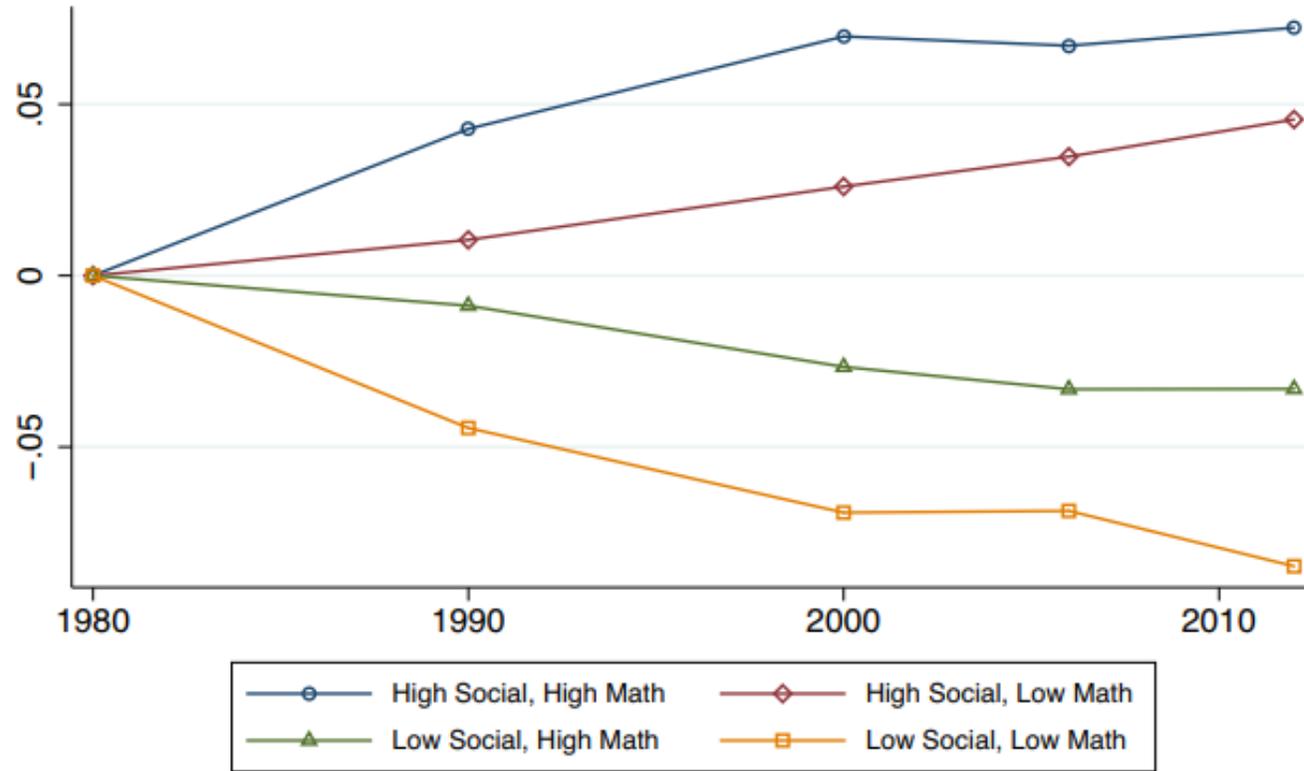
By **James Somers** December 28, 2018

## Clear that AI is gaining skills

- But Watson has yet to revolutionize cancer detection
- Self-driving cars still cannot drive in New Delhi
- AlphaZero needs to play 40 million games to train itself

Surely a matter of time, but not as quick as some expect

# What jobs will be successful in the future?



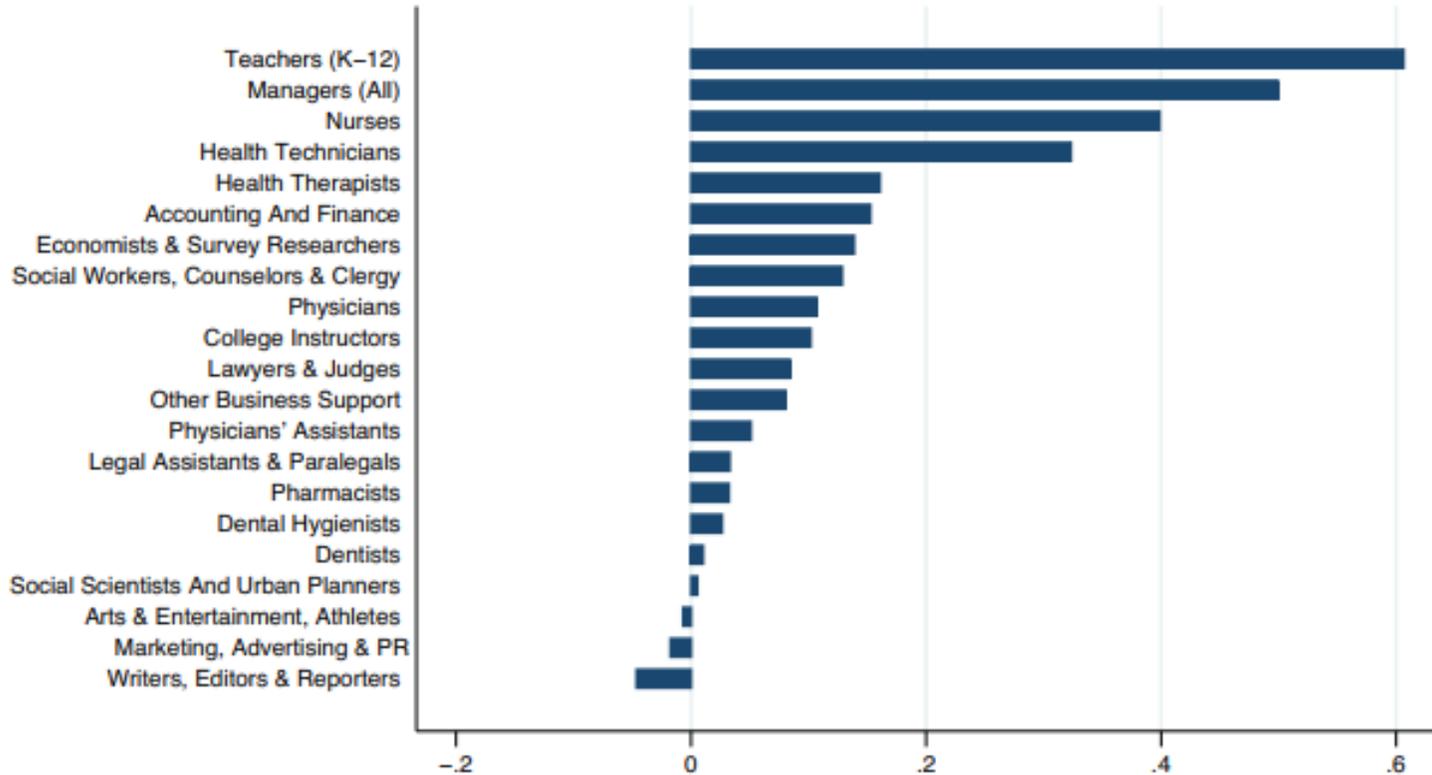
Occupational Task Intensities based on 1998 O\*NET

- Job structure changing: Jobs requiring social skill growing most
- Complementarity between social skills and math skills!

Source: Deming (2017)

# Change in Employment

All Other Managerial or Professional Occupations



● Employment growth especially in caring sectors

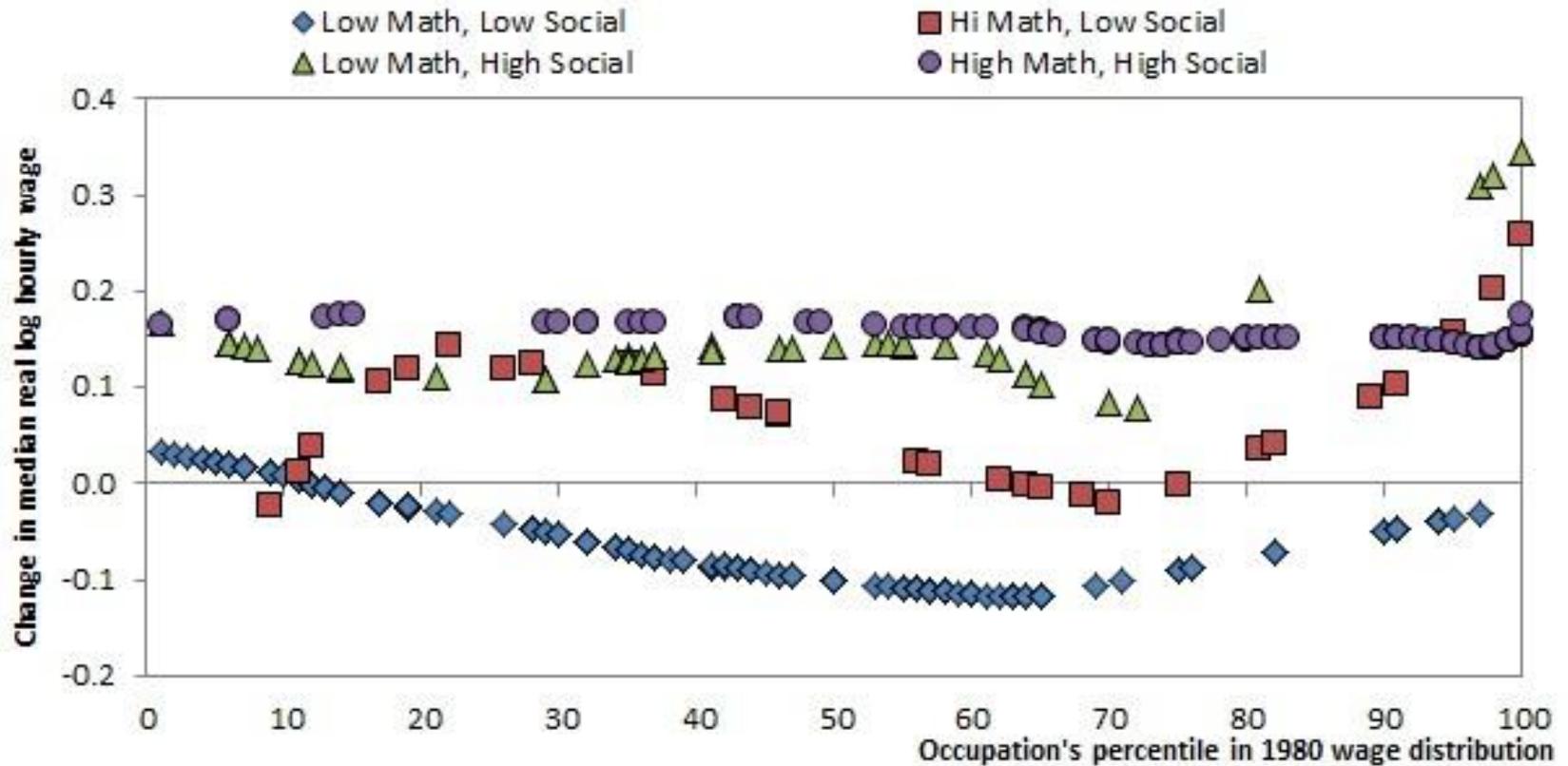
## Conclusion

- Technology doesn't automatically reduce employment; historically not at all!
- Technology replaces certain tasks and is therefore complementary for some occupations and a substitute for others
- Higher technology and wealth in the economy increases demand for some occupations, in particular in services and health
- Whether that is reflected in higher wages or employment depend on adjustments of labor supply
- Computers have tended to complement workers with analytical skills: Likely social skills will see the highest returns in the decades to come

# Appendix

# Wage effects

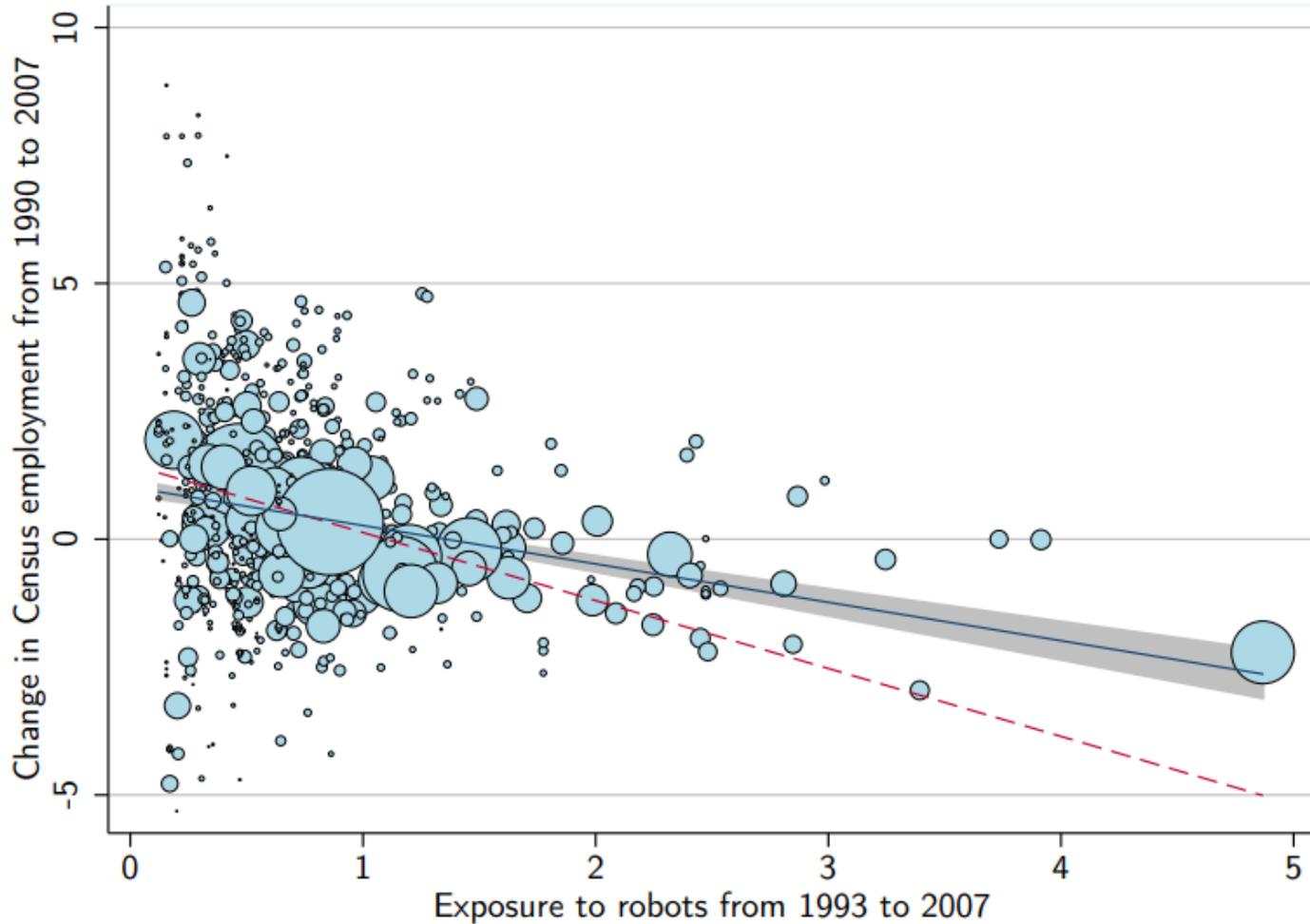
**Figure 2. Smoothed changes in median wages by occupational task intensity, 1980-2012**



Notes: Each line plots 100 times the change in median log hourly real wages between 1980 and 2012 for occupations that are above and/or below the 50th percentile in non-routine analytical and social skill task intensity as measured by the 1998 O\*NET. Lines are smoothed using a locally weighted regression with bandwidth 1.0. Wage percentiles on the horizontal axis are measured as the employment-weighted percentile rank of an occupation's mean log wage in the Census IPUMS 1980 5 percent extract. Consistent occupation codes for 1980-2012 are updated from Autor and Dorn (2013) and Autor and Price (2013). See the text and Appendix for details on the construction of O\*NET task measures.

Source: Deming (2015).

# Some Effects on Employment in the US



- Areas with industries more affected by robots tend to have poorer employment growth
- No such effect found in Germany (Dauth, Findeisen, Südekum and Wößner, 2017)

Source: Acemoglu and Restrepo (2017)

# Certain parts of employment distribution has suffered more

- Employment rate amongst young male Americans has declined substantially past 20 years?
- Permanent decline?

(b) Employment Rates

