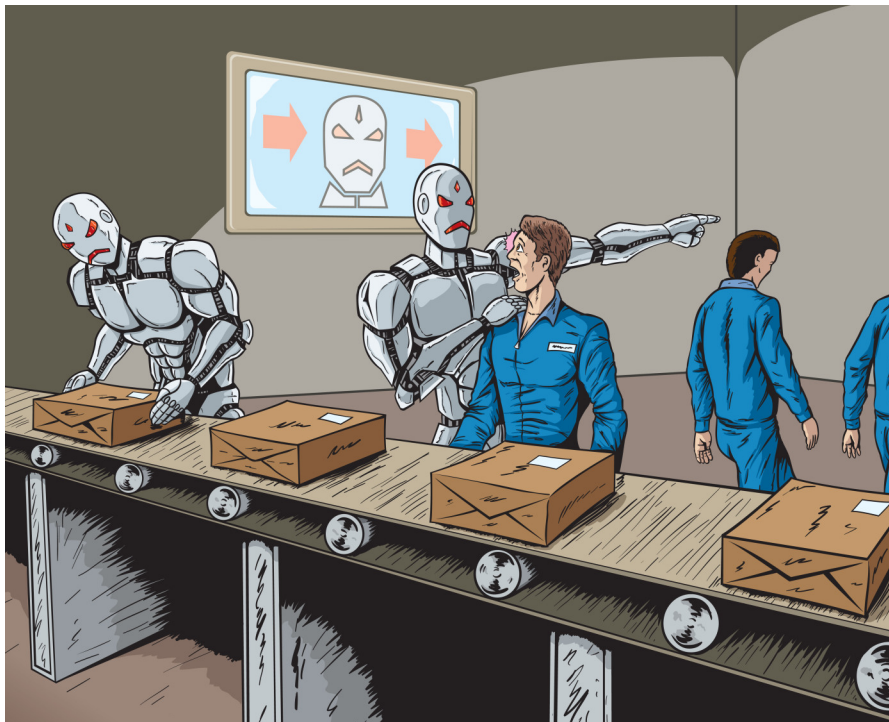


The Changing Labor Market: The Role of Automation and Globalization in Shaping Employment

Morten Olsen, University of Copenhagen



ECONOMY

China trade deficit has cost the US 3.7 million jobs this century, report says

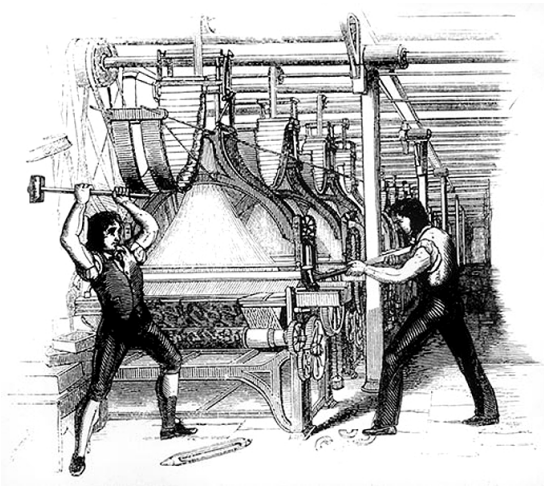
PUBLISHED THU, JAN 30 2020 12:15 PM EST | UPDATED THU, JAN 30 2020 3:19 PM EST



Jeff Cox
@JEFF.COX.7528
@JEFFCOXCNBCOM

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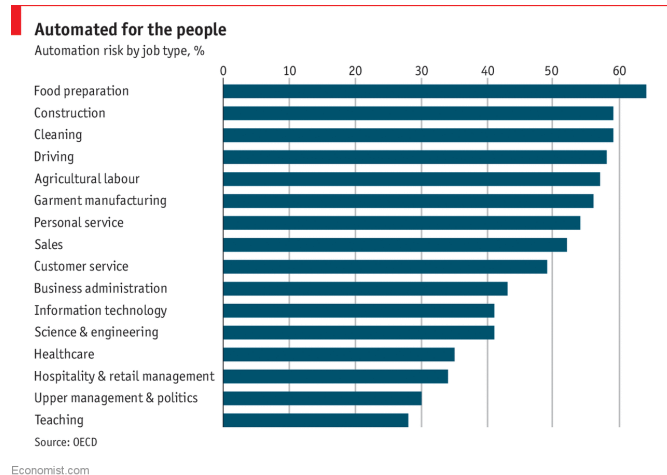
Age-old Question : Is Technology/Globalization good or bad?



Luddites, 19th century



Smoot-Hawley tariff act, 1930



Risk of Automation?, The Economist, 2018



Anti-WTO protests, 1999

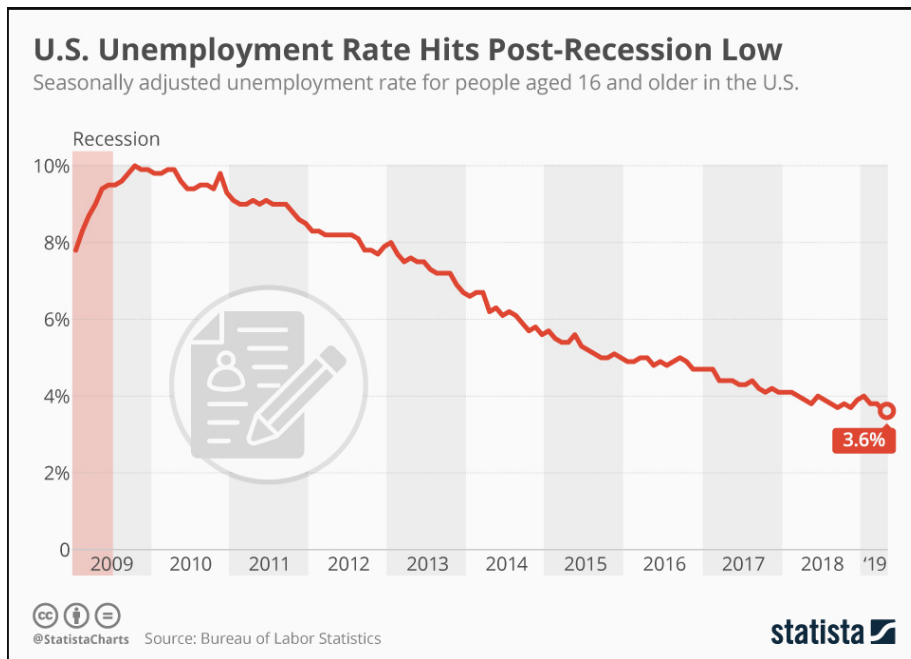


Survey: Are you worried about your job?

- i) Yes, I worry about losing my job to foreign competition
- ii) Yes, I worry about being replaced by AI / Robot
- iii) No, not at all. They'd be fools to let me go!

Pre-corona Unemployment was Historically Low

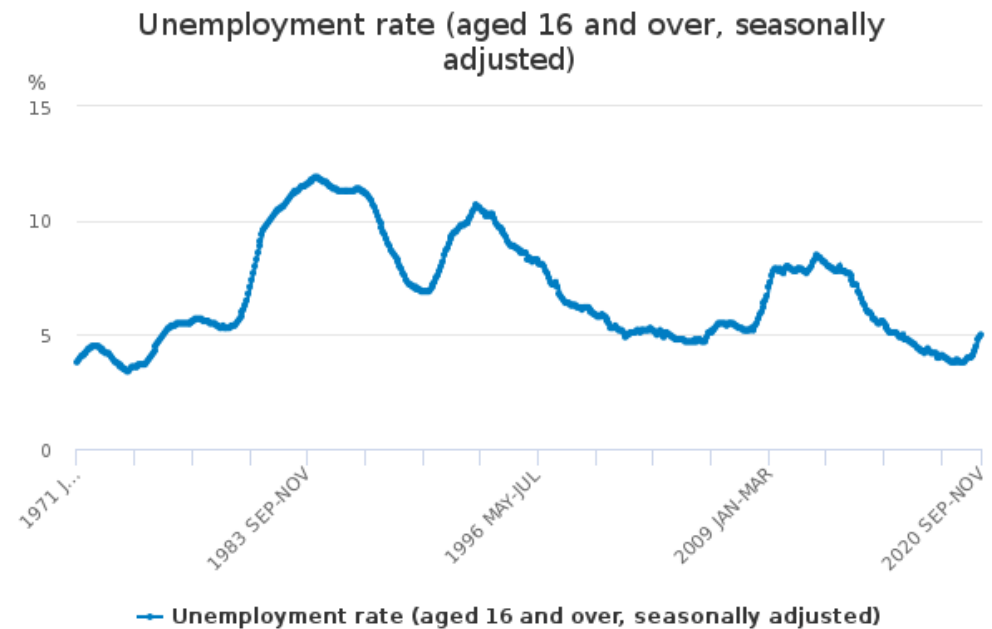
United States



— Unemployment rate (aged 16 and over, seasonally adjusted)

Source:

United Kingdom



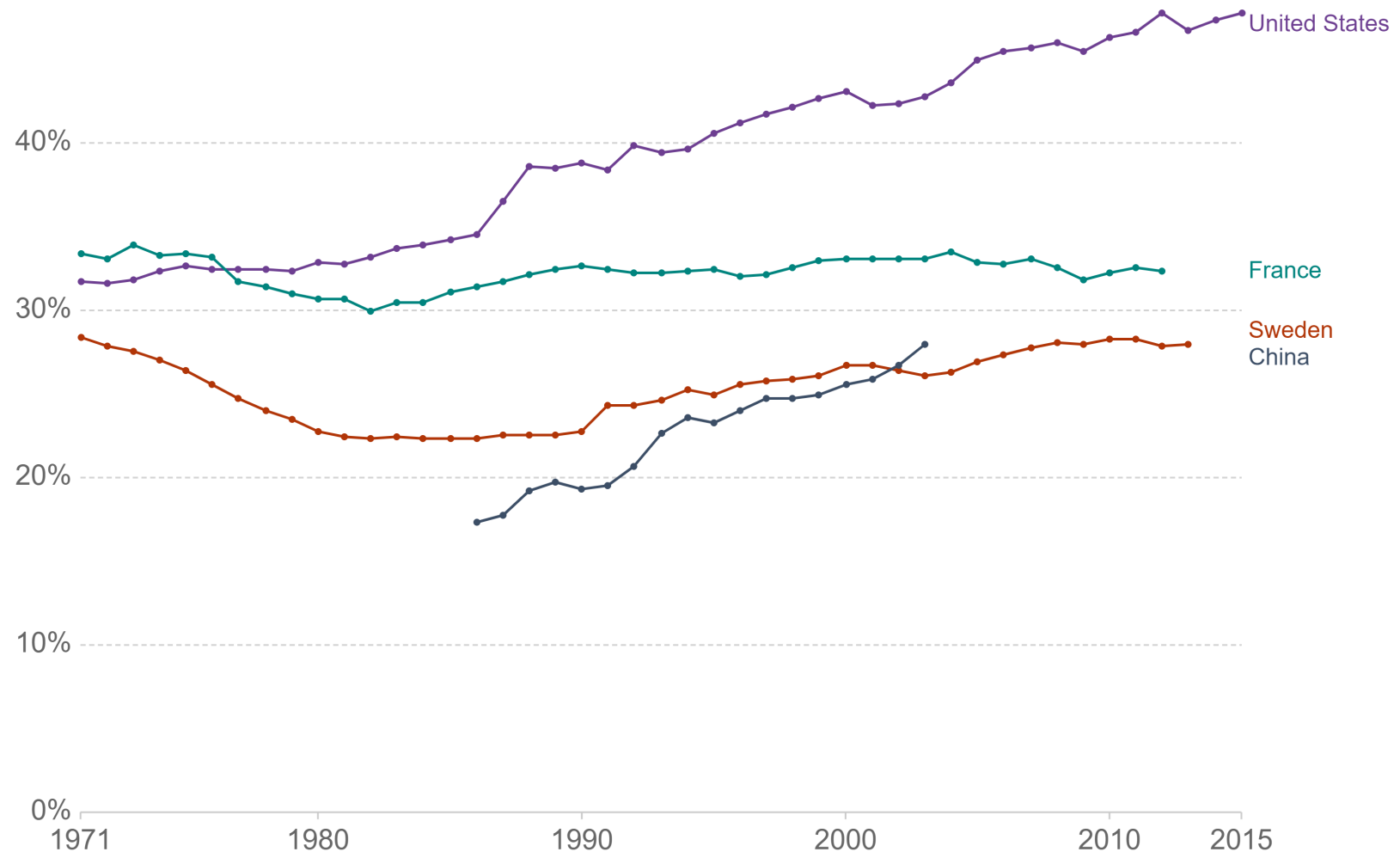
Source: Office for National Statistics

Income Inequality has Gone Up (though not everywhere)

Top 10% income share, 1971 to 2015

Share of income received by the richest 10% of the population.

Our World
in Data

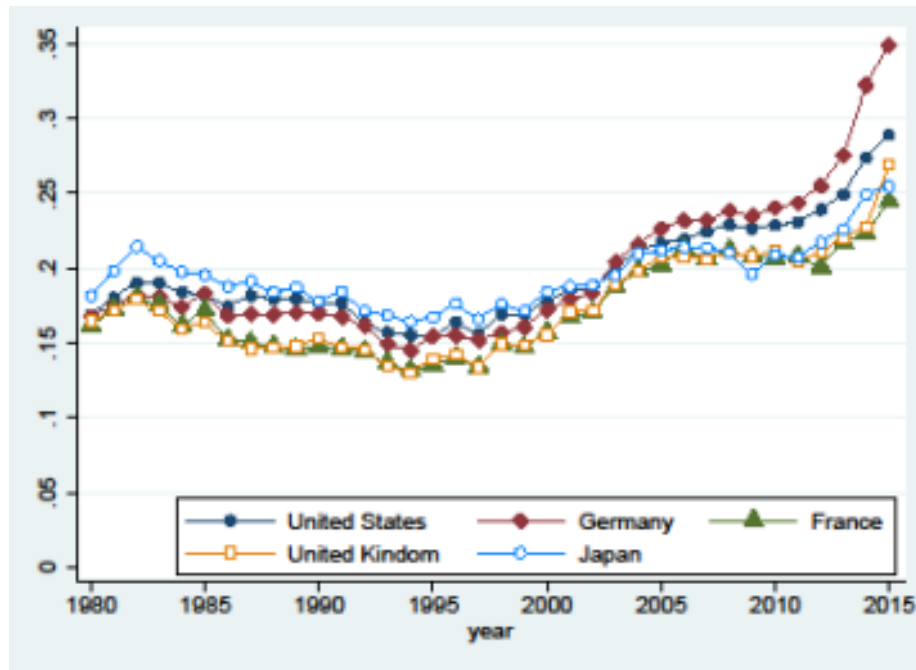


Source: Alvaredo, Facundo, Anthony B. Atkinson, Thomas Piketty and Emmanuel Saez via the Quality of Government dataset

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Maybe this time is different?

Automation patents in machinery

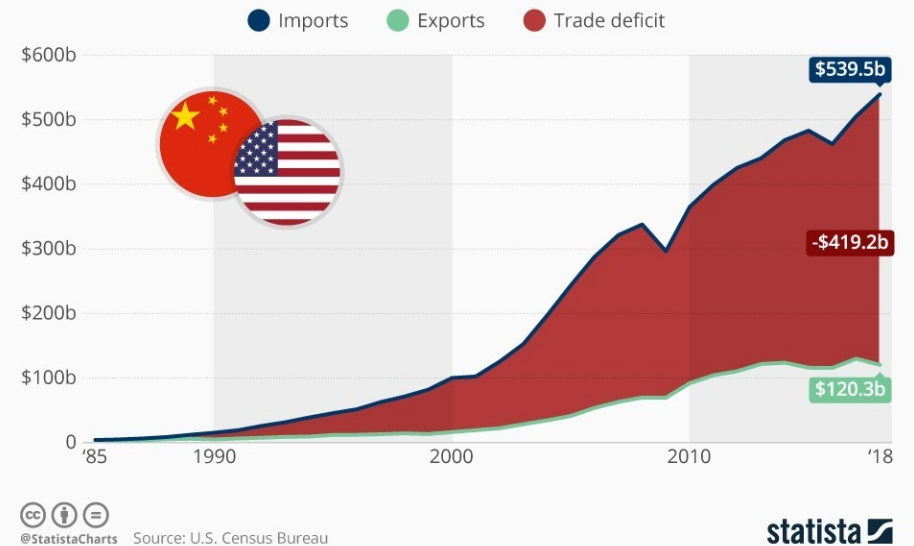


Source: Dechezleprêtre et al. (2021)

US – China Trade

A Long-Term View On U.S. Trade With China

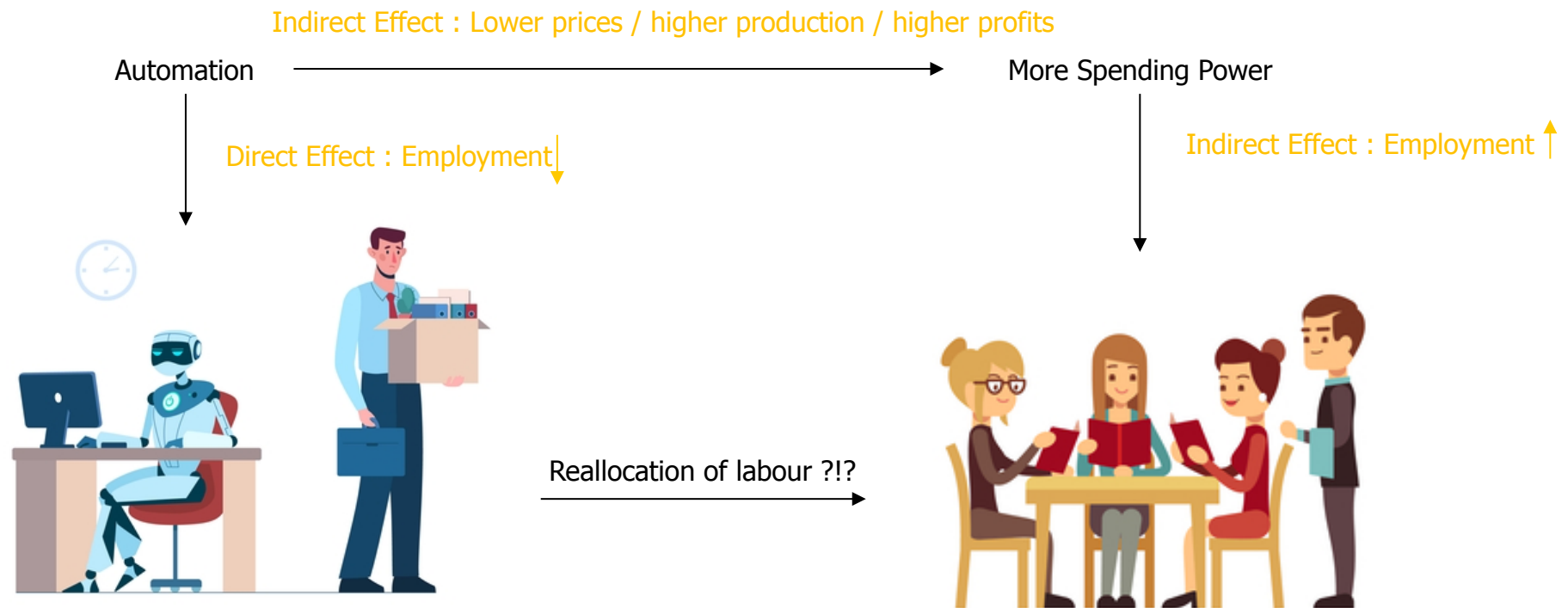
U.S. trade in goods with China since 1985



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.
 - Textile Production used to be a large employer. Has all but moved abroad
- Income inequality has been generally rising in advanced economies
- How does globalization differ from technology? Are things different today?

Why hasn't Unemployment Increased? Standard Economist Answers



Basically same story with globalization

What Does the Data say?

What is Globalization

- International Trade
- Migration
- Free capital flows
(Washington Consensus)

What is technology?

- Computers
- Robots / Automation
- AI

Will be helpful to think of i) 1980 – Late90s and ii) Late90s - now

What does the Data Say?

- Basically Three Empirical Approaches
- What **industries** have been most exposed to international trade / technology?
- What **occupations** have been most exposed to international trade / technology?
- What **regions** have been most exposed to international trade/ technology?
- Problem throughout: We have great data on international trade but poor data on new technology.

International trade 1980 - 2000

- Trade mostly with similar economies
- Little correlation between industries exposed to trade and employment or price changes
- International trade relatively small



→ Economists largely conclude(d) that there was little effect

Technology 1980 - 2000

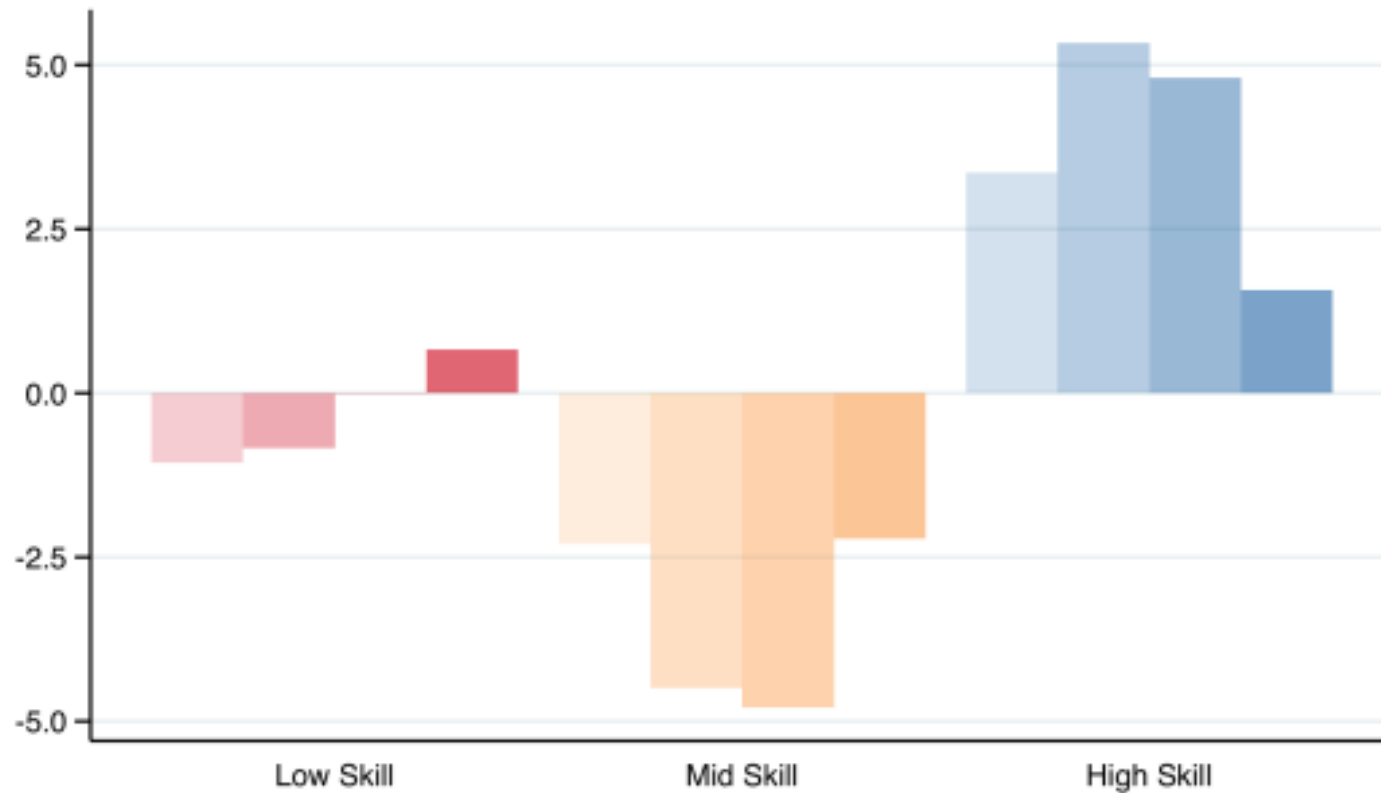
- Dominant technology: **Computers**
- But all **industries** use computers.
- Instead: What **occupations** are replaced by computers? Use information on the tasks performed by each occupation (Routine-Biased Technical Change)

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

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

Second wave of automation: End of 20th century: Computers (Cognitive/routine). These are the middle occupations

Effect of computers 1980 – 2000: Job Polarization



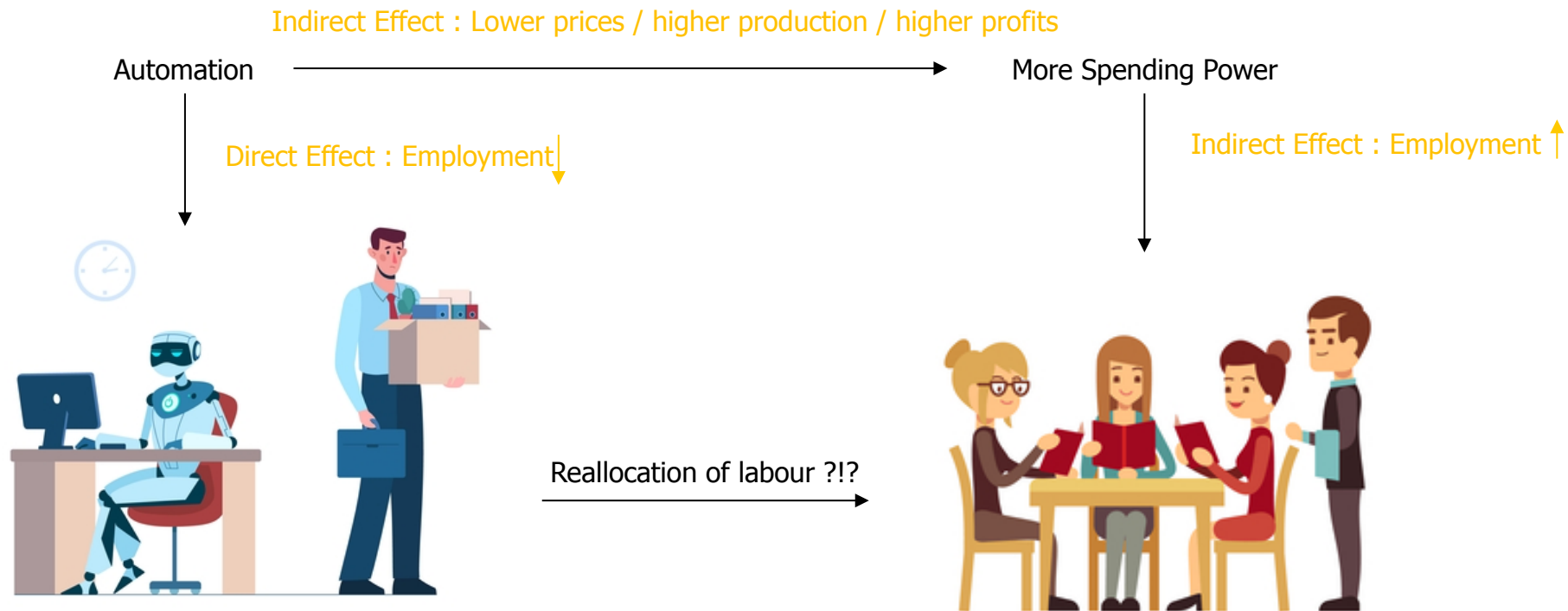
Source: Autor (2019)



Largely the same in all OECD countries

Back to Our Framework

- Dominant Effect: Technology / computers
- No aggregate effects on employment, but effects on income inequality



- College workers → moved up the skill-distribution.
- Non-college workers → moved down the skill-distribution

The Consensus Around 2000

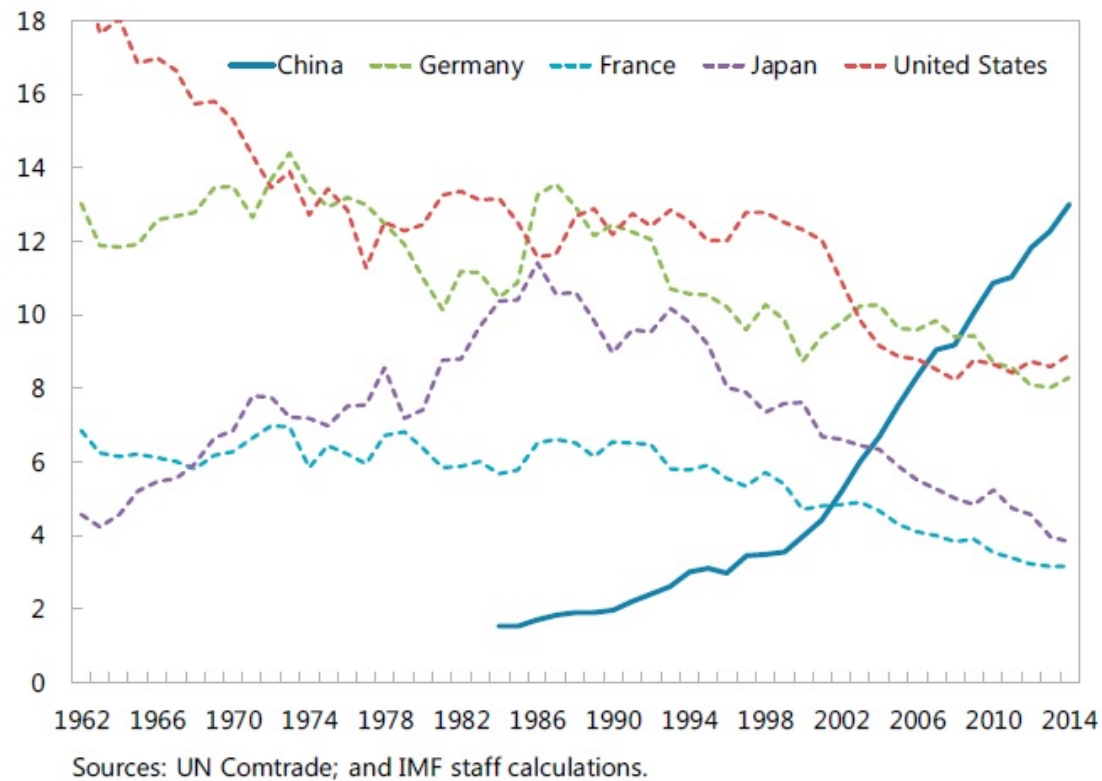
Krugman, [in 1997](#):

But even if the global economy matters less than the sweeping assertions would have us believe, does this "globaloney," as the cognoscenti call it, do any real harm? Yes, in part because the public, misguided into believing that international trade is the source of all our problems, might turn protectionist — **undermining the real good that globalization has done for most people here and abroad.**

- International trade is too small to really matter and doesn't have big national effects. Plus Germany-UK trade isn't about competition from low-wage countries
- New technology might increase income inequality but hasn't increased unemployment. Growth in demand elsewhere compensated.
- What changed thereafter: **China**

The Rise of China

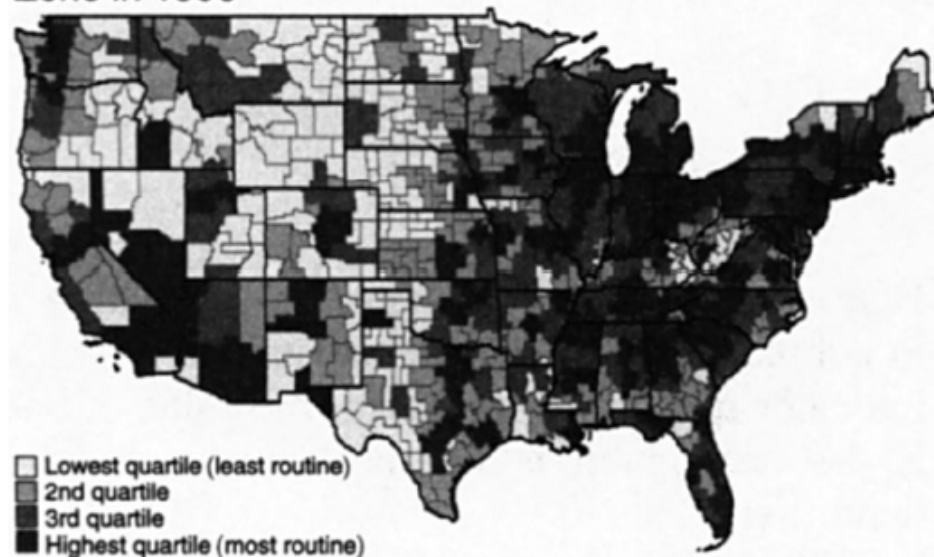
Figure 1. Global Export Market Share
(Percent; top five exporters)



The Geographical Variation across Labour Markets

- In the US: 740 labour market areas with varying industries and occupations. Which are exposed to trade, which to technology?

Panel A. Routine Employment Share by Commuting Zone in 1990



Panel B. Trade Exposure by Commuting Zone, 1990–2007

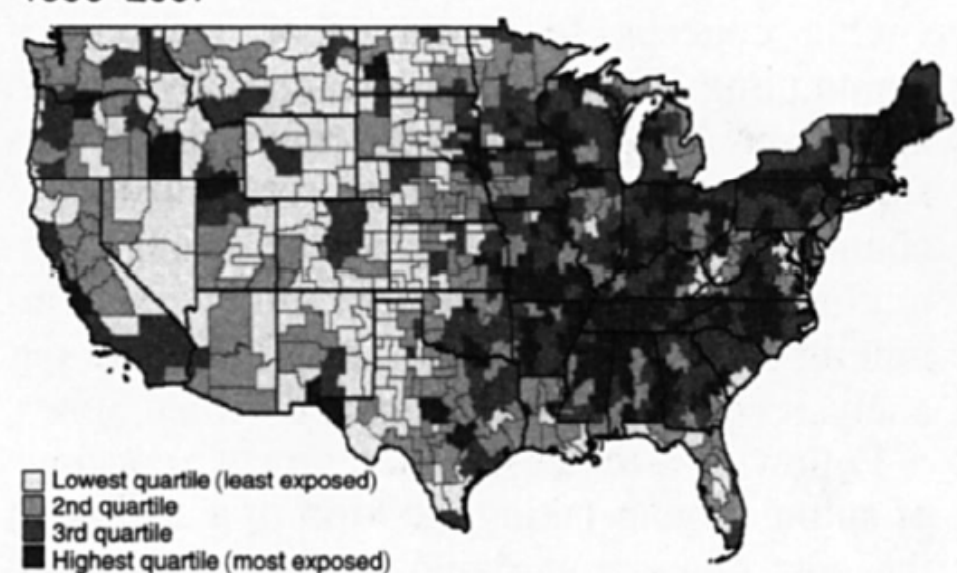


FIGURE 1. ROUTINE EMPLOYMENT AND TRADE EXPOSURE BY COMMUTING ZONE

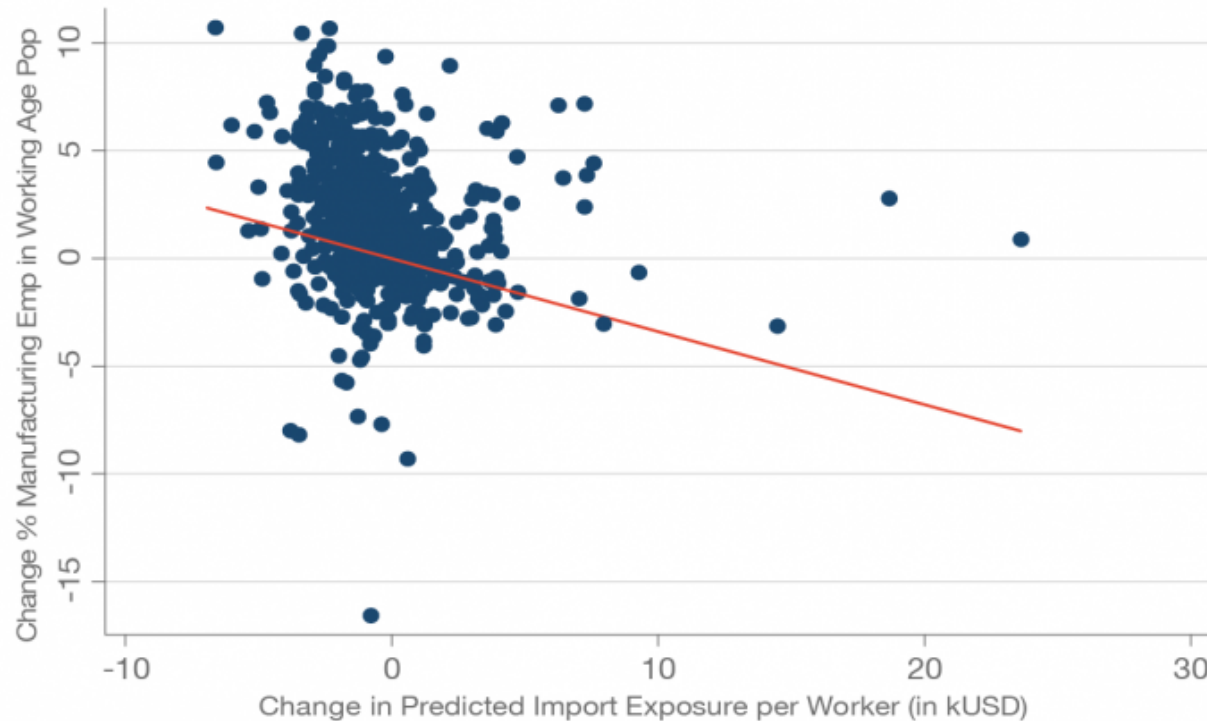
Source: Autor, Dorn and Hanson (2013)

More Trade Exposure → Less Employment in Manufacturing

Exposure to rising Chinese imports and changes in employment across local labor markets in the US (1999-2007)

Our World
in Data

Regions correspond to commuting zone in the US. The trend line shows a reduction in manufacturing employment in the commuting zones facing large increases in Chinese import exposure.



Note: OLS reduced form regression using the full Sample (N=722; coef = -.33976267, robust standard error = .07116474, t = -4.77)

Source: Figure 2B in Autor, Dom and Hanson (2013): "The China syndrome: Local labor market effects of import competition in the United States". American Economic Review, 103(6), 2121-68

04/10/2018

Same in other countries (Dauth et al. 2014 for Germany)

- Question is: Do these people find jobs elsewhere?

Findings (Autor, Dorn, Hanson 2013)

- **US** Areas exposed to technology saw substantial shifts in employment distribution but no overall decline
- **US** Areas exposed to trade saw declines in manufacturing employment and overall declines in employment, including amongst managers, sales etc.
- In **Germany** trade lowered employment in manufacturing but not overall (Dauth et. al., 2014)
- Other work has tied trade shocks to
 - Deaths of despair (Pierce and Schott, 2020)
 - Voting behaviour (Dippel, Gold and Heblich for Germany)

Why Would the Two be Different?

Computers:

Some people lose their job

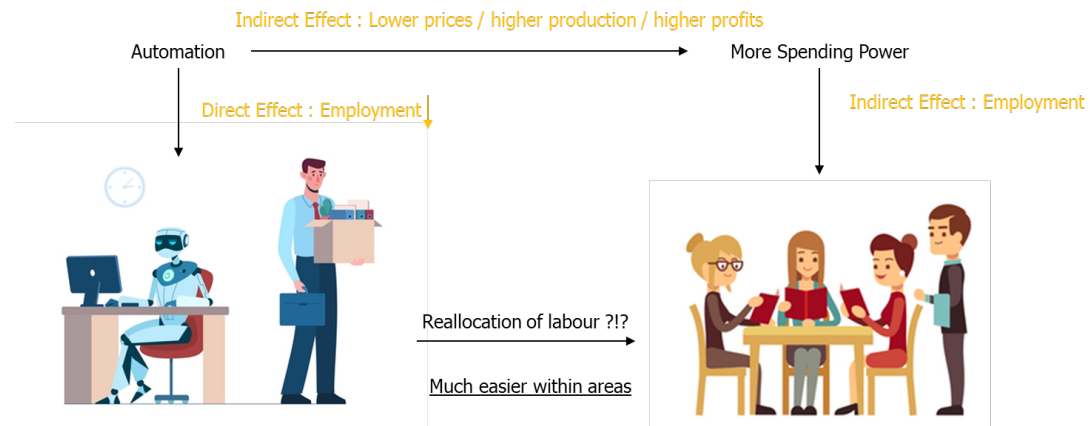
Industry continues to exist

Overall demand **in the local area** for services → other jobs available

Trade

Whole industry shuts down. Broad job losses

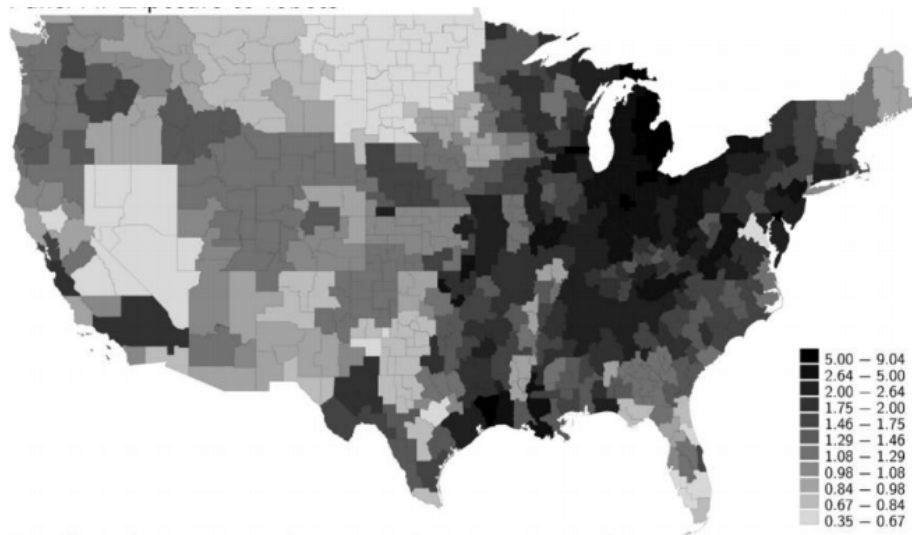
Other industries do better but **in other areas**.



Are things different for robots?

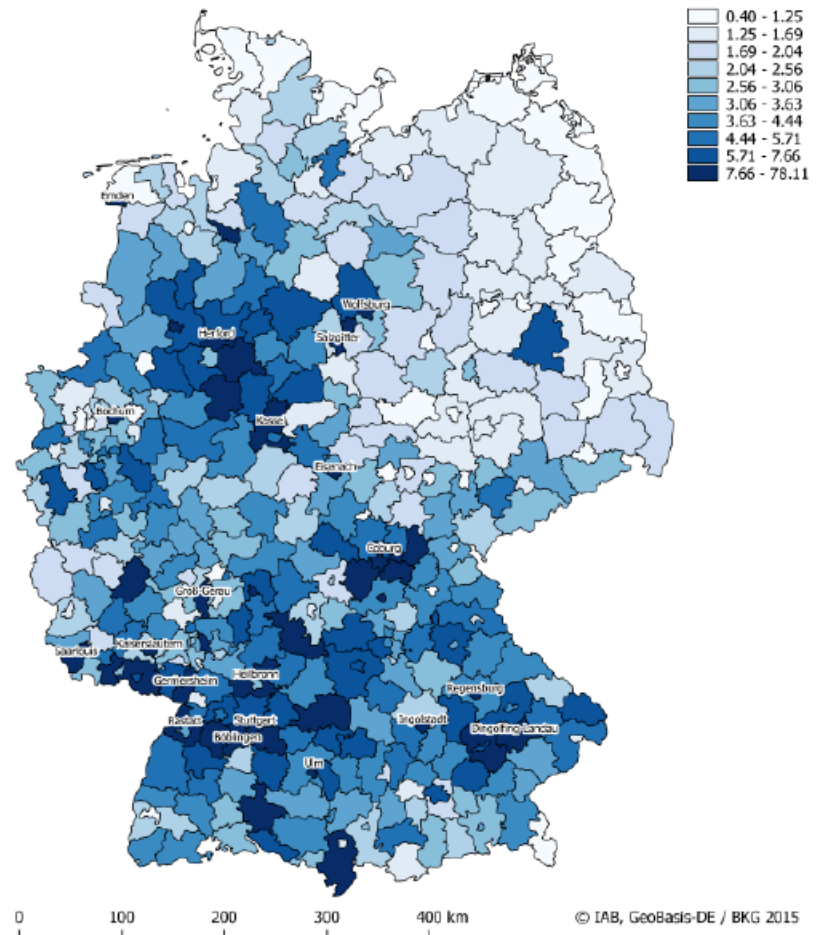
What about Recent Robots?

United States



Source: Acemoglu and Restrepo (2020)

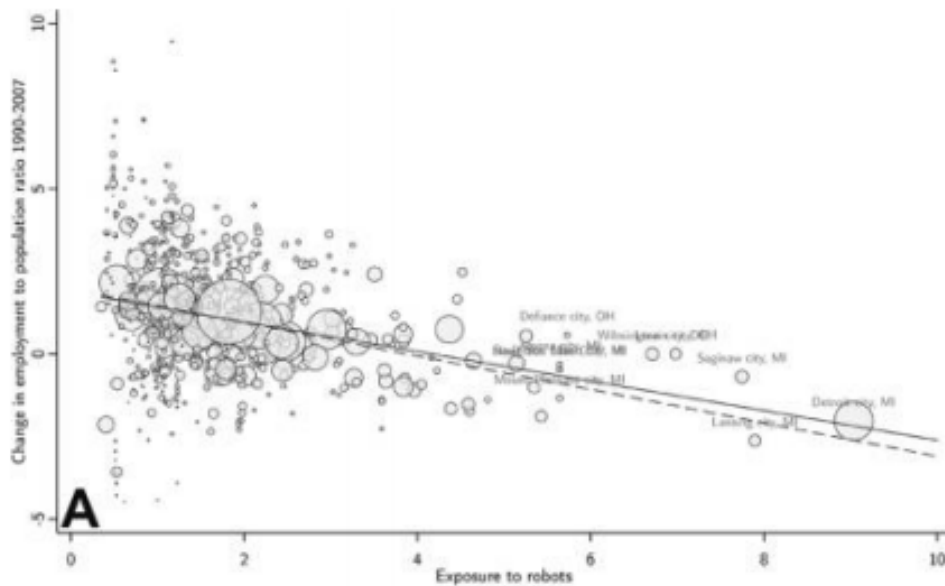
Germany



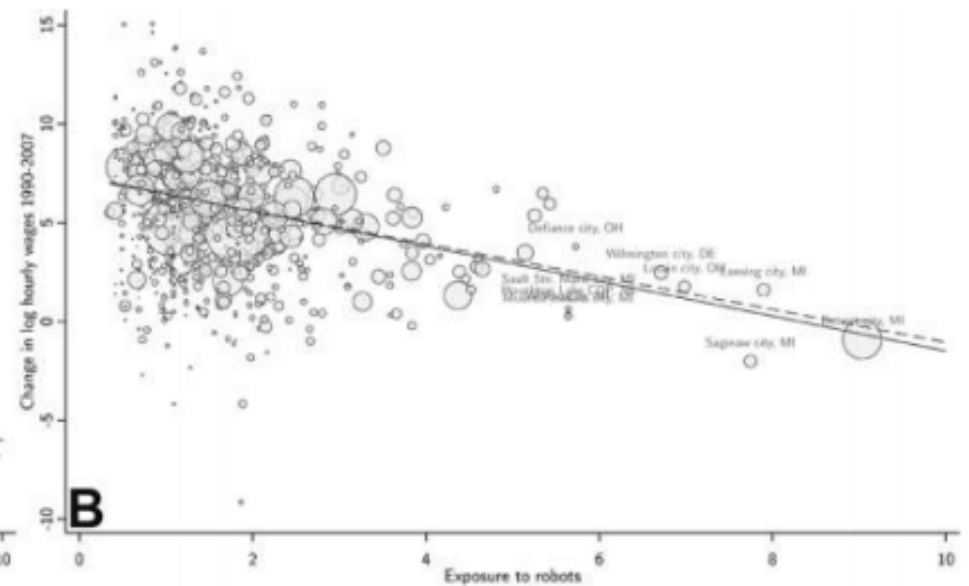
Source: Dauth, Findeisen, Suedekum and Woessner (2017)

United States

Employment



Wages



- Negative Effects on Employment
- Negative Effects on Wages

Other Countries

- **For Germany:**

- Declining Employment in Manufacturing

- Employment losses compensated by increases in services

- Downward pressure on wages for manual workers

- **For 17 Advanced Countries**

- Little overall effect for employment

- Downward pressure on wages for manual workers

Why does the United States Look so Different?

- Germany also seems not to have suffered declines from trade
- What's the difference:
 - The United States is much more geographically spread out and economic growth is very concentrated in cities
 - Educational system is great in the high end, less so in the low end
 - Germany has a fantastic apprentice system
 - Labour market systems differ (unions, retraining etc).
 - Unclear what the drivers are

Survey: So what do we do about this?

- i) Nothing
- ii) Minimum wage increases
- iii) Roll back globalization (tariff barriers and no new trade deals)
- iv) Tax robots
- v) Massive government spending: green infrastructure etc.



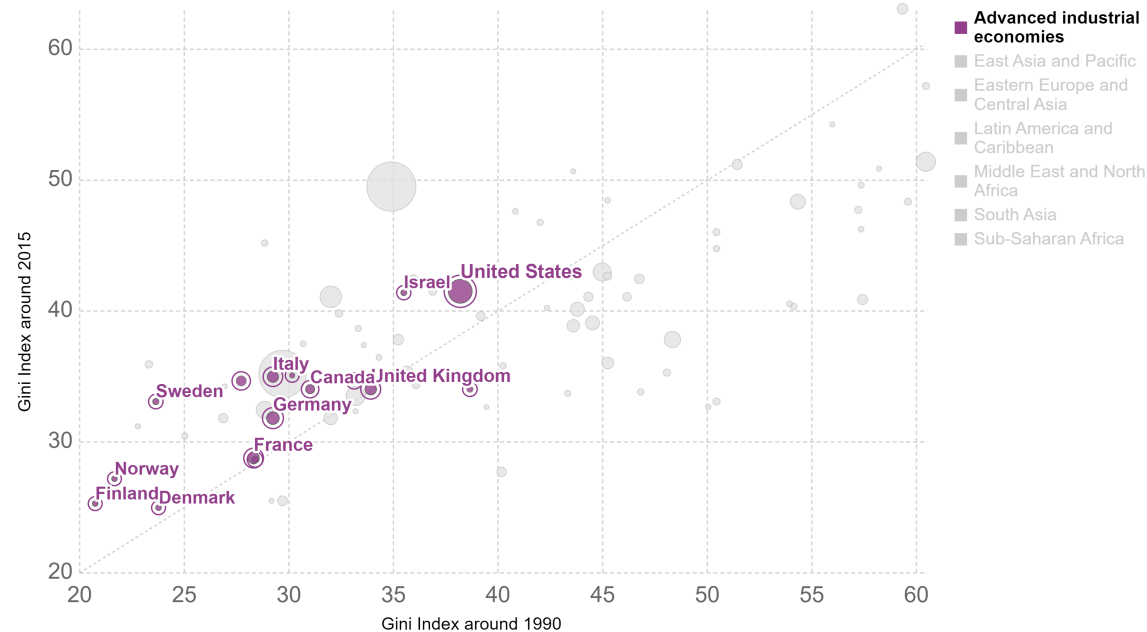
Nothing

Do nothing: Income Inequality Hasn't Gone up Everywhere

- For many countries:
- No big effect on employment
- No large rise in income ineq.
- Trade and Technology make countries richer

Inequality in 1990 vs 2015

A higher Gini index represents higher inequality.



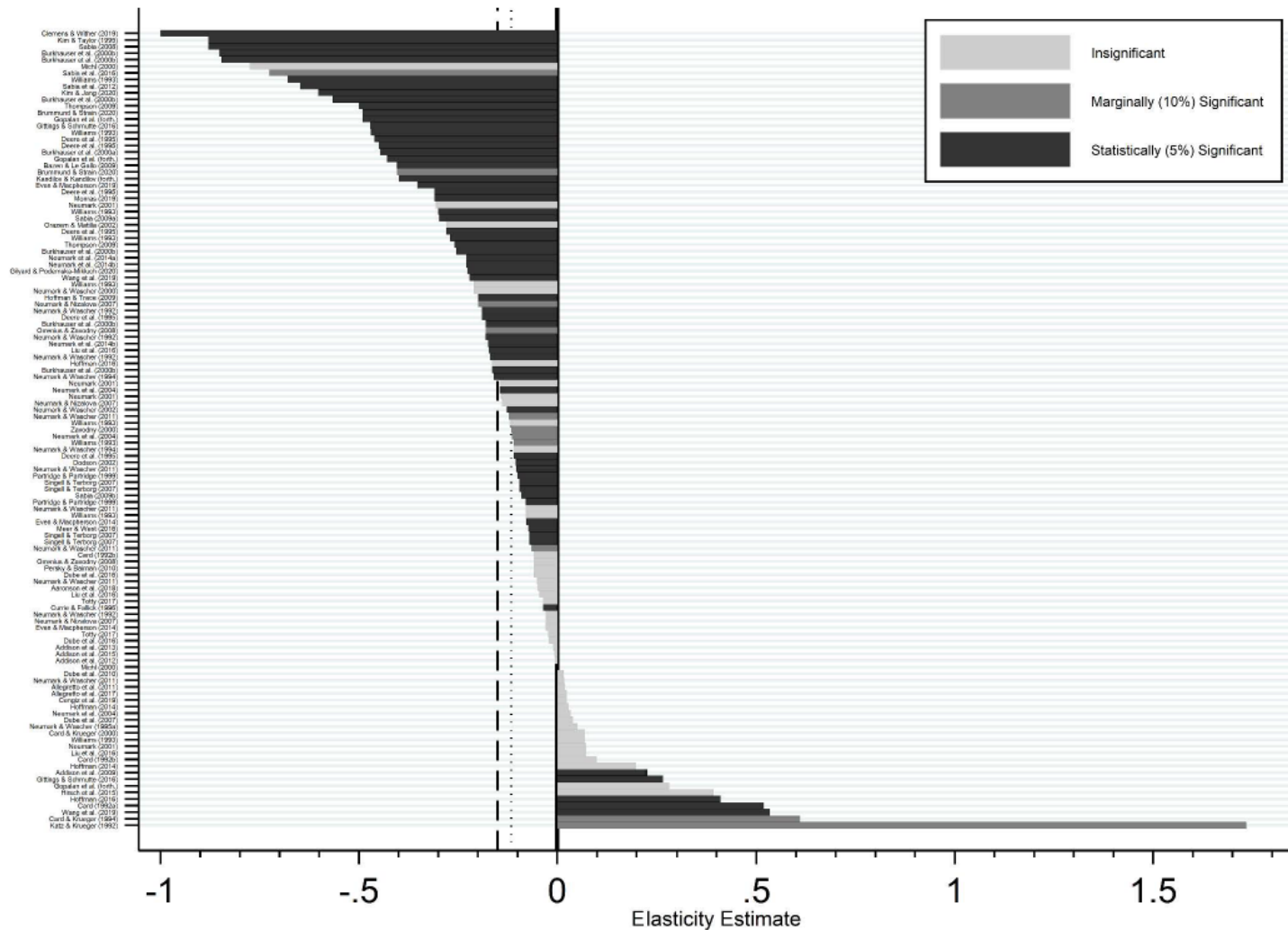
Source: Povcal (2018), The Chartbook of Economic Inequality (2017), Kandbur et al. (2017) Table 1.B

Note: Estimates are based on household survey data of either incomes or consumption. All countries for which comparable surveys within five years of each reference year were available are shown.

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Minimum Wage

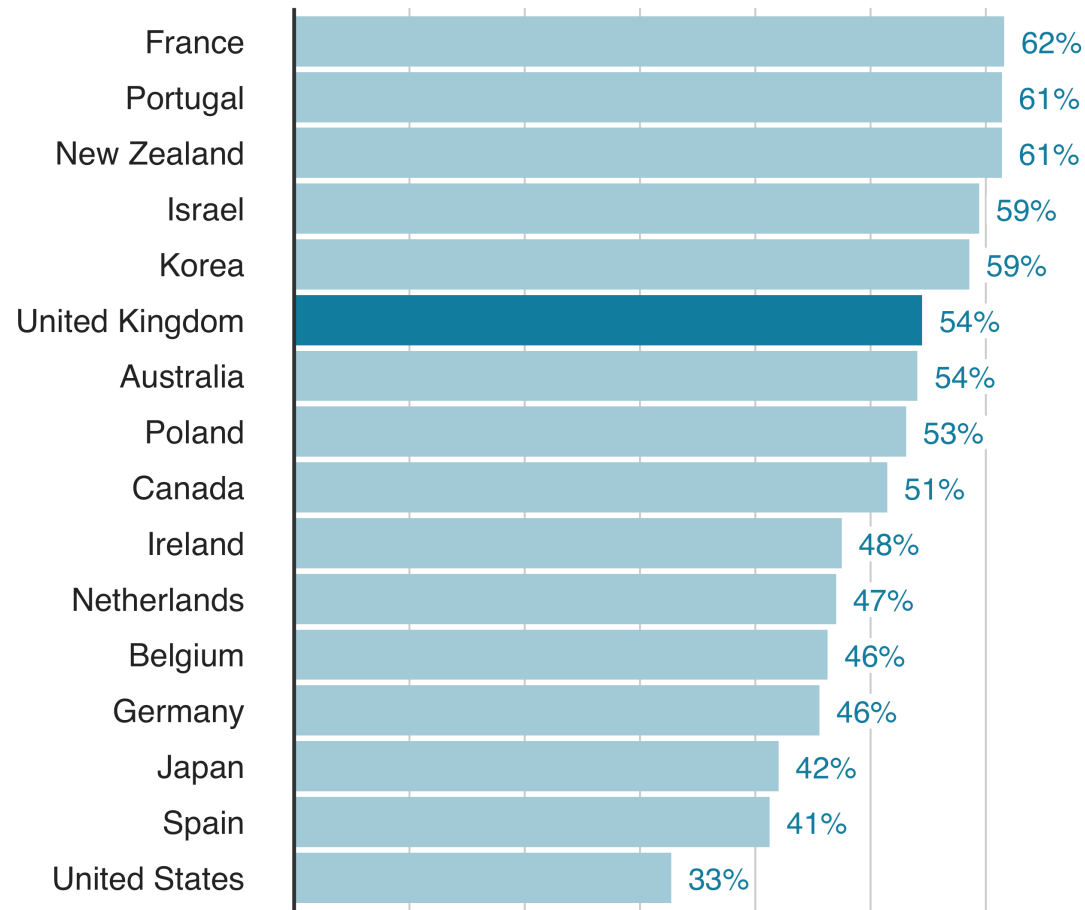
Estimates of Minimum wage on employment



Source: Neumark and Shirley (2021)

Minimum Wage

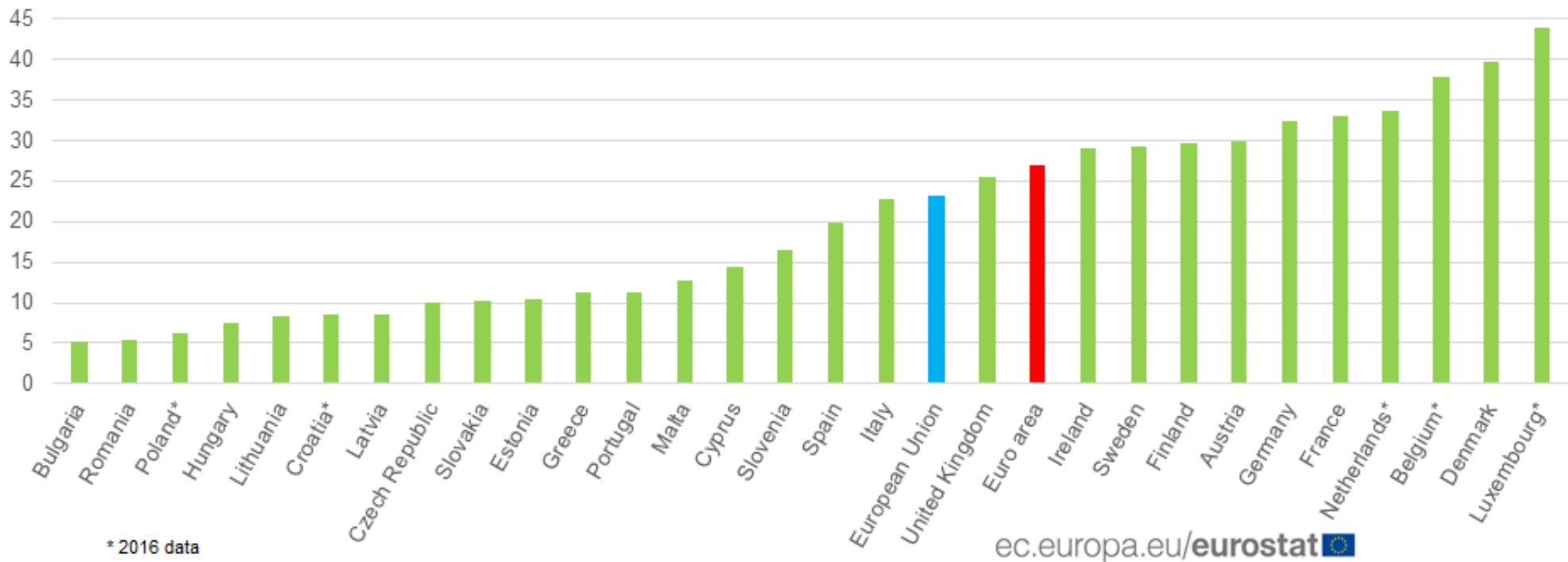
World minimum wages as a proportion of median full time salary (2018)



Source: OECD

Definitely not at the European (or US national) level

Average compensation of employee received by hour worked, 2017
(in euro)



Pro: Difficult to make ends meet for many low-wage workers

Con: These workers already find it difficult competing with technology and foreign workers



Roll back Globalization

Roll Back Globalization

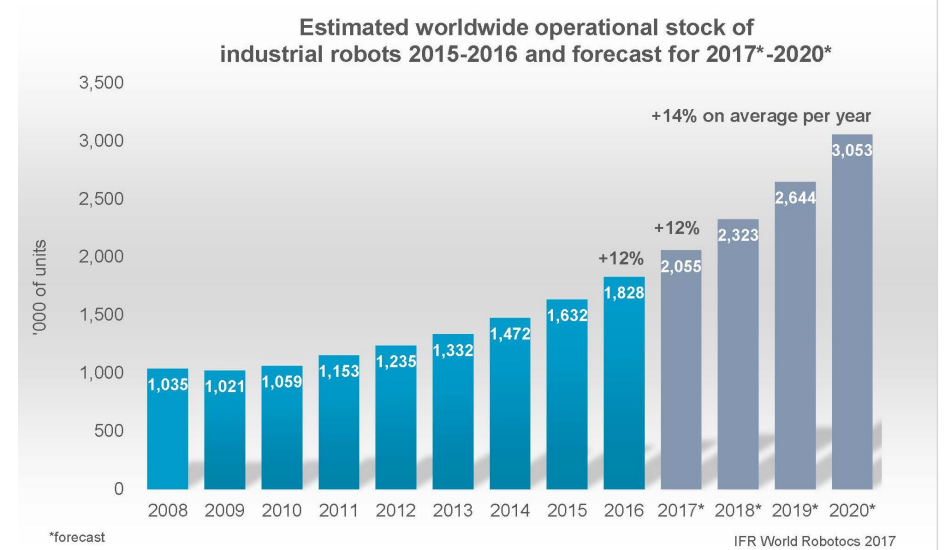
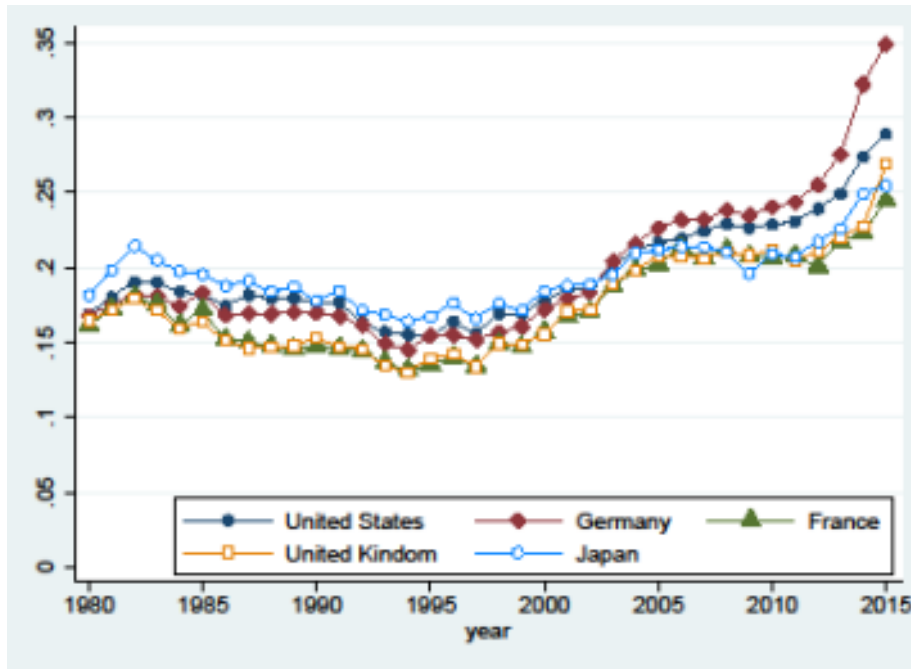
- The horse is out of the barn. It might have been a good idea to slow down trade opening. Impossible to meaningfully reverse it
- Unclear whether tariffs even increase employment
- Typical estimates of costs are (OECD, 2008)
 - US sugar industry: \$1 mio per job per year
 - EU 1990s protection of steel industry: €500,000 per job
 - Japanese families pay around \$2000 / yr extra for food.



Tax Robots

Tax Robots and new technology

Robot / Automation technology seems to be speeding up



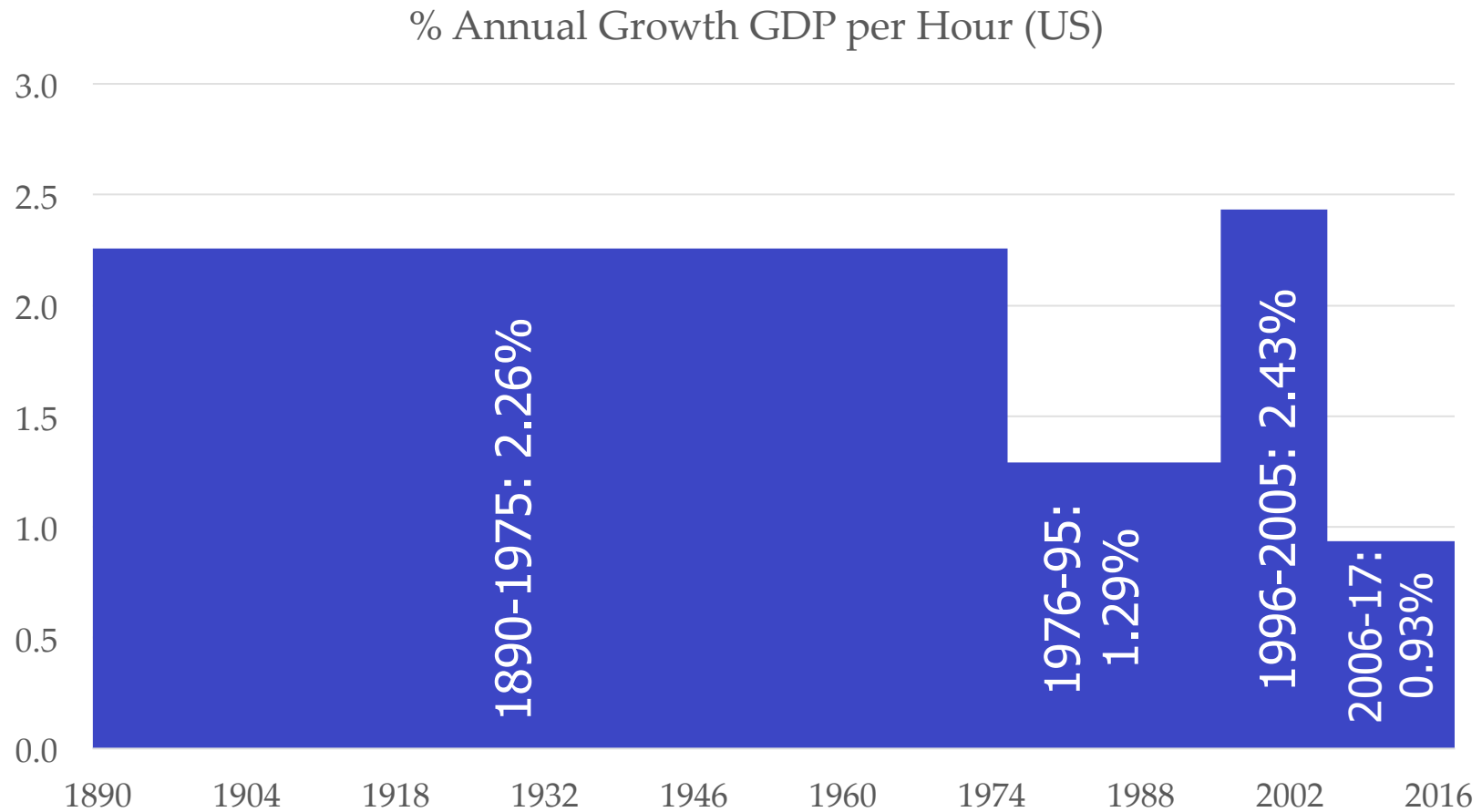
Did Tesla Overdo the Automation?



Source: Business Insider

Innovation: Slower?

But productivity growth points in the opposite direction.
Slowdown since the mid 1970s.



Big Problem

- Innovation builds on innovation
- We usually try to subsidize innovation and research
- Doing the opposite could have serious implications on growth
- Also: How do you define robots compared with general capital?

Pro: Technology might be too focused on automation technology (Acemoglu and Restrepo, 2019 and Hemous and Olsen, forthcoming)

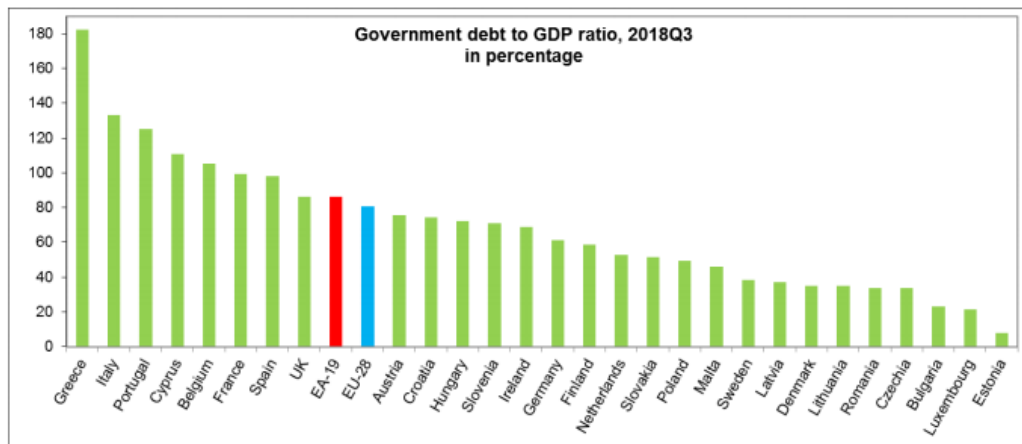
Con: Living standards are driven by new technology. Constrain at your peril.



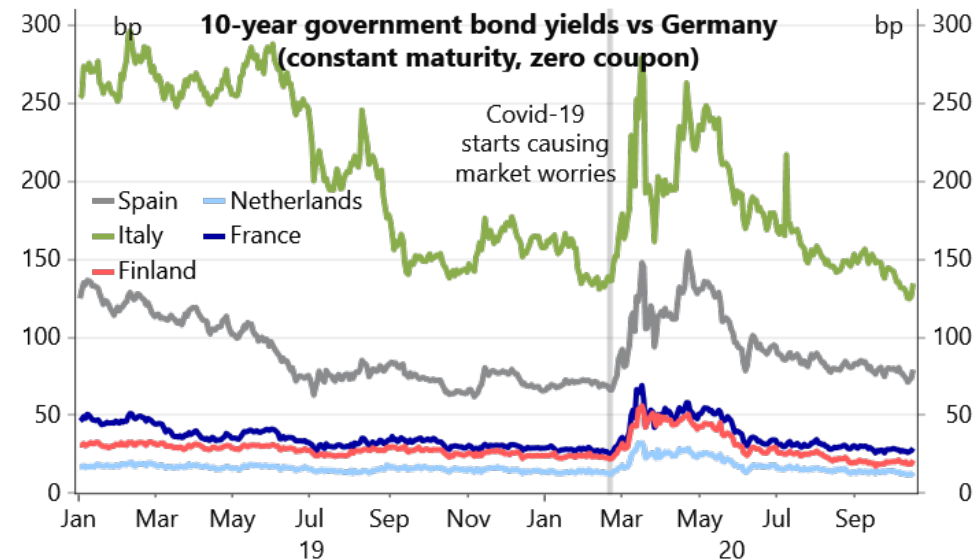
Massive Government Spending

Government Spending

- Government debt is reasonable in many countries



- Yields are on gov bonds are very low



Source: Nordea and Macrobond

- Pro: Should be easy to find projects with $ROI > 0$
- Con: Will these projects be well-targeted or wasteful?

Conclusion

- The consensus 20 years ago:
 - Little overall effect on employment or income inequality from trade
 - New technology favored college-educated workers but no negative employment effects
- The change in view (still not fully settled)
 - The rise of China had a stronger impact on employment and income inequality than expected. Not much done to compensate
 - The recent trend towards industrial robots is showing early signs of negative impacts
 - These effects are **much stronger** in the United States than in Europe.



Survey: Are you worried about your job?

- i) Yes, I worry about losing my job to foreign competition
- ii) Yes, I worry about being replaced by AI / Robot
- iii) No, not at all. They'd be fools to let me go!



Appendix



Wealth Jobs and Frontier Jobs



Wealth Jobs and Frontier Jobs

Wealth Jobs

Sommelier



Zuma | Azumi ltd. - Boston, MA

Minimum one year sommelier experience required. Notifies Head Sommelier of wines that are 86ed or low. Supports Head Sommelier in preparing wine orders on a...

Estimated: \$28,000 - \$38,000 a year ⓘ [Quick Apply](#)

Spa Concierge



Four Seasons - Boston, MA 4.2★

The Spa Receptionist provides exceptional service to Spa and Fitness Center guests that upholds the standards of Four Seasons. Essential function of the job:

Estimated: \$28,000 - \$37,000 a year ⓘ

Part-time / Full-time Barista & Counter Staff



Amorino | NIMBA, LLC | Boston - Boston, MA

Amorino is looking for awesome Counter Staff / Baristas / Cashier to join the team! As a Counter Staff/Cashier and Barista, your job will be to welcome and...

\$14 - \$18 an hour

7d

Frontier Jobs

Robotic Assembly Technician



Skyborn Robotics - Boston, MA

We build robots in Amsterdam, Boston and Izmir! We design and currently build many of our robots right here in Amsterdam. High School Diploma or GED.

Estimated: \$31,000 - \$45,000 a year ⓘ

Artificial Intelligence Researcher



MIT Lincoln Laboratory - Lexington, MA 4.2★

The mission of the Artificial Intelligence (AI) Software Architectures & Algorithms Group is to lead the nation in exploring and applying AI and Machine...

Estimated: \$130,000 - \$170,000 a year ⓘ

Operations Engineer



Neurala - Boston, MA

We're working on a revolutionary platform, which enables human operators to interactively teach and deploy a neural network.

Estimated: \$110,000 - \$160,000 a year ⓘ

Frontier Jobs and Wealth Jobs are Increasingly in Cities

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



Source: Autor (2019)

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)



AI

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



Task Discussion

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

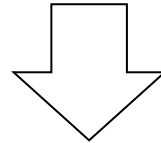
Gardener tasks

- 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)

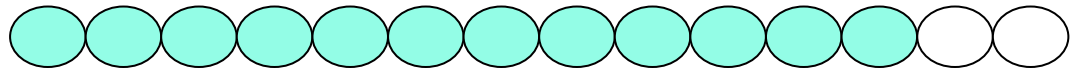
Job with some tasks automated



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

Or?

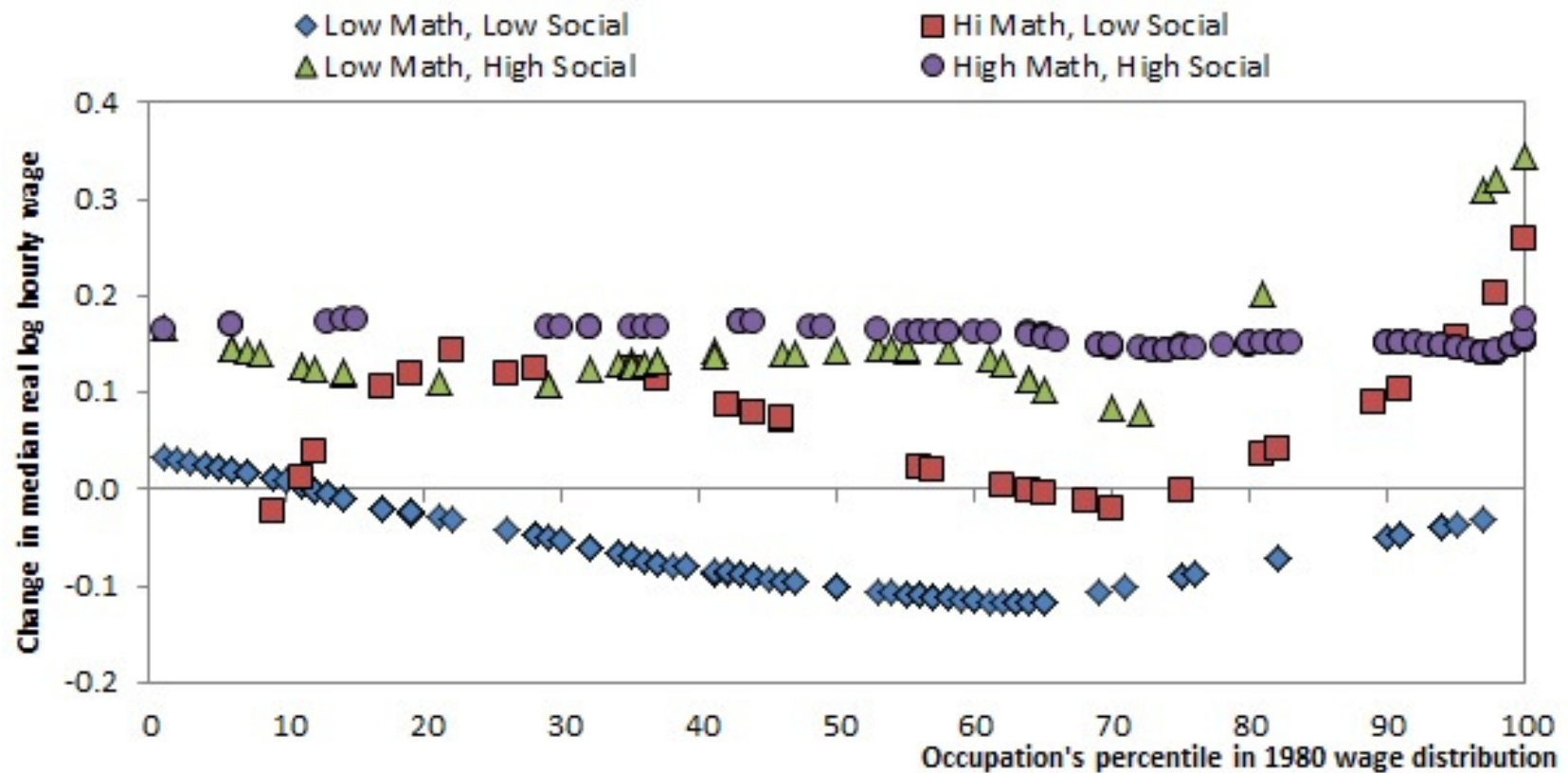
Job with many tasks automated



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

Social Skills

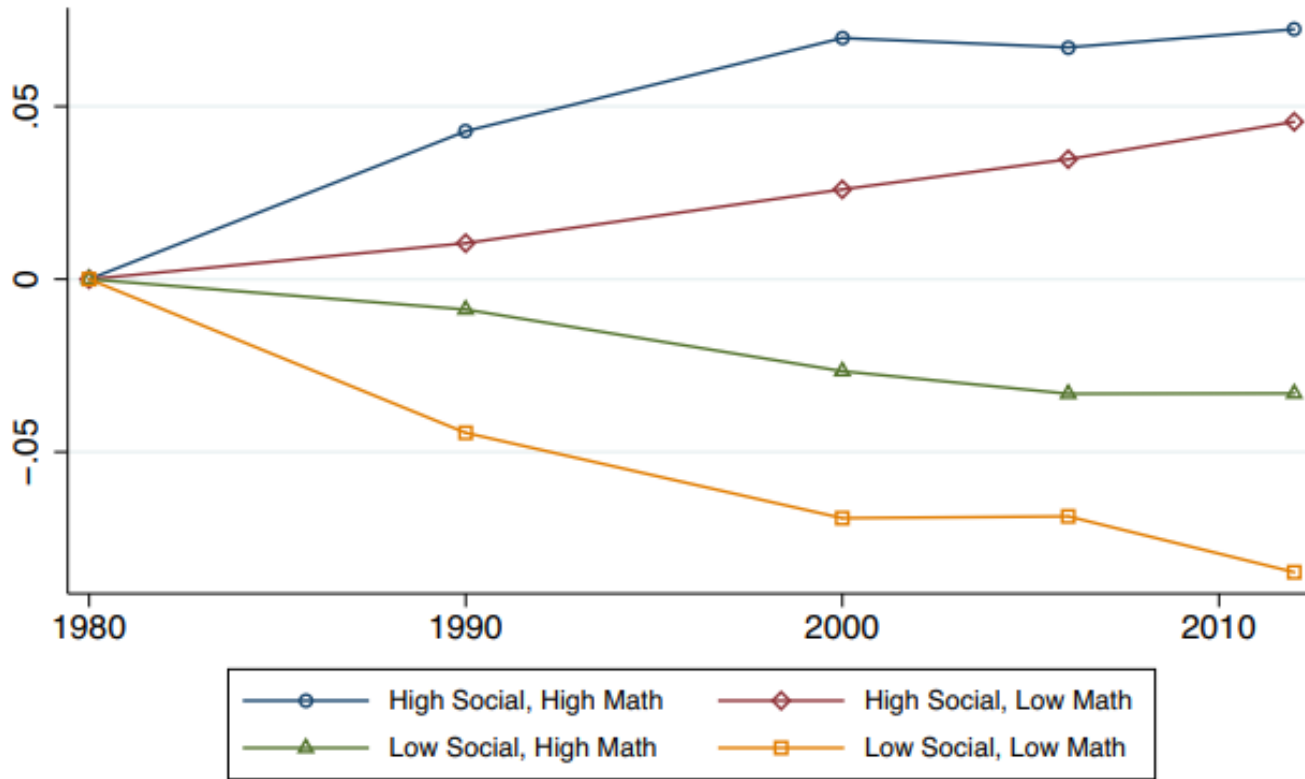
Figure 2. Smoothed changes in median wages by occupational task intensity, 1980-2012



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).

What jobs will be successful in the future?



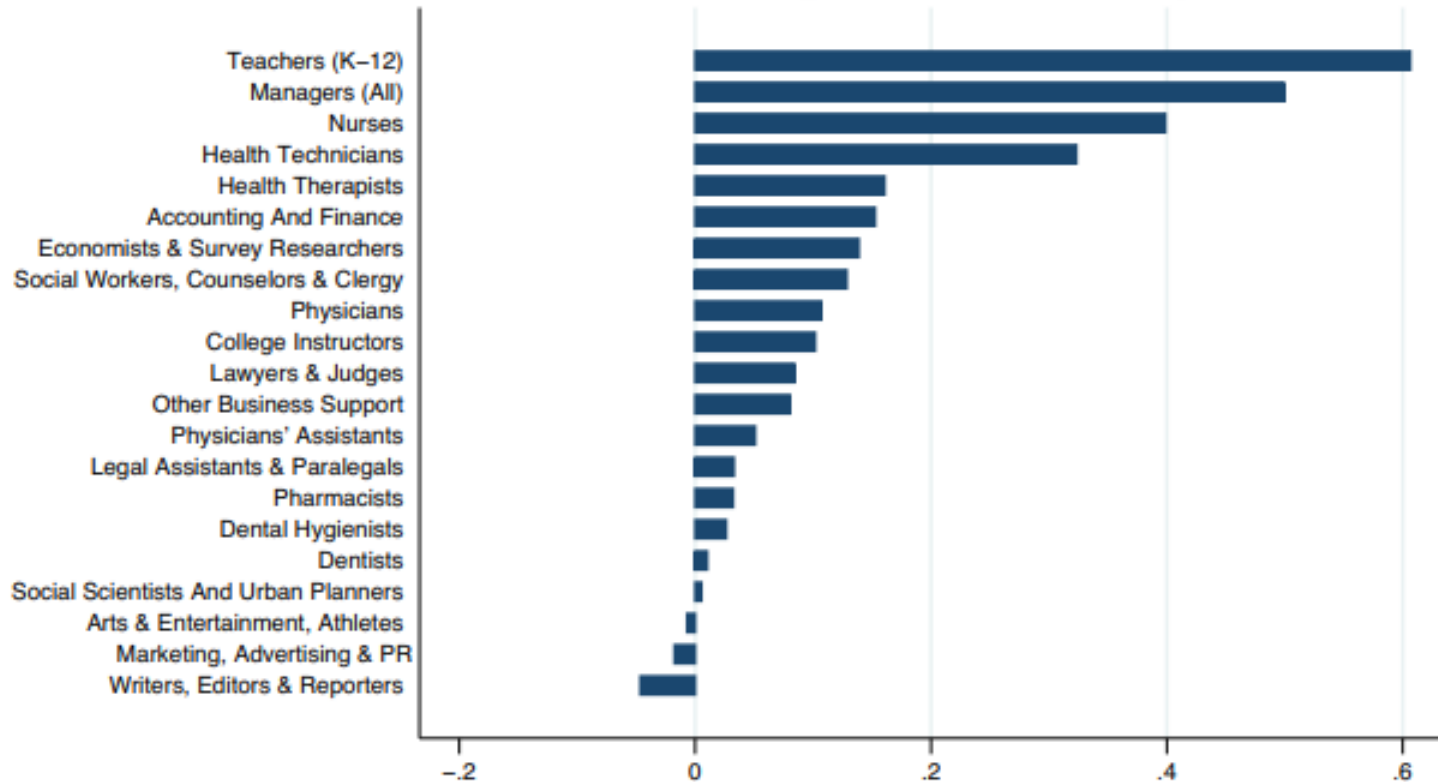
Occupational Task Intensities based on 1998 O*NET

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

Source: Deming (2017)

Change in Employment

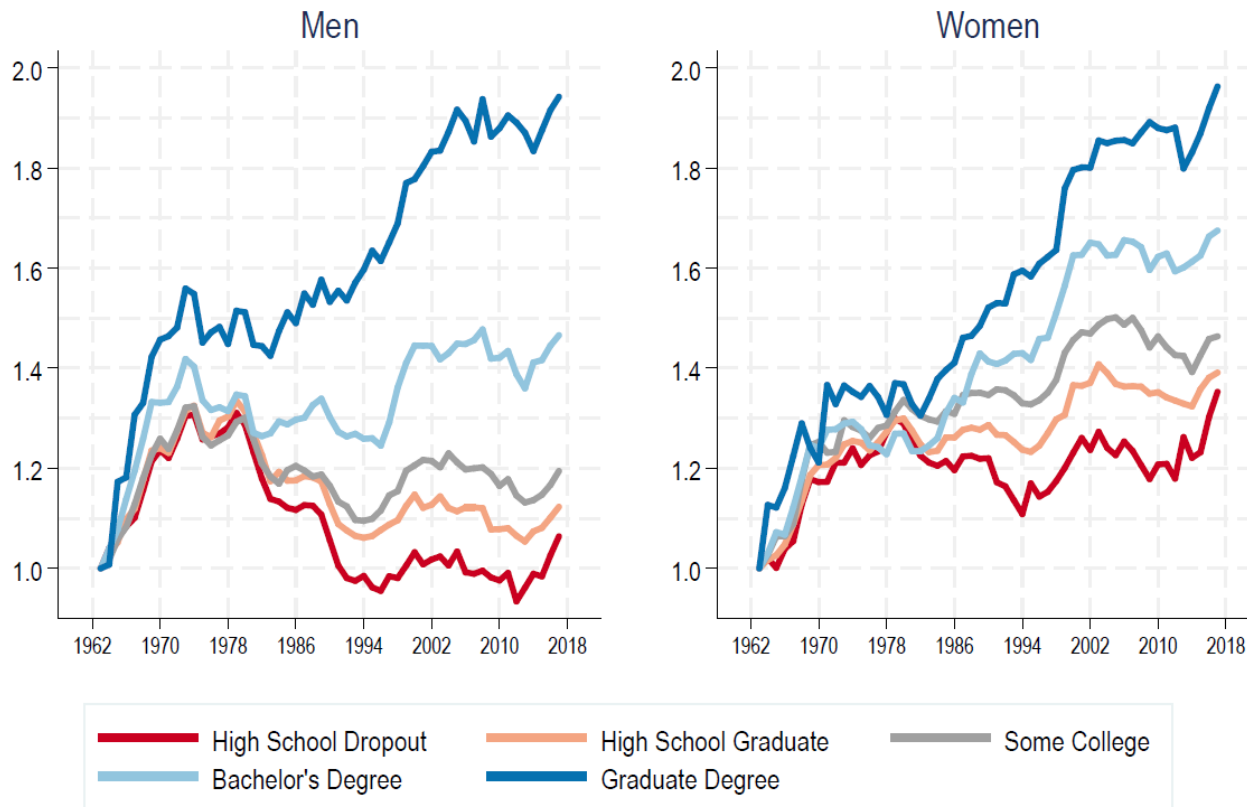
All Other Managerial or Professional Occupations



● Employment growth especially in caring sectors

Inequality often comes from Rising Return to Education

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

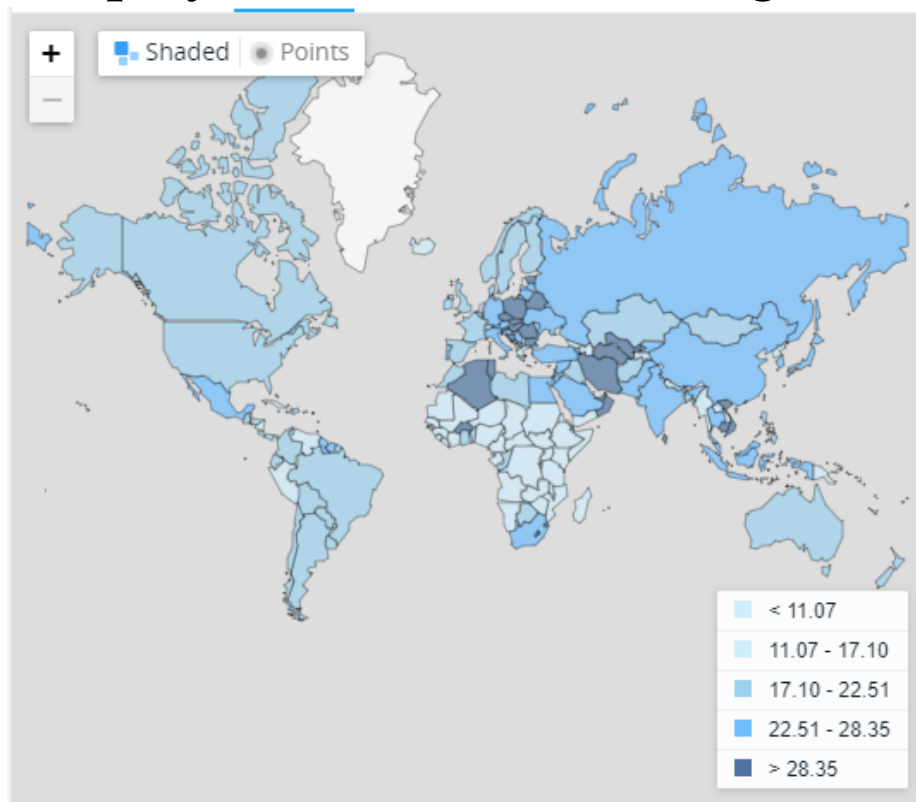


- Rising returns to education
- Most pronounced in the U.S. but is general pattern in Europe as well
- Puzzling fact:
 - Returns to schooling ↑
 - While uni. graduates ↑
- Clearly the changing economy has disproportionately benefitted educated workers.
- But why?

Employment Trends

Employment in Manufacturing - worldwide

Employment in manufacturing (%)



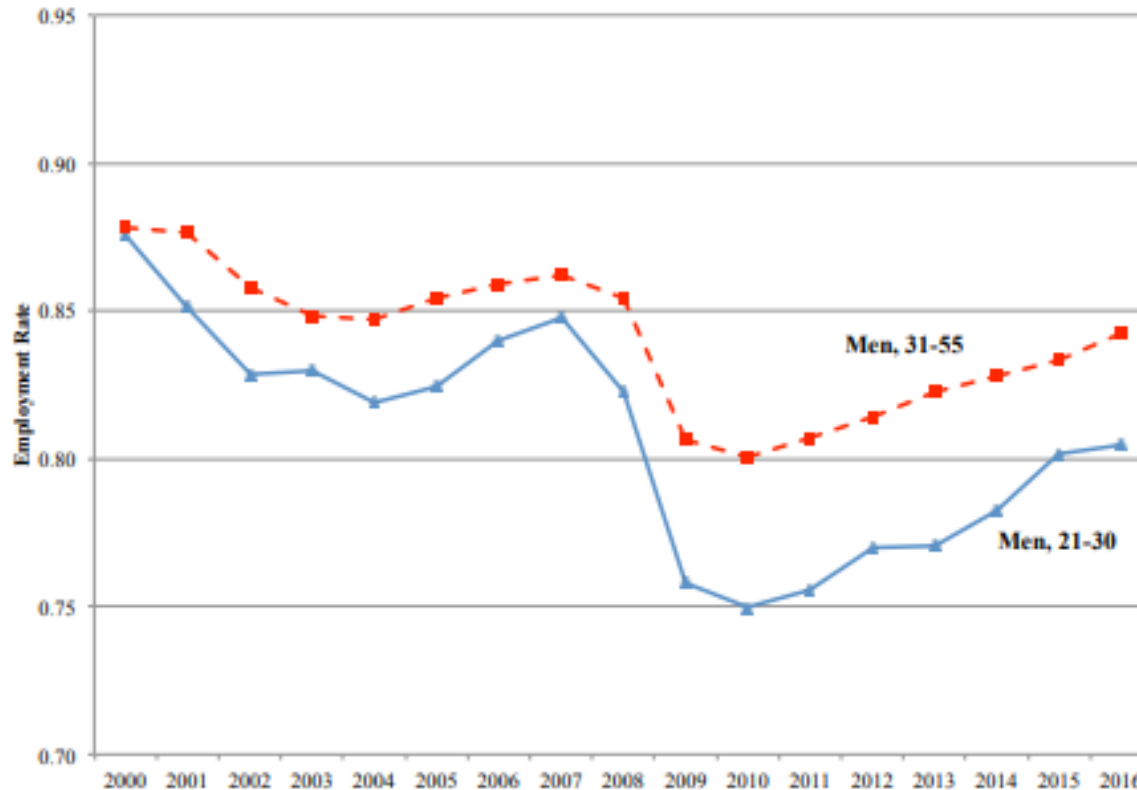
World growth in man employ (%)



Source: International Labour Organization, ILOSTAT database. Data retrieved in September 20, 2020.

Certain parts of employment distribution has suffered more

(b) Employment Rates

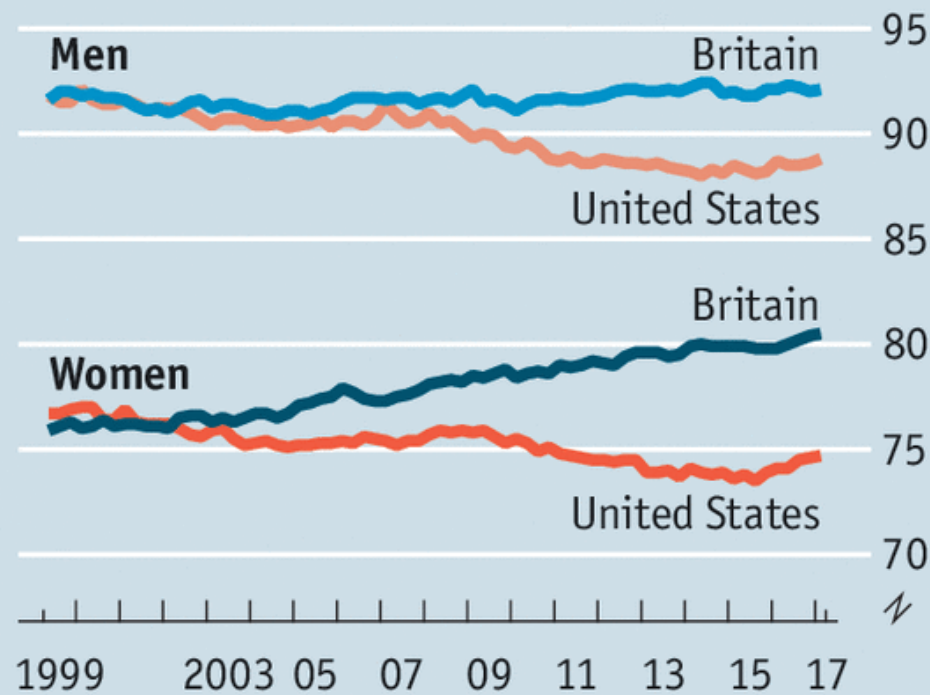


- Employment rate amongst young male Americans has declined substantially past 20 years?
- Permanent decline?

Prime-age Employment Rate

Working it

Labour-force participation rate
25- to 54-year-olds, %



Sources: OECD; Federal Reserve Bank of St Louis

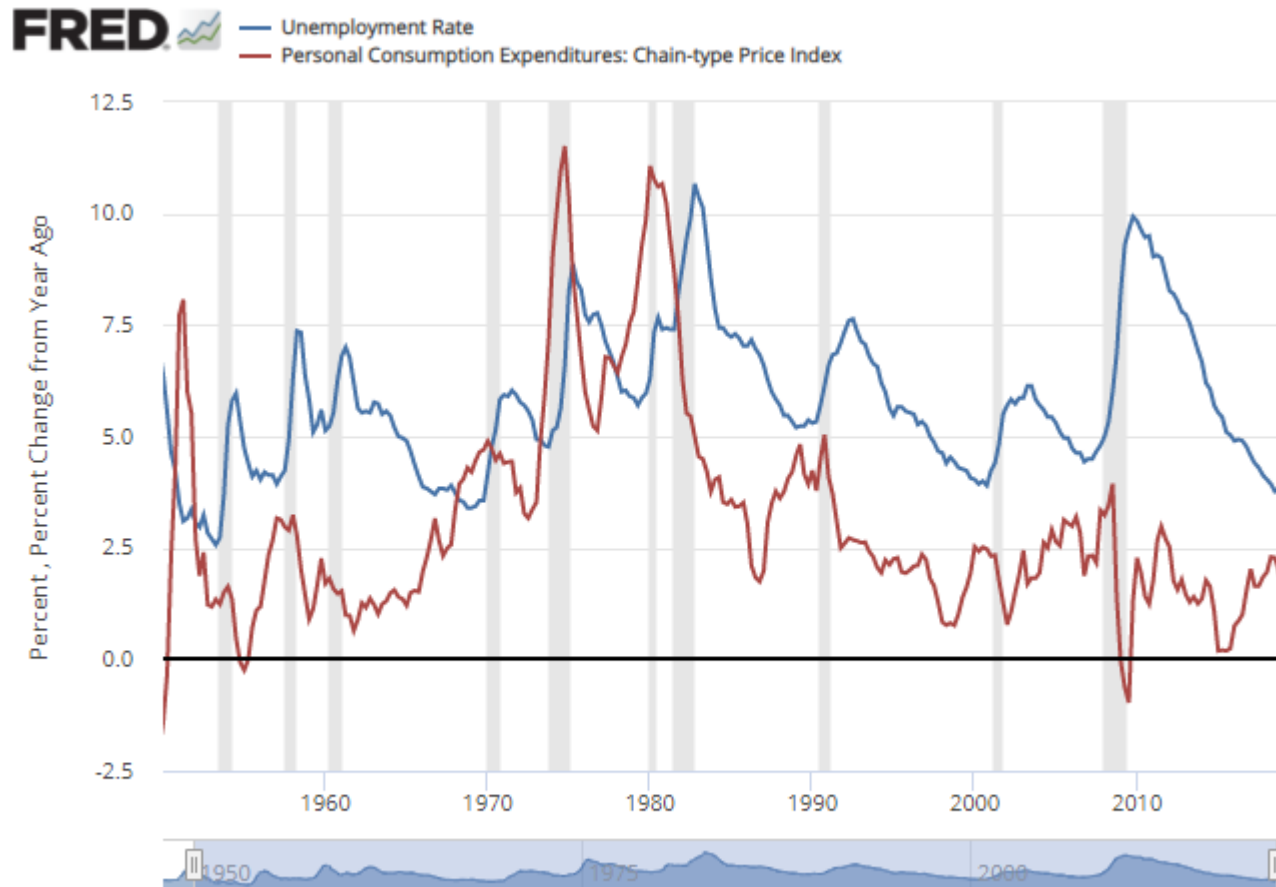


Future Inflation

The Covid Stimulus



A flatter Philips curve



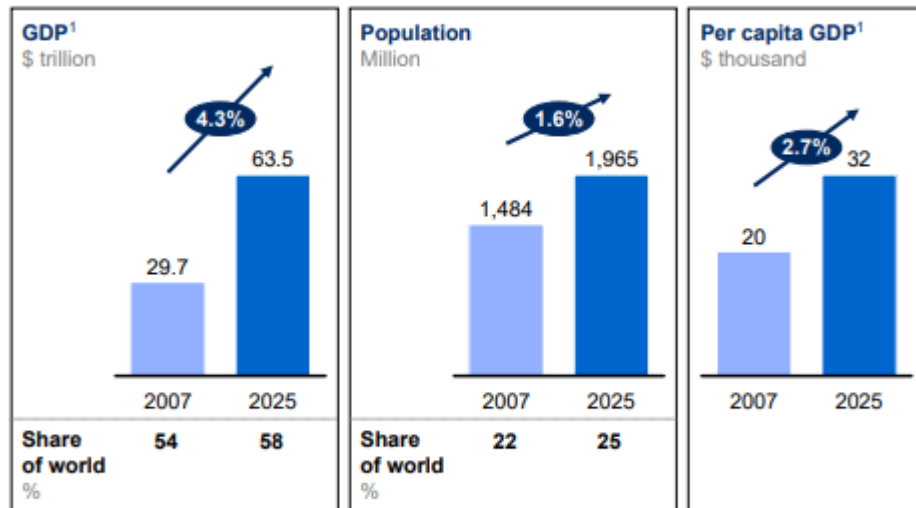
Sources: BLS; BEA



Importance of Cities

Importance of cities (world)

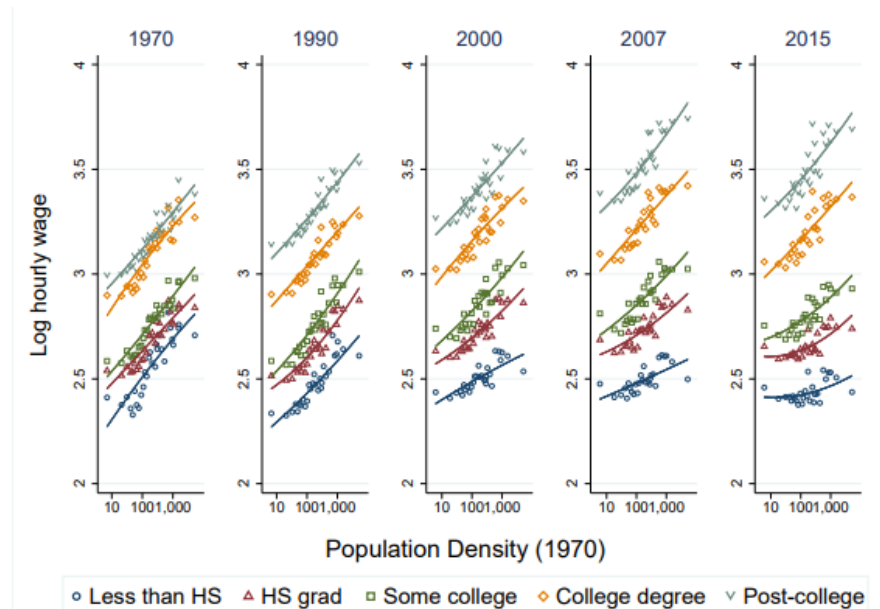
The City 600's fast growth is fueled by both GDP per capita and population growth



¹ Predicted real exchange rate.

SOURCE: McKinsey Global Institute Cityscope 1.0

Real wages by educational group



Source: Autor (2019)

References

- Dechezleprêtre, Hemous, Olsen and Zanella “Automating Labor: Evidence from Firm-Level Patent Data”, Working paper, 2020
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