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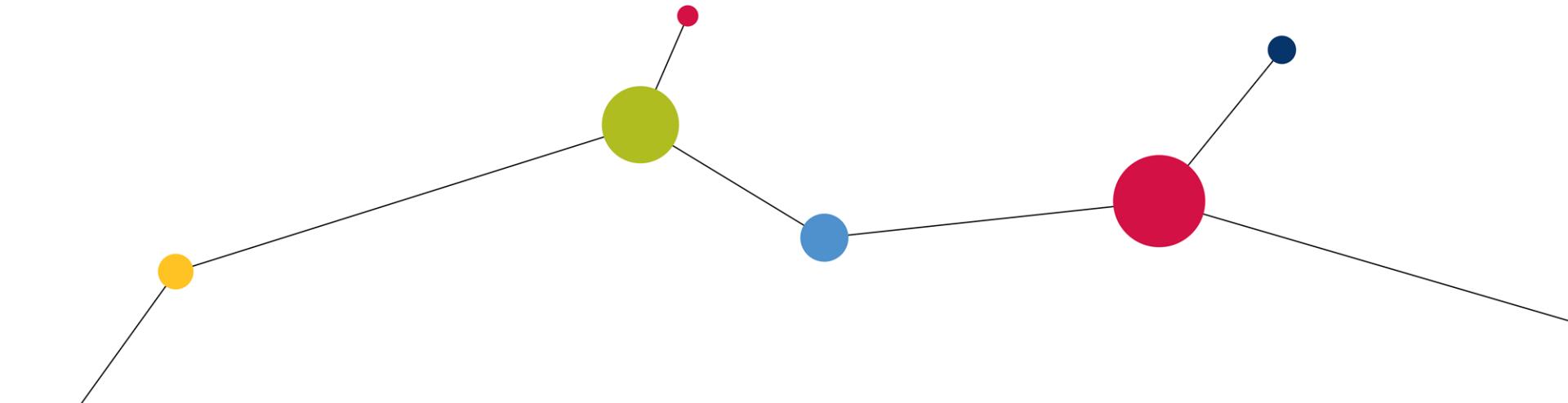
Attitudes Towards Automation: Past, Present and Future

Carl Benedikt Frey



A Brief History of Progress

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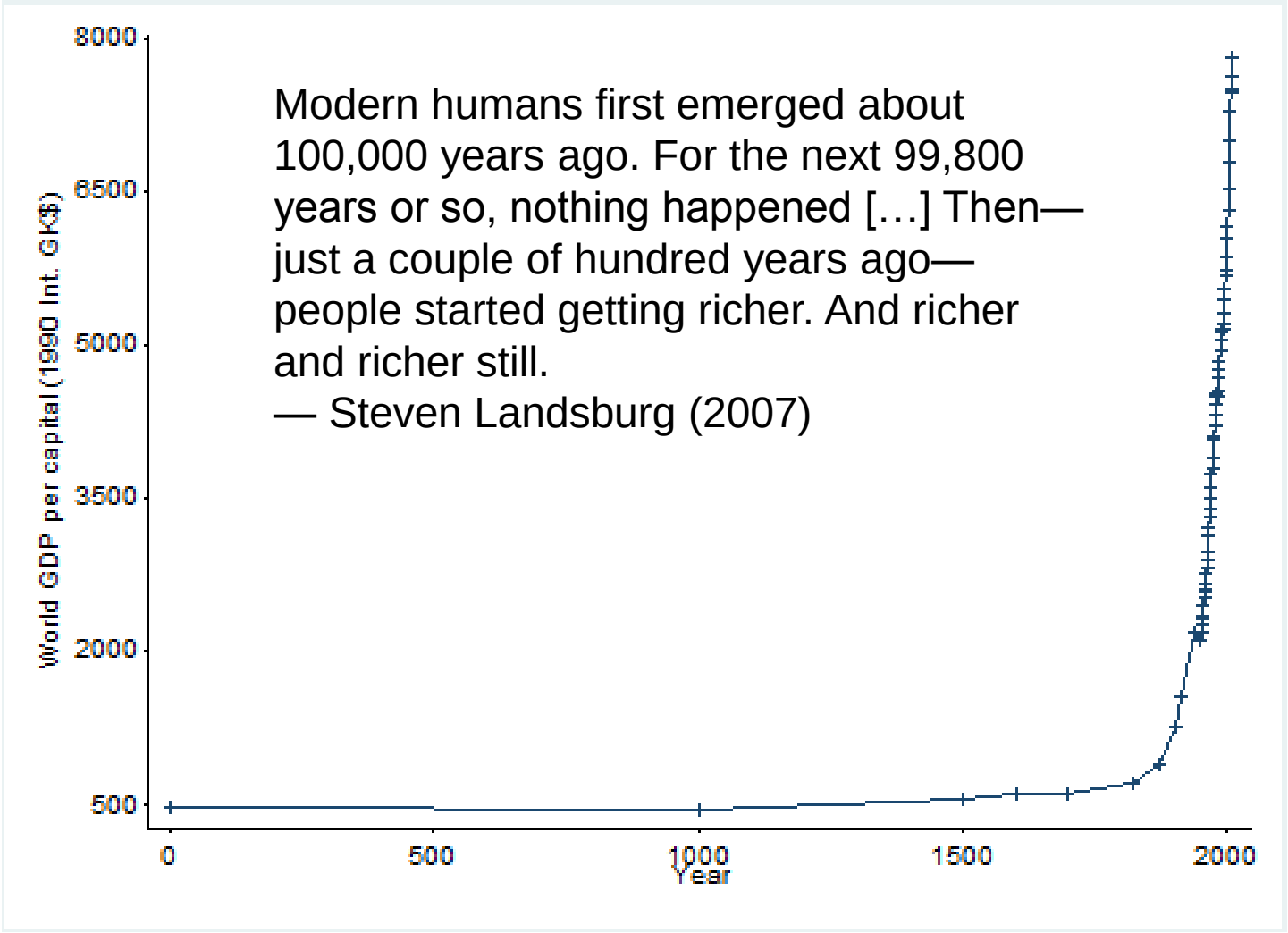

Source: Maddison (2018)

A Tale of Two Industrial Revolutions

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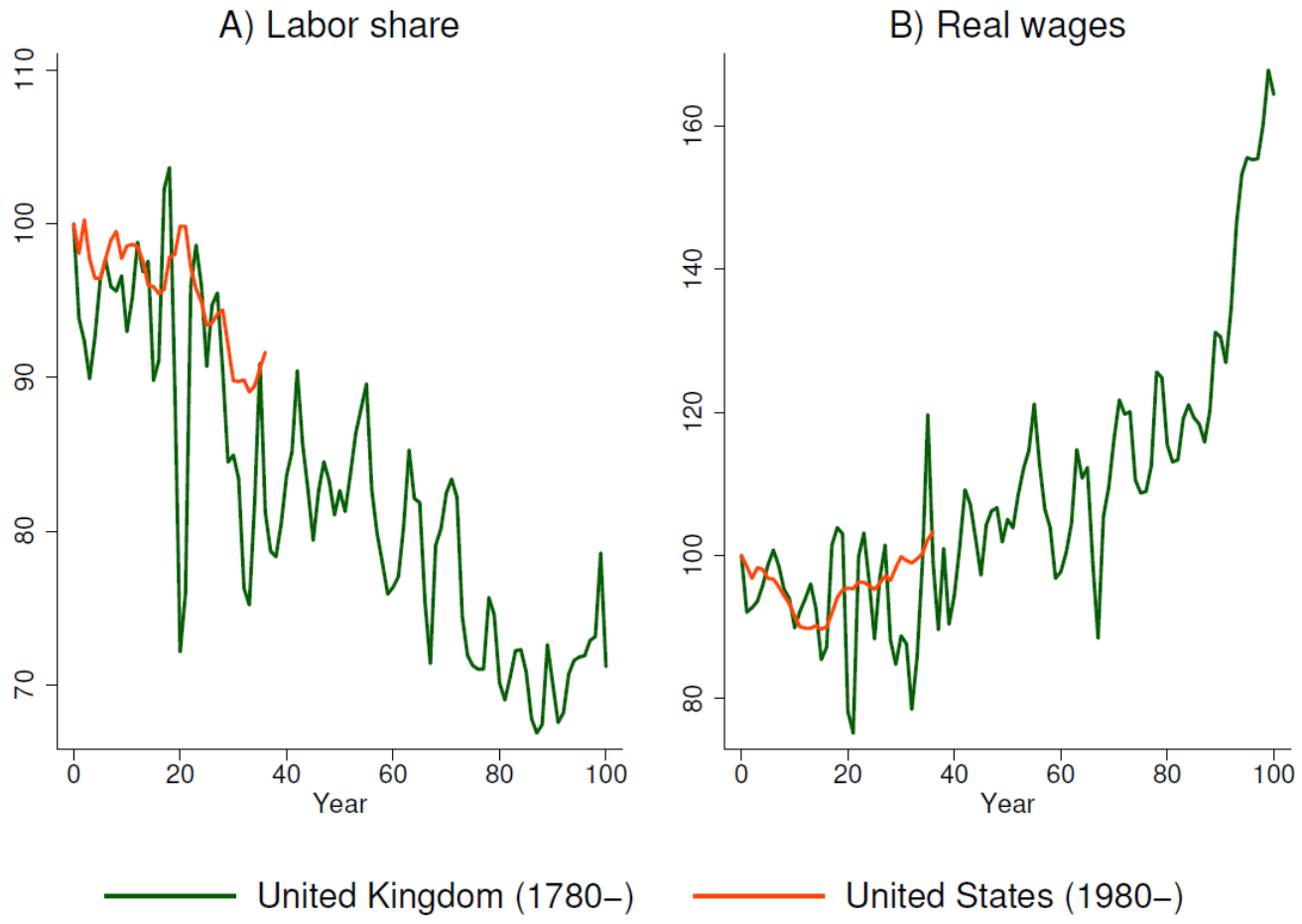

Source: Frey et al. (2018)

A Tale of Two Industrial Revolutions

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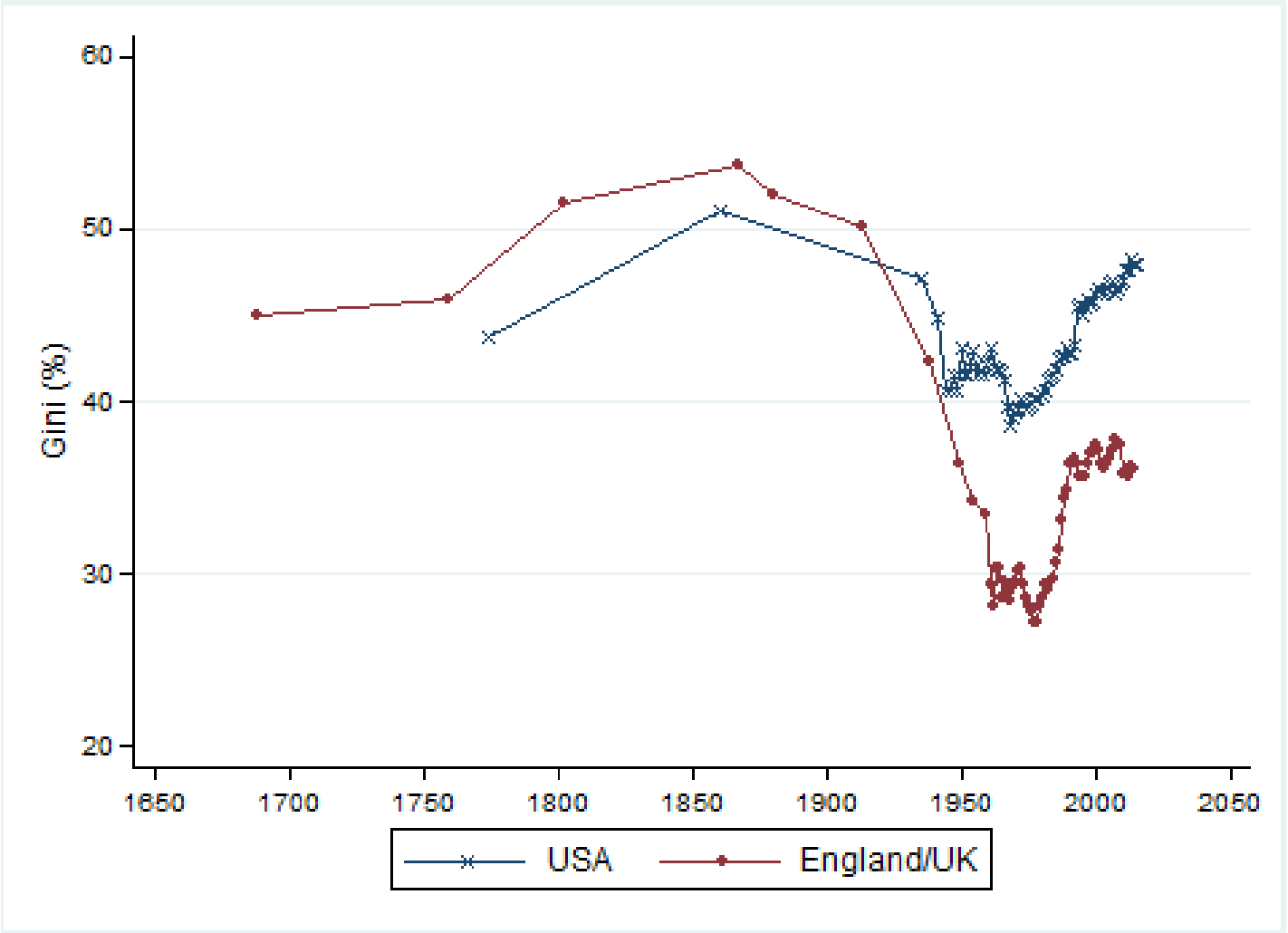

Source: Milanovic (2016)

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Since the Industrial Revolution, mechanization has been controversial. Machines pushed up productivity, raising incomes per capita. But they threatened to put people out of work, to lower their wages and to divert all the gains from growth to the owners of businesses. […] Now, it is robots that threaten work, wages and equality. […] There have been long periods of economic history in which things did not work out well, and we must wonder whether we are in another. […] The Luddites and other opponents of mechanization are often portrayed as irrational enemies of progress, but they were not the people set to benefit from the new machinery, so their opposition makes sense.

—Robert C. Allen

Acemoglu and Restrepo (2018)

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Augmenting technologies – telescope, typewriter, CAD

- Rising wages, labour share of income, and employment

Replacing technologies – power loom, tractor, robots

- Reduction in wages, labour share of income, and employment

The Simple Idea

Attitudes towards technological progress depend on:

- The race between tasks replacement and new task creation
- Adjustment costs

Outline

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- British Industrial Revolution
- Second Industrial Revolution
- Computer Revolutions
- Robots, AI and the future

The British Industrial Revolution

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"Even in the present day [...] it is found to be nearly impossible to convert persons past the age of puberty […] into useful factory hands."

— Andrew Ure (1835)

Spinners – 1580 to 1790

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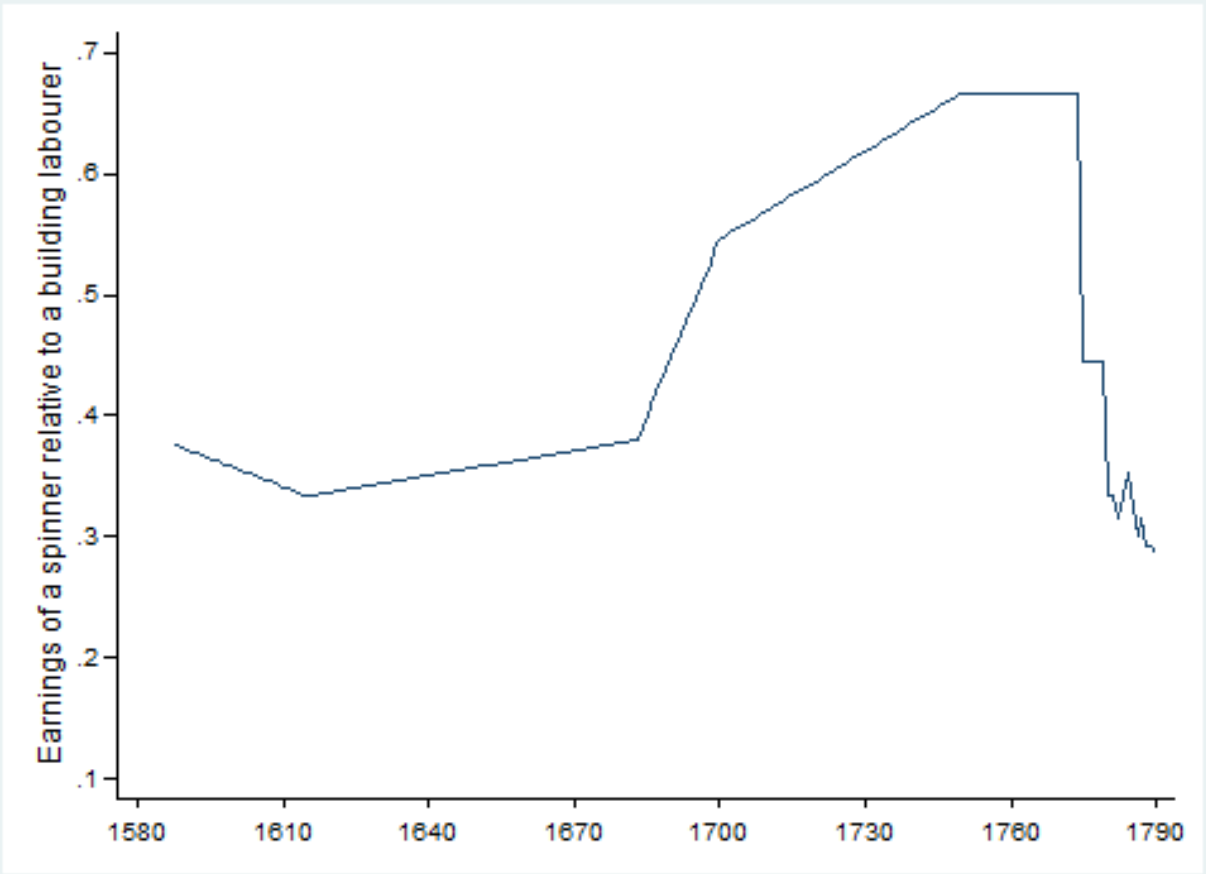

Source: Allen (2009)

Weavers – 1770 to 1840

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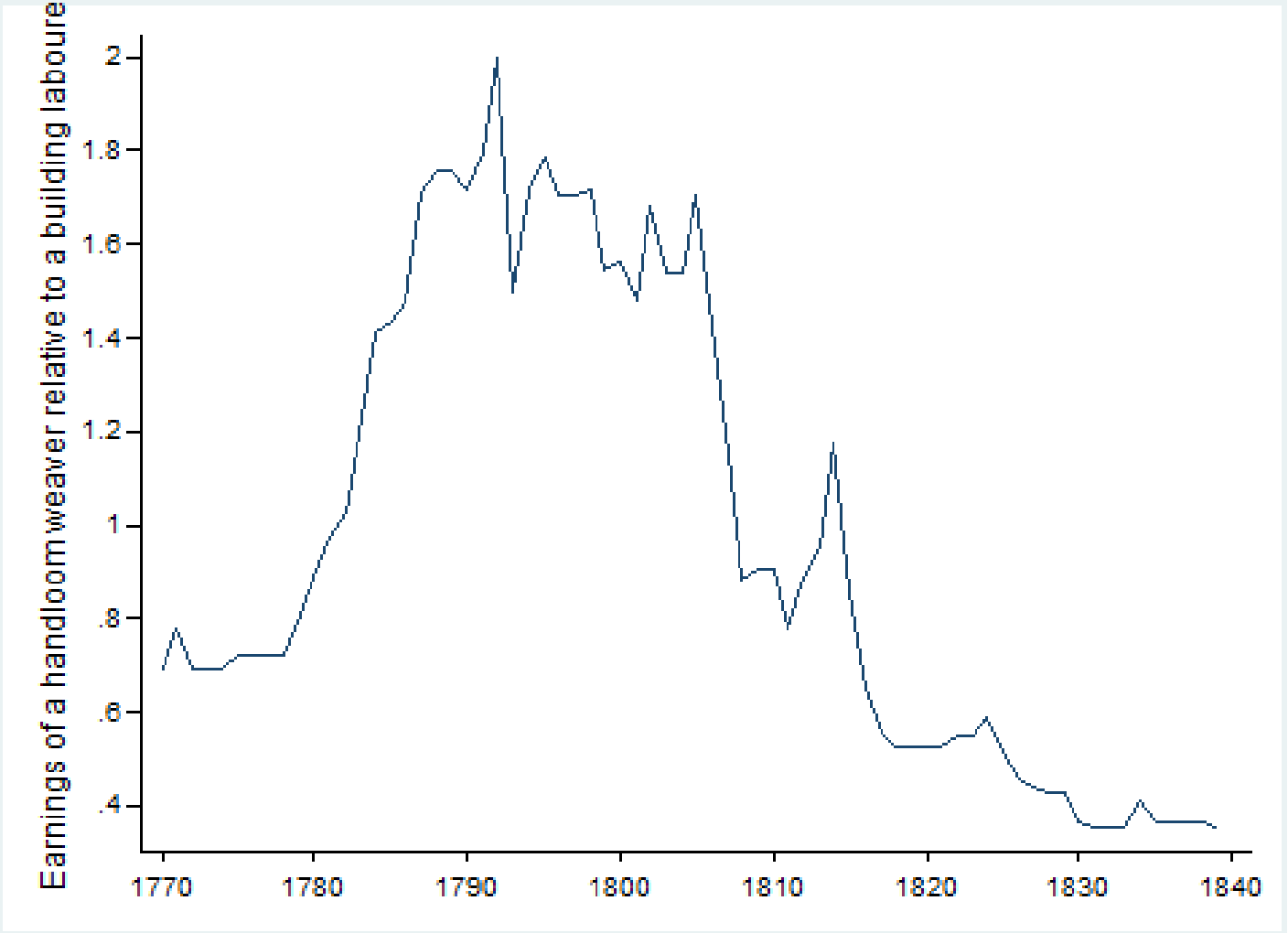

Source: Allen (2016)

Attitudes towards mechanization

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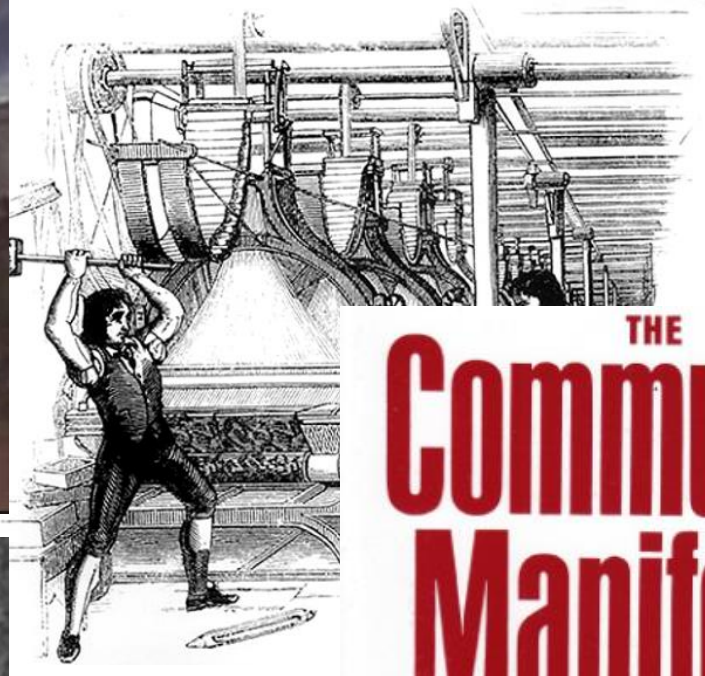
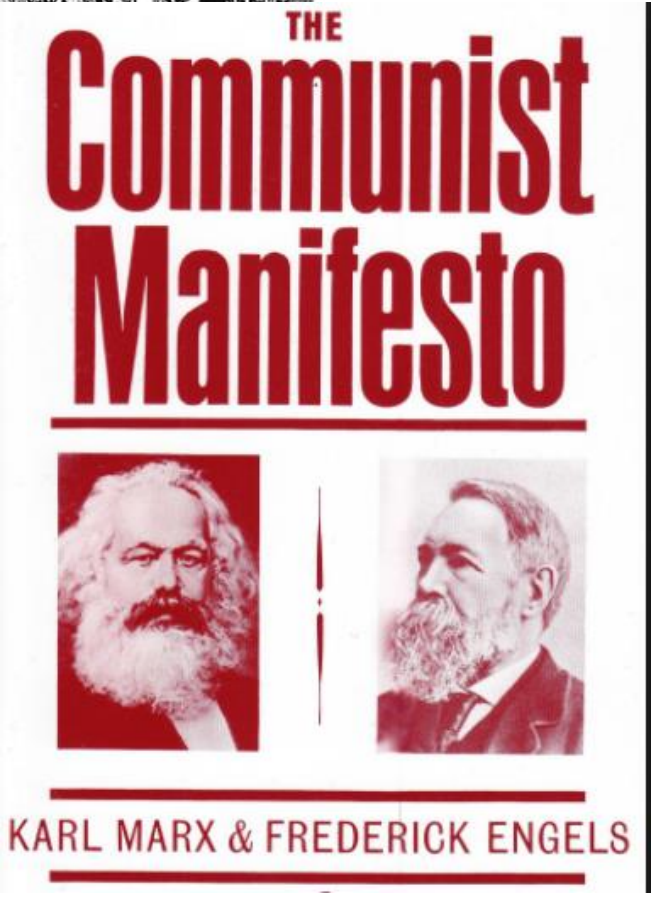




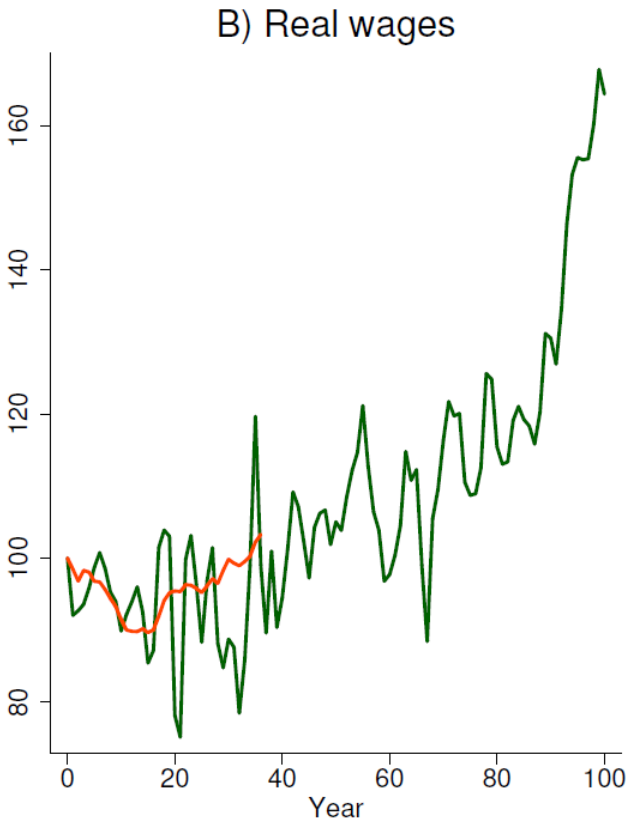
What changed?

During the early Industrial Revolution, the share of children—under 14 years of age—rapidly expanded and reached about half of the workforce employed in textiles, and a third of coal mining workers up until the 1830s (Tuttle 1999; Humphries (2003).

The Factor Acts of 1833 and 1844 served to improve children's working conditions

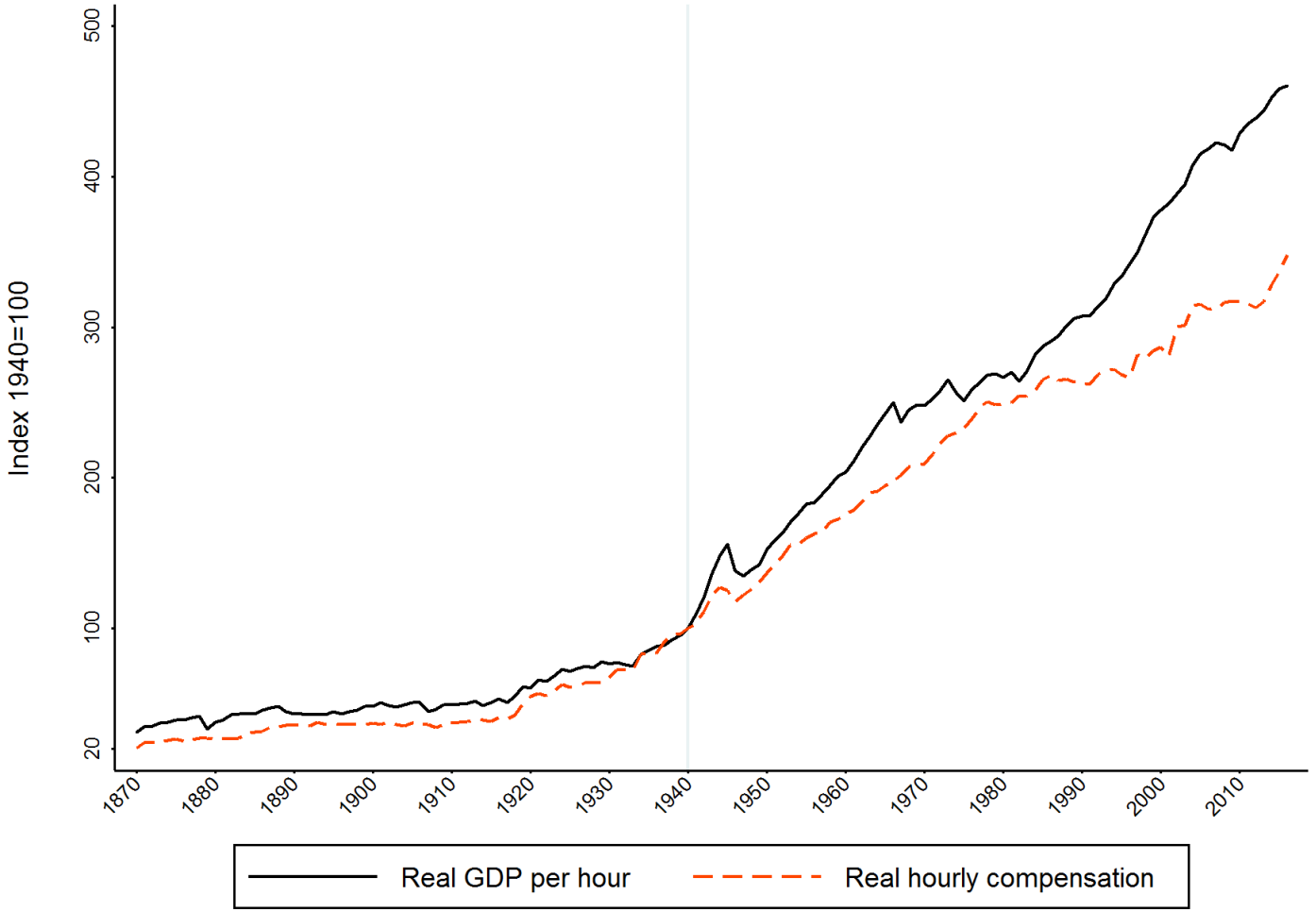
The more widespread adoption of steam power from the 1830s onwards (Crafts 2004)

Peter Gaskell already observed this tendency in the 1830s, asserting that:
"since steam-weaving became so general as to supersede the hand-loom, the number of adults engaged in the mills have been progressively advancing; inasmuch that very young children are no longer competent to take charge of a steam-loom."



Source: Frey et al. (2018)

U.S. labour productivity vs. hourly compensation, 1870-2015



Source: Frey (2018); See also Gordon (2016)

The race between technology and education

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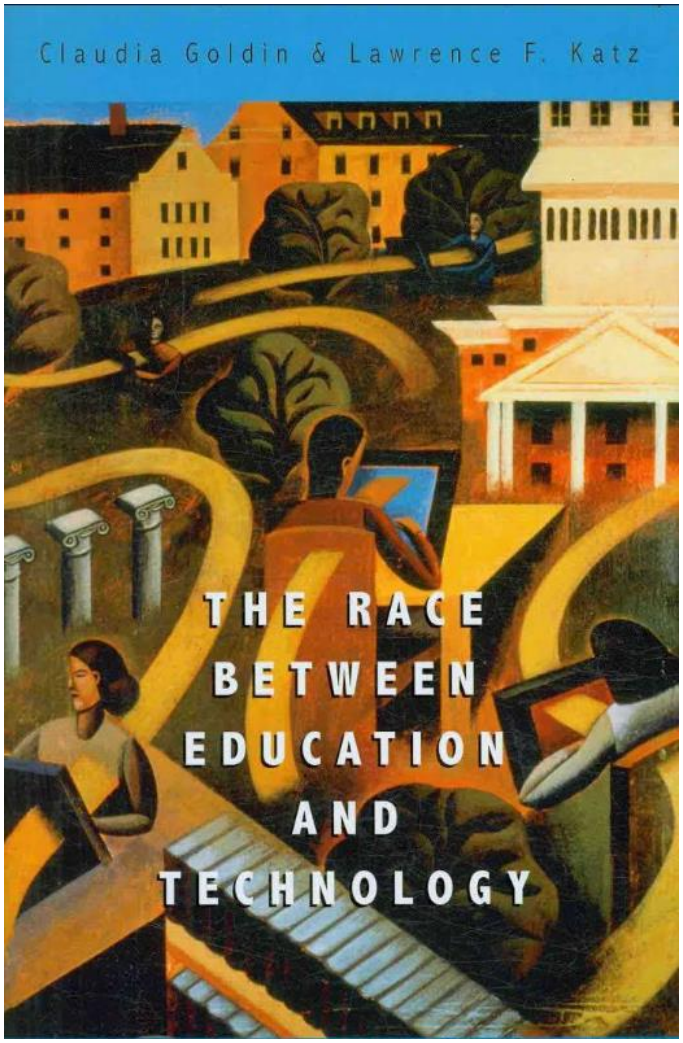
Acemoglu and Restrepo (2018):

"The importance of these new tasks is well illustrated by the technological and organizational changes during the Second Industrial Revolution, which […] the creation of new labor-intensive tasks. These tasks generated jobs for a new class of engineers, machinists, repairmen, conductors, back-office workers and managers involved with the introduction and operation of new technologies"



Occupations that disappeared – a few examples

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The composition of the U.S. workforce, 1870-2015

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			1870	1900	1940	1980	2015
Farmers and Farm labours		(1)	45.9	33.7	17.3	2.2	1.0
Blue collar	Total		33.5	38.0	38.7	31.1	21.5
	Craft Workers	(2)	11.4	11.4	11.5	12.0	8.4
	Operatives	(3)	12.7	13.9	18.0	14.7	8.9
	Labours	(4)	9.4	12.7	9.2	4.3	4.3
White collar	Total		12.6	18.3	28.1	38.9	37.3
	Clerical Workers	(5)	1.1	3.8	10.4	19.2	15.5
	Sales Workers	(6)	2.3	3.6	6.2	6.7	6.2
	Domestice Service Workers	(7)	7.8	7.6	4.4	0.6	0.0
	Other Service Workers	(8)	1.4	3.2	7.1	12.3	15.6
Managers and Professionals	Total		8.0	10.0	15.1	27.8	40.1
	Managers and Propretors	(9)	5.0	5.9	7.9	10.4	14.7
	Professionals	(10)	3.0	4.1	7.1	17.5	25.4

Source: Frey (2018)

Skilled vs. unskilled

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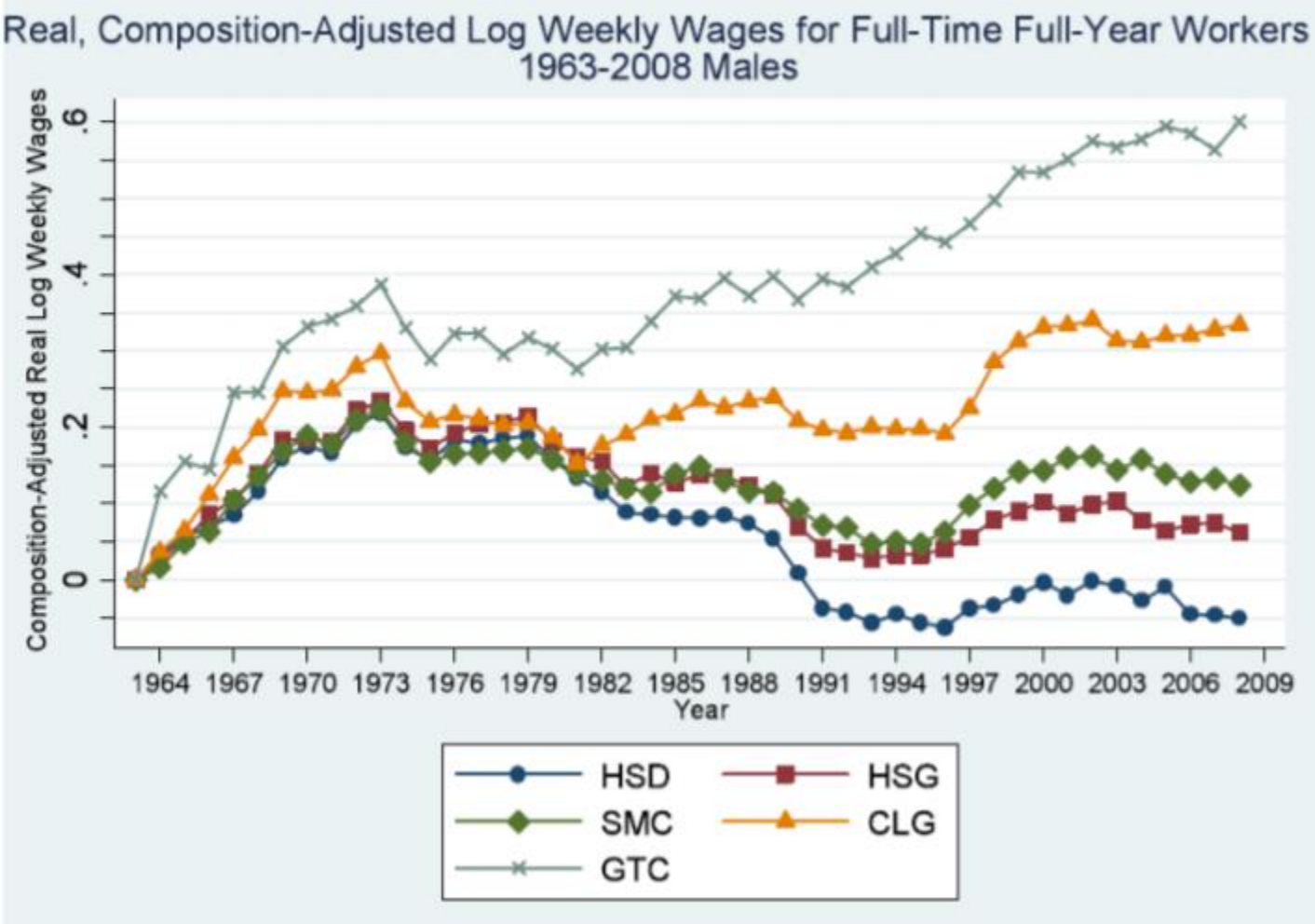

Source: Acemoglu (2016)

Labor Force Participation Rate for Men Ages 25-54 by Educational Attainment

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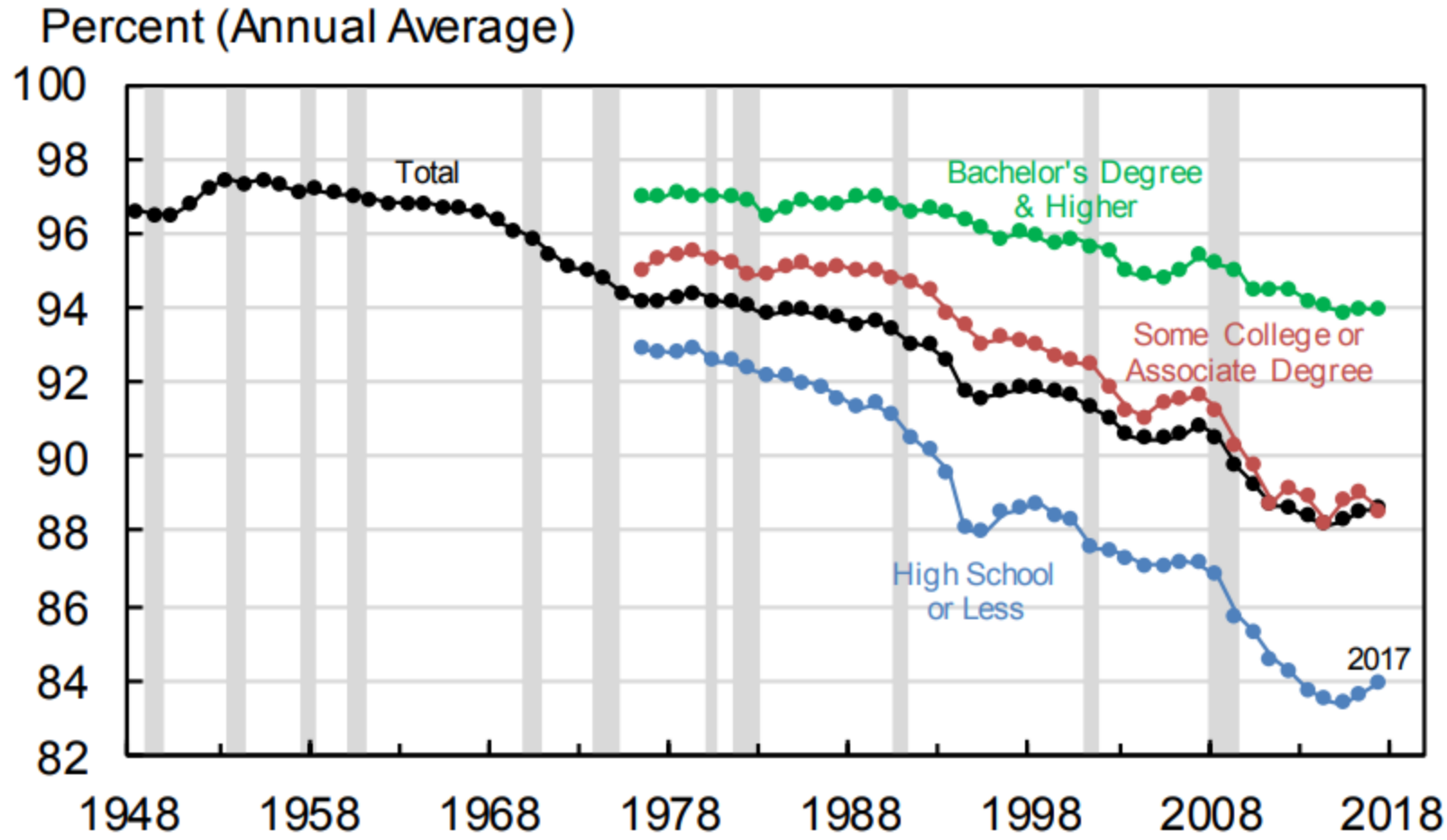
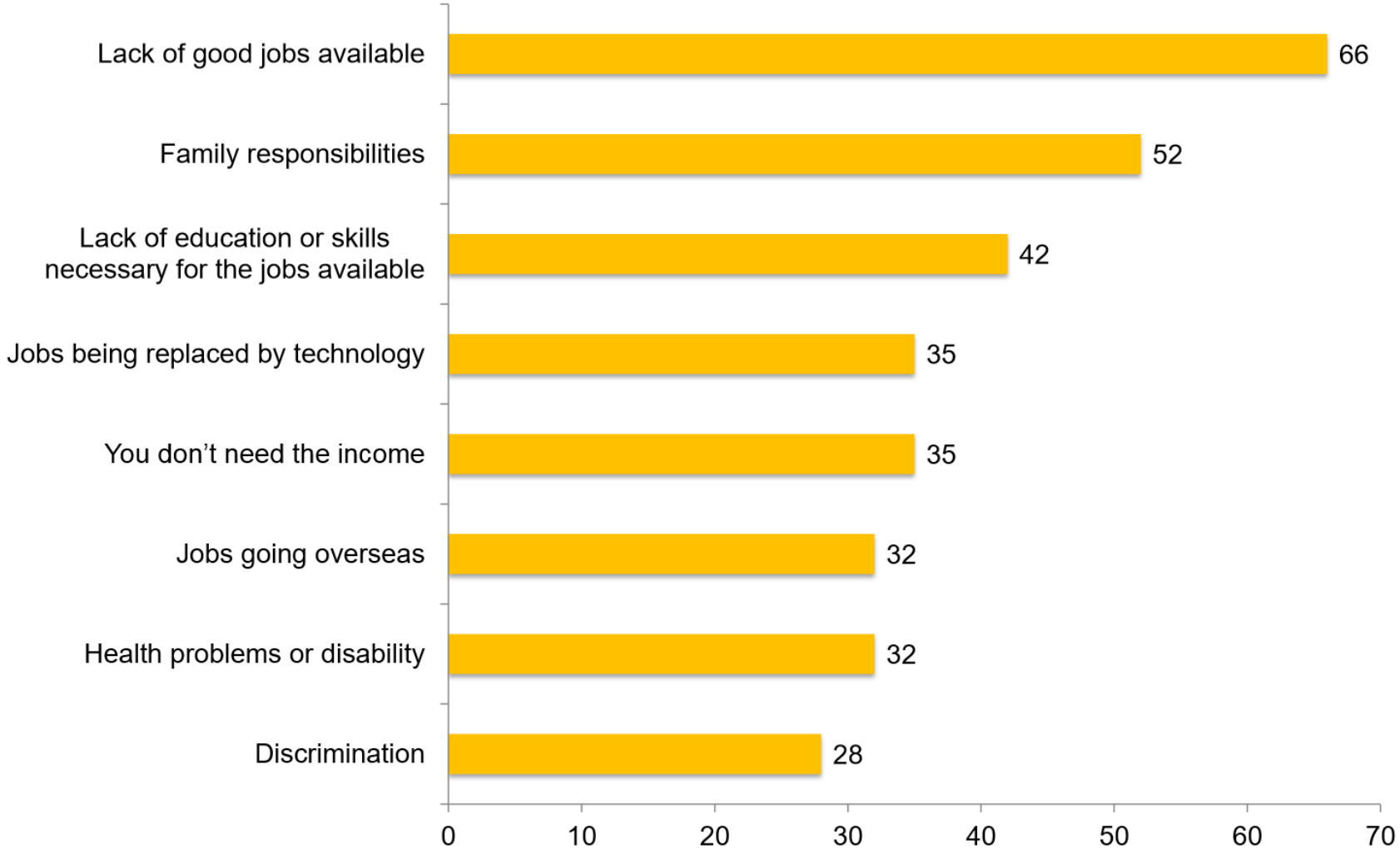


Note: Annual averages of monthly data from the Current Population Survey. 2017 represents the average of data from January through May. Shading denotes recession.
Source: Bureau of Labor Statistics; National Bureau of Economic Research; author's calculations.

Source: Kruger (2017)

Why Americans are not working



Note: KaiserFamilyFoundation/NewYork Times/CBS News survey based on interviews with 1,002 respondents between the ages of 25 and 54 who are currently not employed either full-time or part-time.

Robots and jobs

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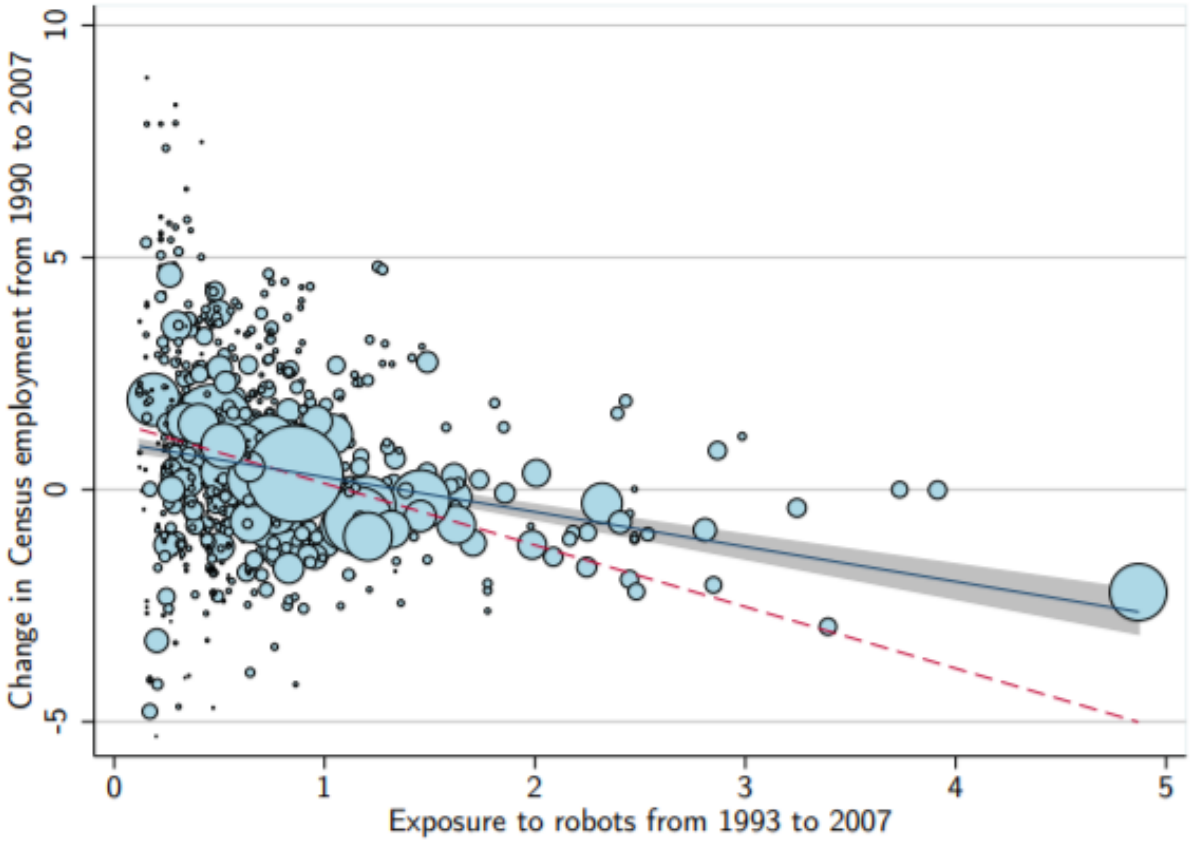

Source: Acemoglu & Restrepo (2017)

When jobs disappear

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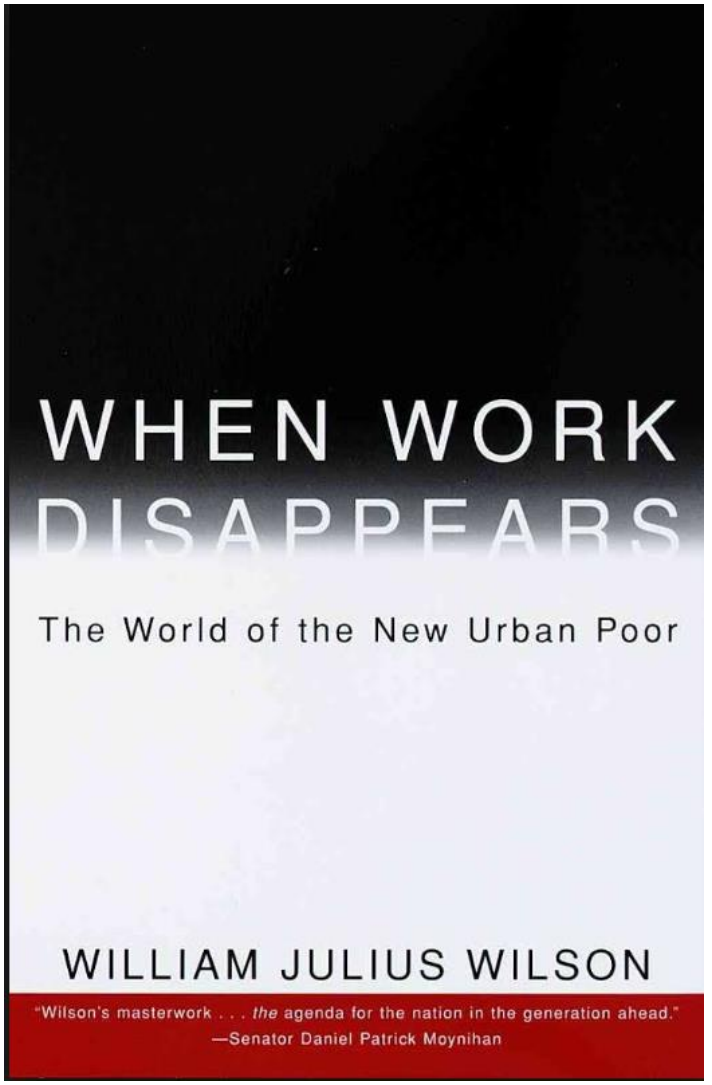
The consequences of high neighborhood joblessness are more devastating than those of high neighborhood poverty. A neighborhood in which people are poor but employed is different from a neighborhood in which people are poor and jobless. Many of today's problems in the inner-city ghettos—crime, family dissolution, welfare, low levels of social organization, and so on—are fundamentally a consequence of the disappearance of work.



Mapping the robot revolution – 2012-2016

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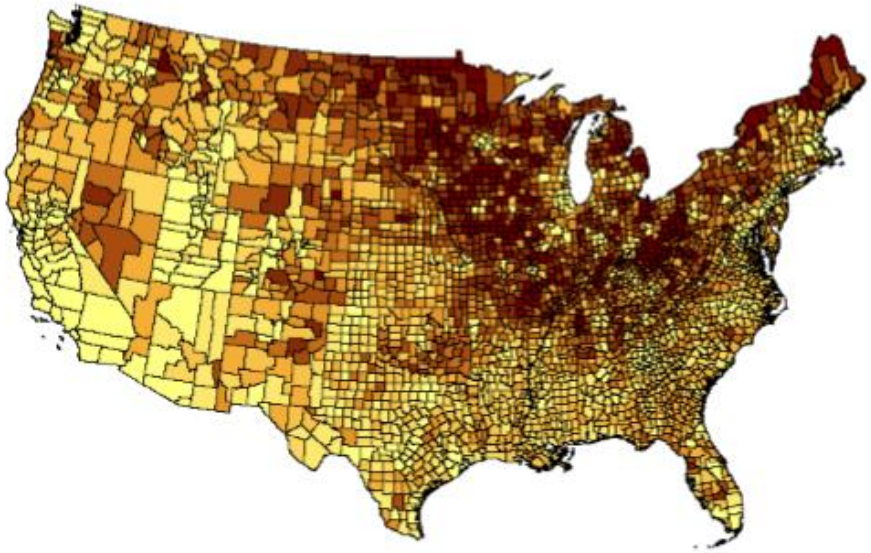
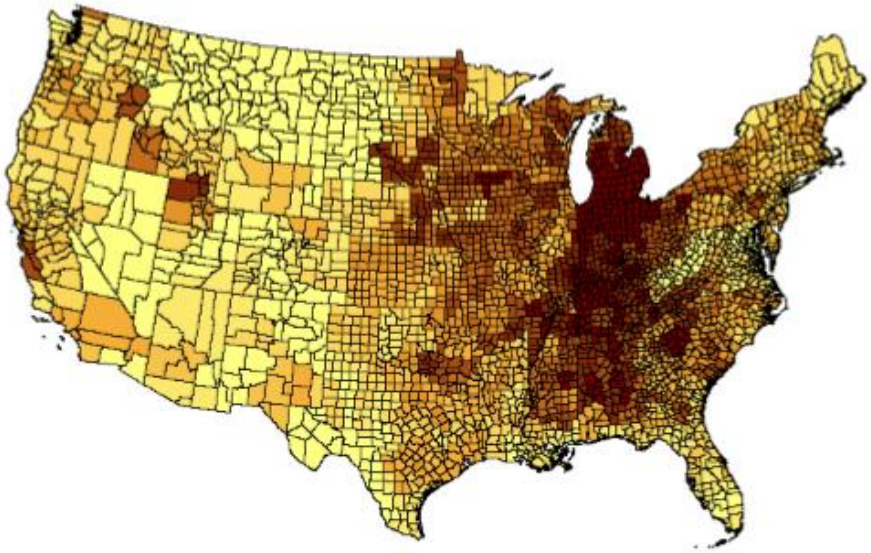


(a) Changes in the Republican two-party vote share



(b) Changes in the exposure to robots

Source: Frey et al. (2018)

Robots and the 2016 U.S. presidential election

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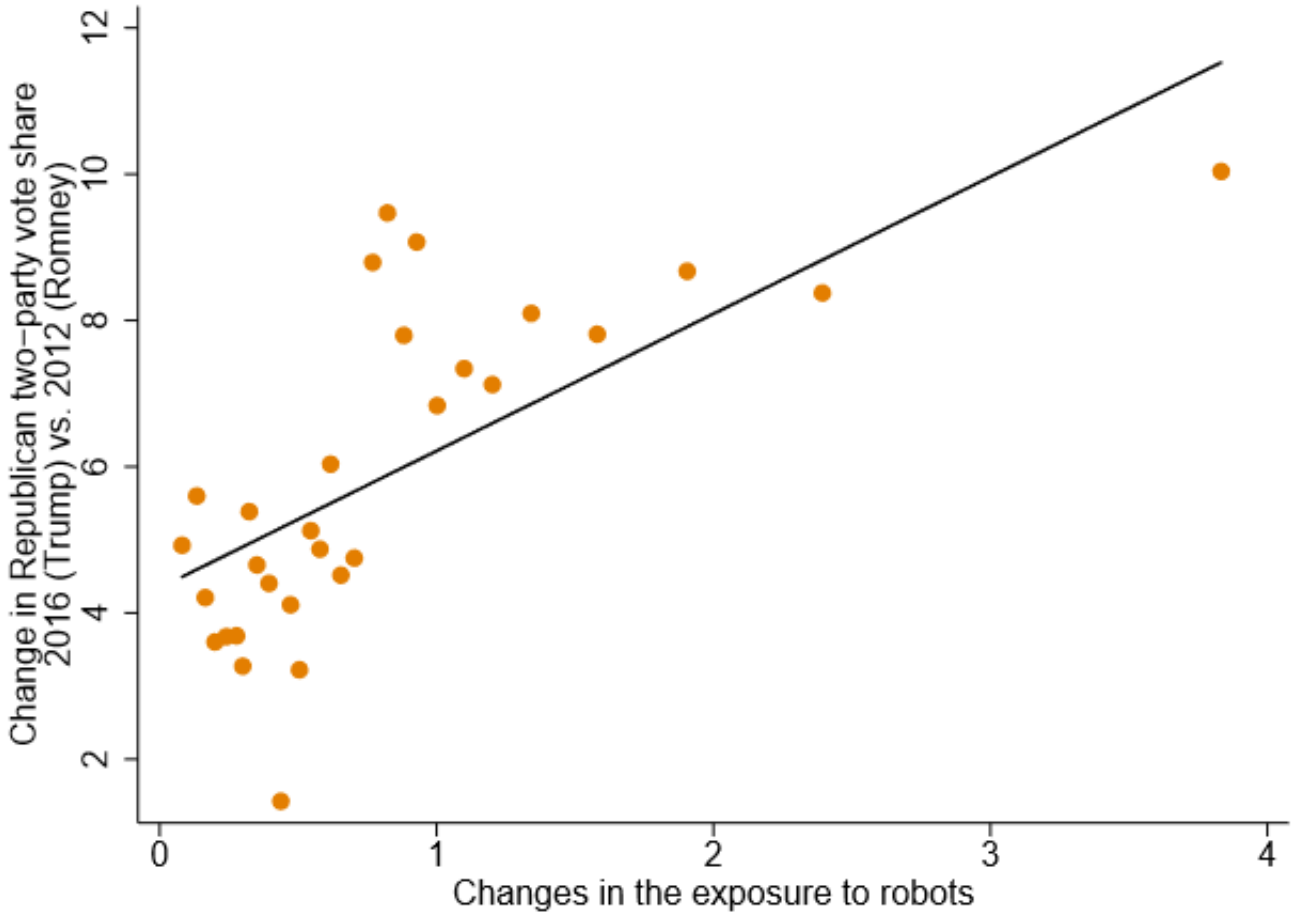

Source: Frey et al. (2018)

We Have Seen Nothing Yet?

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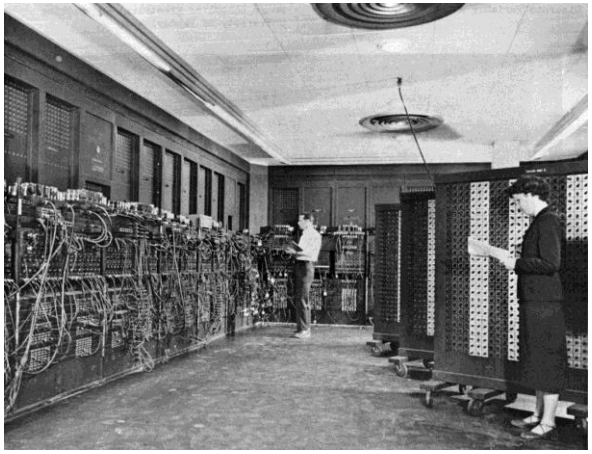
Human computers performing mathematical calculations

"The human computer is supposed to be following fixed rules; he has no authority to deviate from them in any detail." (Turing, 1950)

Electronic computers performing routine tasks:

- **Calculation**
- **Repetitive customer service**
- **Picking or sorting**
- **Repetitive assembly**



Machine learning algorithms performing **non-**routine tasks:

- **Medical diagnostics**
- **Document review**
- **Translation**
- **Driving**

Google Translate

Break through language barriers.

Predicting the Future of Employment

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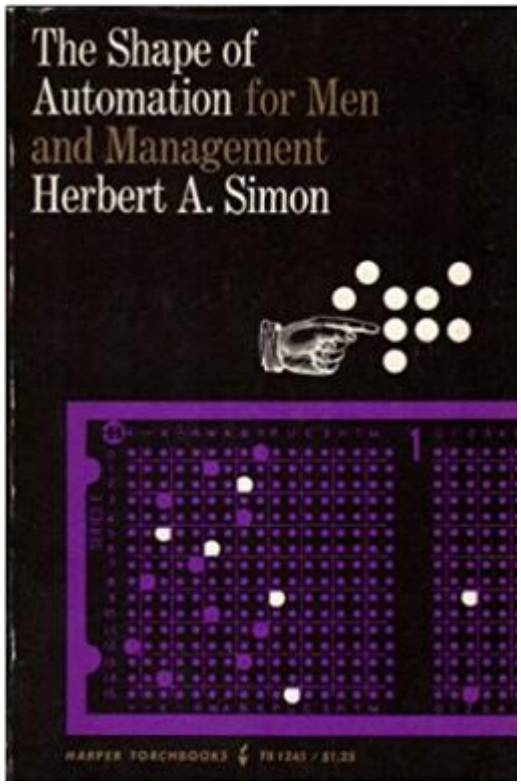
In *The Corporation: Will It Be Managed by Machines?,* Herbert Simon quite accurately predicted the future of work:

- "There will be a few vestigial "workmen"—probably a smaller part of the total labor force than today—who will be part of in-line production, primarily doing tasks requiring relatively flexible eye-brain-hand coordination."
- We can conjecture that by 1985, the departments of a company concerned with major clerical functions—accounting, processing of customers' orders, inventory and production control, purchasing and the like—will have reached an even higher level of automation than most factories."
- "[…] a larger fraction of members than at present will be engaged in occupations where "personal service" involving face-to-face human interaction is an important part of the job. I am confident of stating this conclusion; far less confident in conjecturing what these occupations will be"



Predicting the Future of Employment

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Another BLS case study, carried out in 1960, also found that automation overwhelmingly concerned routine jobs:

"A little over 80 percent of the employees affected by the change were in routine jobs involving posting, checking, and maintaining records; filing; computing; or tabulating, keypunch, and related machine operations. The rest were mainly in administrative, supervisory, and accounting work. Only a little over 4 percent were engaged in correspondence, stenographic, and secretarial jobs, i.e., the less routine clerical jobs."

Disappearing routine jobs

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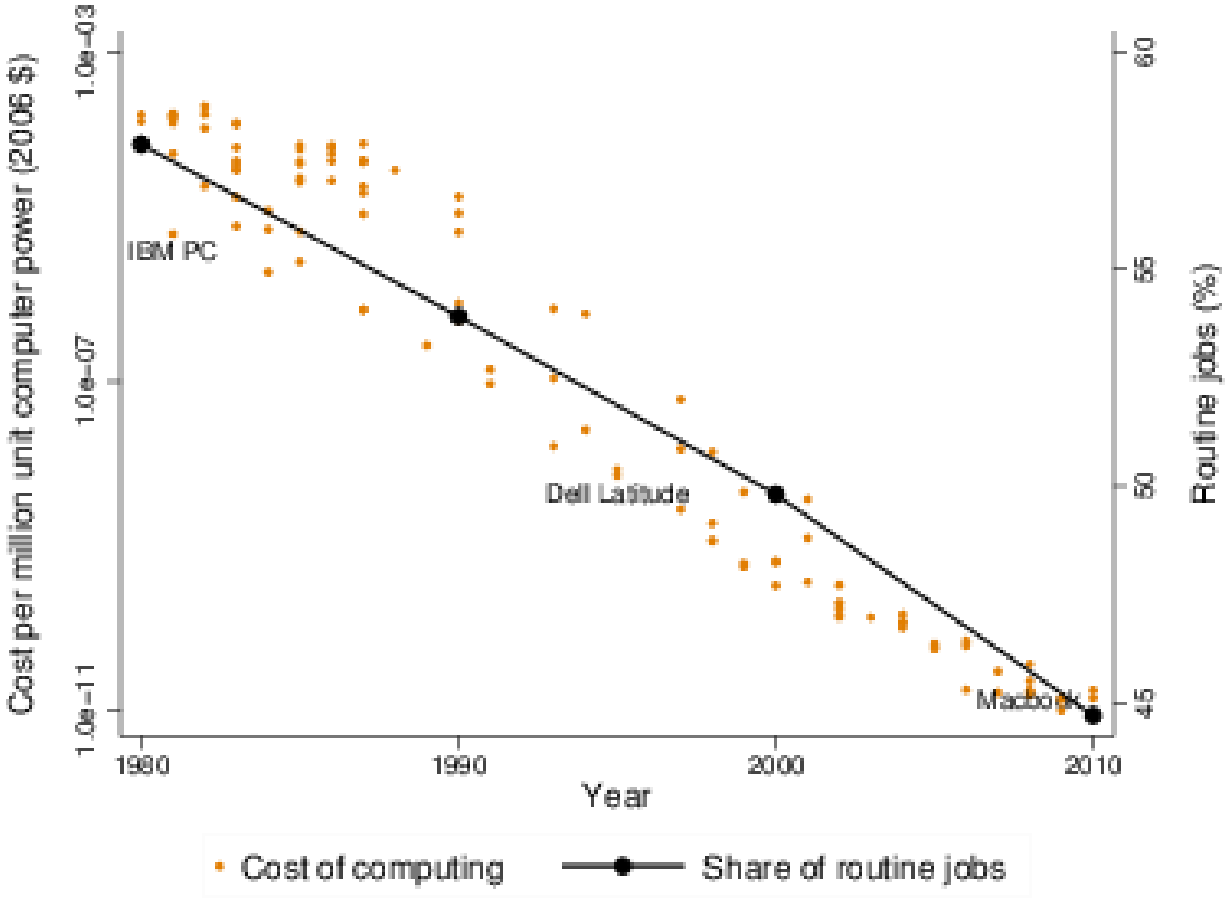
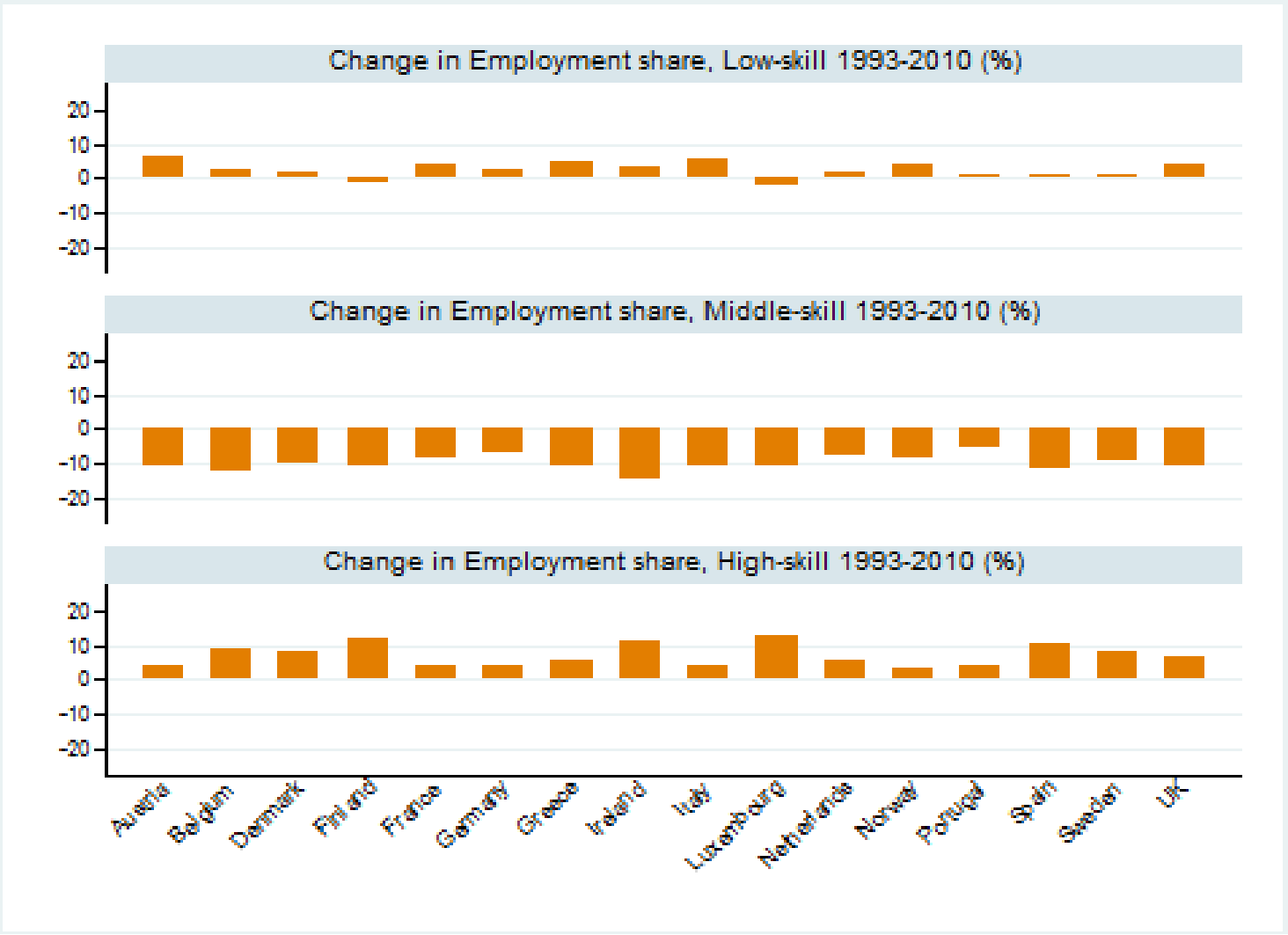


Source: Frey et al. (2018)

Job polarization



Source: Goos et al (2014)

The Human Advantage

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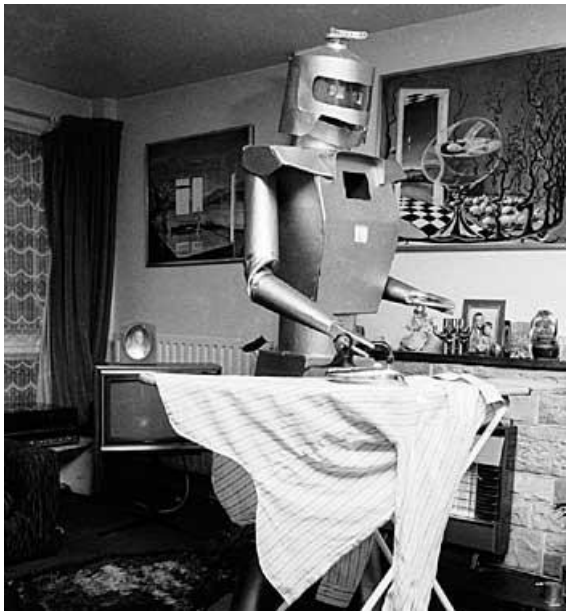
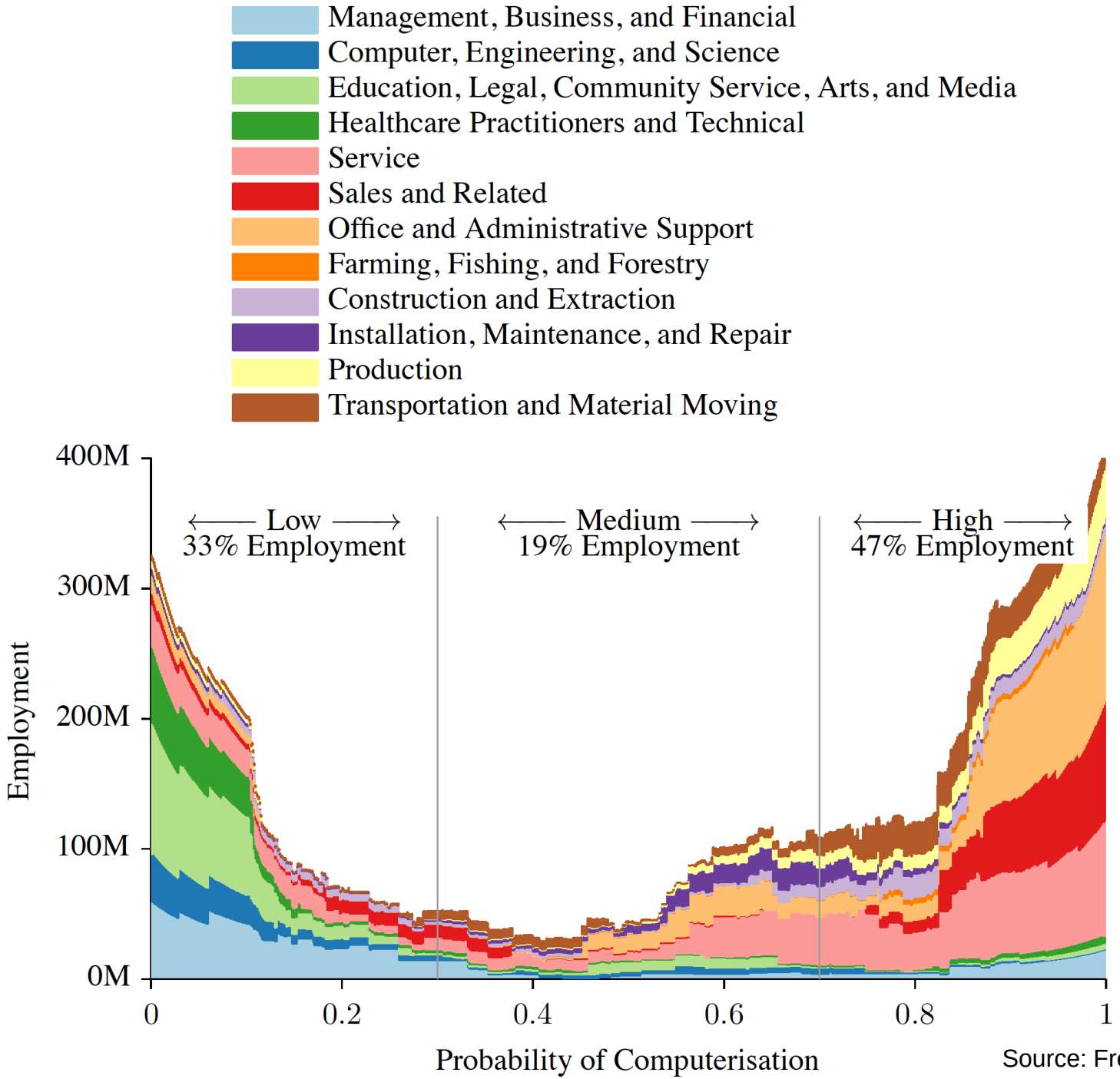
Creativity

Social intelligence

Perception and manipulation





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Source: Frey & Osborne (2017)

Other estimates

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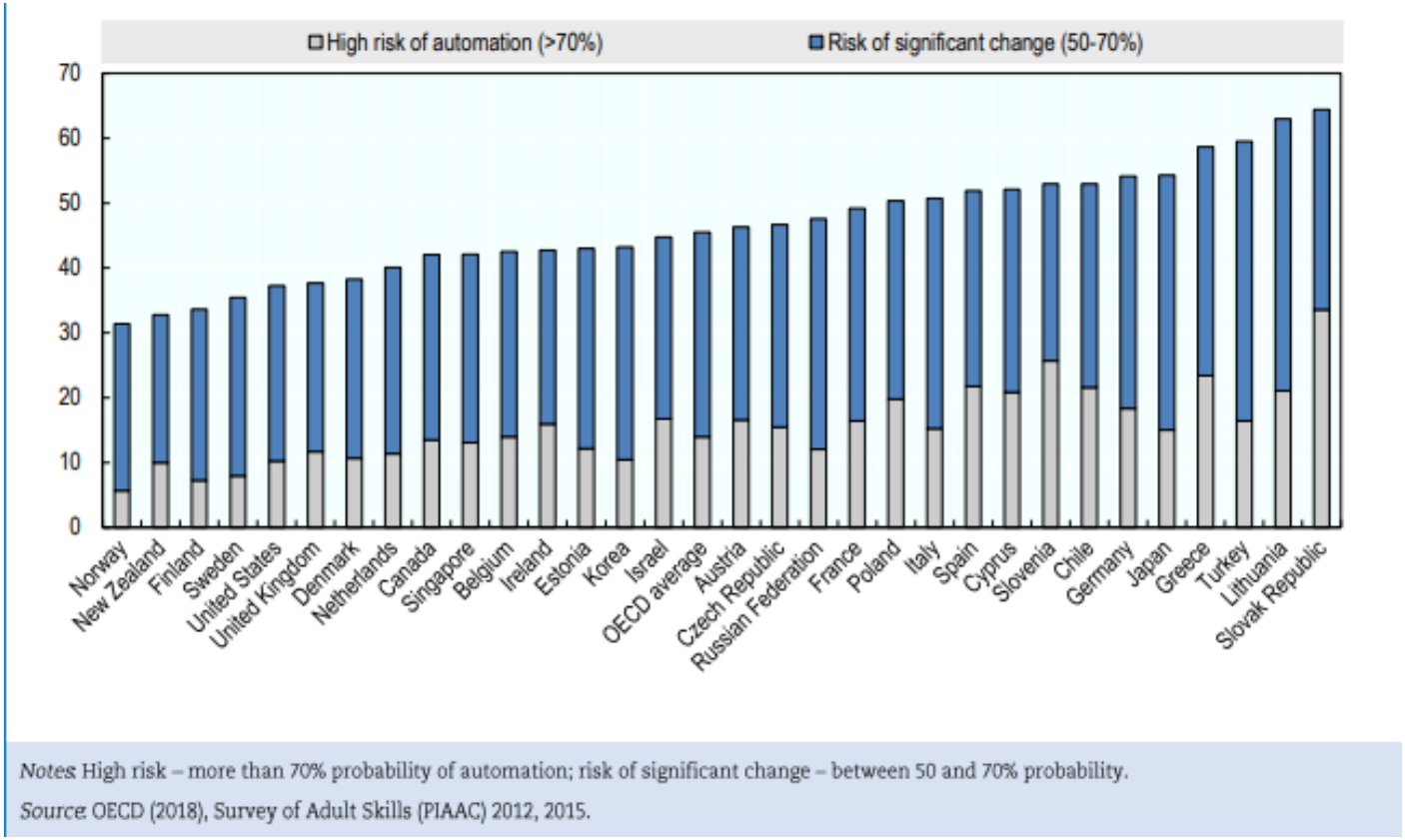
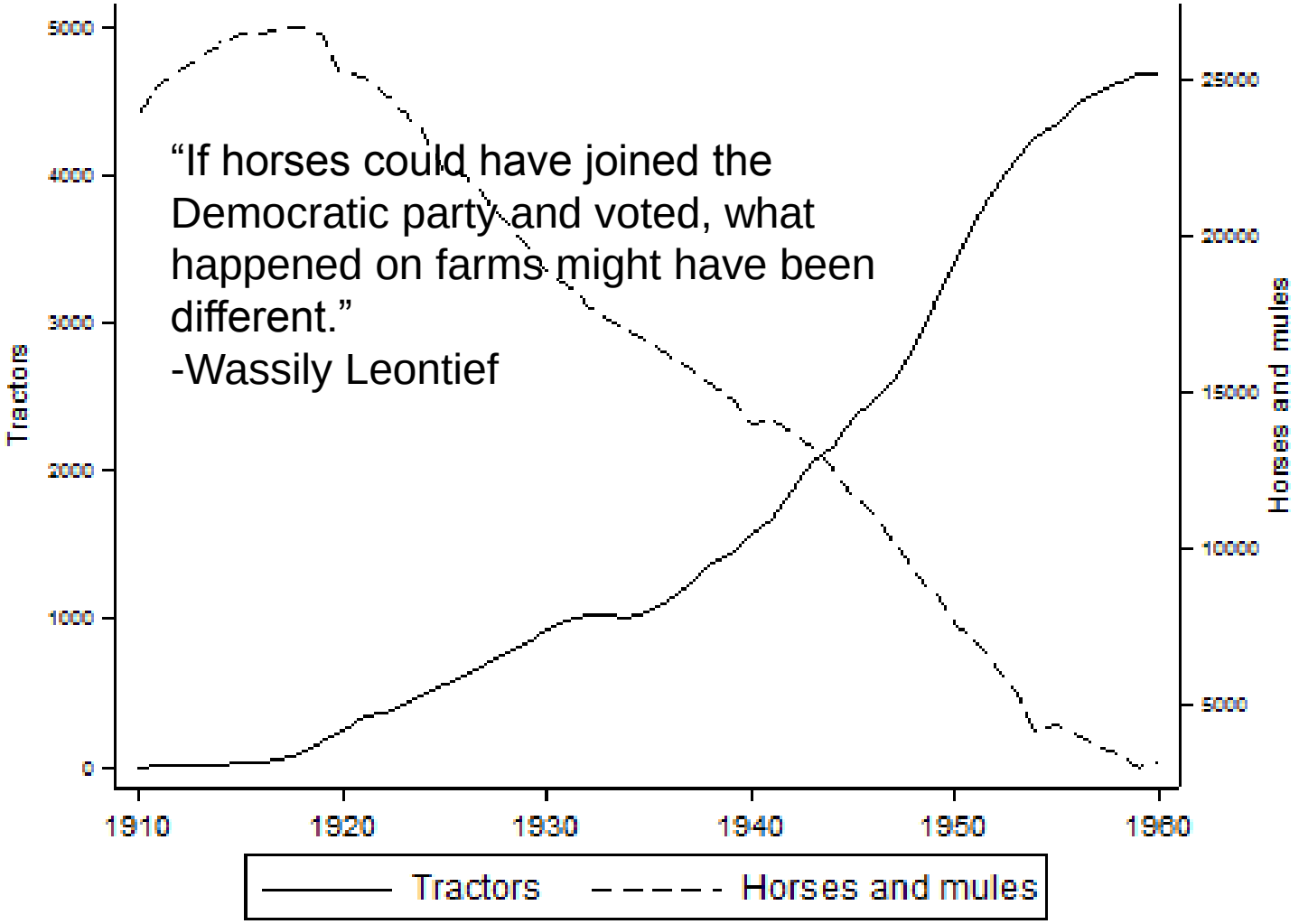


Notes: High risk – more than 70% probability of automation; risk of significant change – between 50 and 70% probability.

Source: OECD (2018), Survey of Adult Skills (PIAAC) 2012, 2015.

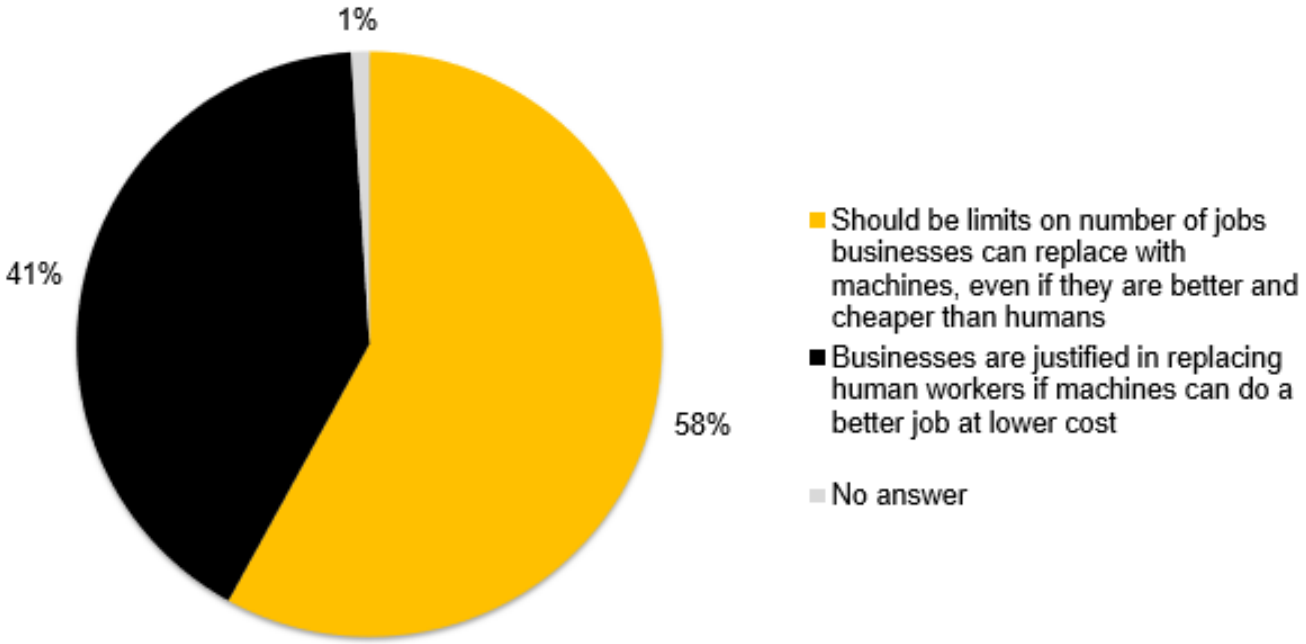
Source: OECD (2018)

The fate of the horse



Source: Rodolfo E. Manuelli Ananth Seshadri (2014)

Attitudes towards automation



Source: Pew Research Center (2017)

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