AI as a Technological Revolution – what can we learn from history?

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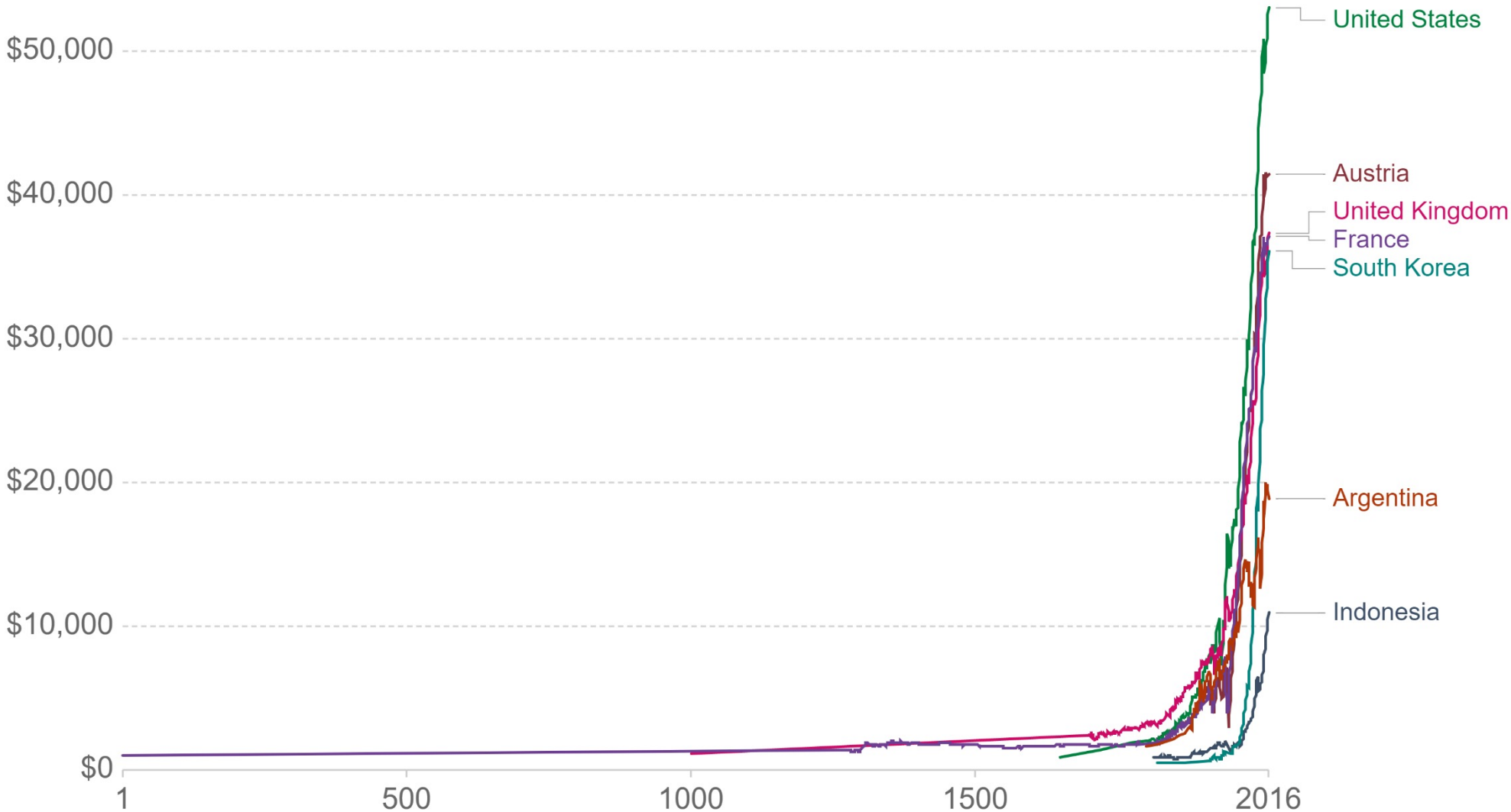
GDP per capita, 1 to 2016

GDP per capita adjusted for price changes over time (inflation) and price differences between countries – it is measured in international-$ in 2011 prices.



Source: Maddison Project Database (2018)

OurWorldInData.org/economic-growth • CC BY

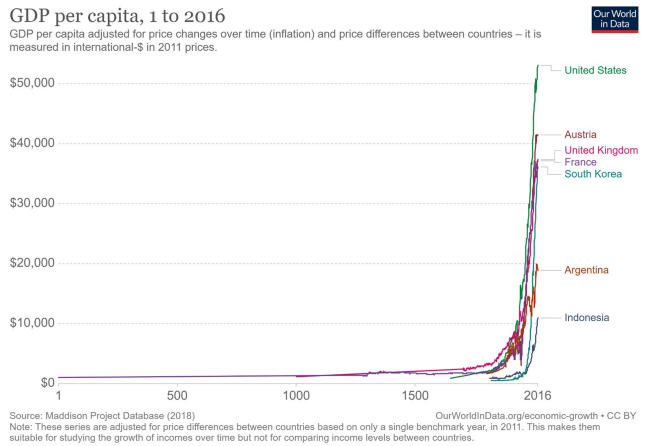
Note: These series are adjusted for price differences between countries based on only a single benchmark year, in 2011. This makes them suitable for studying the growth of incomes over time but not for comparing income levels between countries.

First Industrial Revolution

- 1760s Britain, energy crisis developments in iron and steel.
- Solution: Steam engine
  - Allowed fossile fule (coal) to fuel machinery and mehanize the production system.
- The effects on society were enormous:
  - Mechanization
  - Invention of factories
  - Replacing man with machine
  - Urbanization
  - Large scale trade

Industrial revolutions

- Center around a block of pathbreaking innovations that combine into a General Purpose Technology that is *bigger than their separate parts*.
- General Purpose Technologies that have the ability to *transform almost every part of* society.
- The first industrial revolution transformed the stagnant agrarian economy into an industrial one where modern economic growth became the norm.



Industrial revolutions in history

1st industrial revolution: 1760s

- Mechanisation, steam and water power. Iron and steel.

2nd industrial revolution: 1860s

- Combustion engine and electricity. Chemical technology and new materials such as rubber and plastics.

3rd industrial revolution, 1970s

- Electronics. ICT. Automation

4th industrial revolution, 2020s?

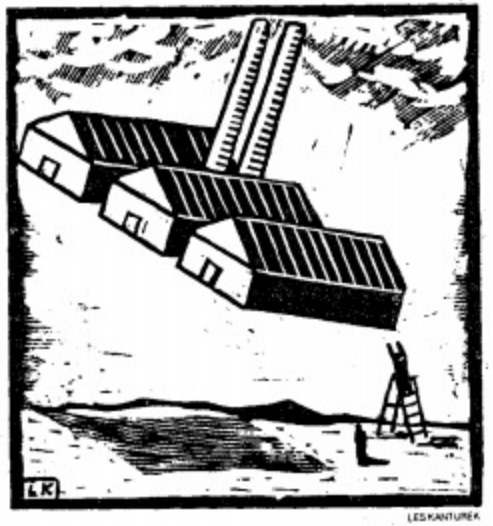
- Cyber-physical systems. Learning machines. Computerisation.

The Solow Paradox

We'd Better Watch Out

MANUFACTURING MATTERS
The Myth of the Post-Industrial Economy.
By Stephen S. Cohen and John Zysman.
Tables and Charts. 297 pp. New York:
A Council on Foreign Relations Book/
Basic Books. $19.95.

By Robert M. Solow



LES KANTUREK

THERE is a lot of loose talk about the "deindustrialization" of the United States economy. We are losing our manufacturing industry to foreigners and becoming a "service economy" (if you like the idea) or a "nation of hamburger stands and insurance companies" (if you don't like the idea). Stephen S. Cohen and John Zysman begin their book, "Manufacturing Matters: The Myth of the Post-Industrial Economy," by insisting, quite correctly, that no such thing can happen. The orders of magnitude are such that the United States could not hope to pay for its manufacturing imports by selling services abroad. We need too many goods, and there are not enough services. One way or another we will continue to be producers of goods, including manufactures, and probably net exporters of goods in order to pay
debts we have incurred during the cons
of the 1980's.

That doesn't make things all right
course balance our trade — and we will
tion of our currency and reductions in
There is no trick to that. Every country
and so unpromising that no one will lend
its trade, precisely by being so poor th
ford to import more than it can pay for by exporting.
And what it exports are the products of cheap labor. If American manufacturing is to win back a competitive edge against Japan, South Korea and West Germany, it will have to find a way to sell goods here, there and in third markets while paying high wages and earning a good return on investment. That can only happen if we catch up with, and at least sometimes surpass, our rivals in productivity, quality and design.

The authors also make the probably valid point

Went Wrong with the United States manufacturing in-

down of productivity growth, not by a step up. You can see the computer age everywhere but in the productivity statistics.

vantage. Critically, corporate strategies at home and abroad will use the possibilities of the new technology to capture competitive advantage. We cannot, of course, demonstrate how technologies that are only now emerging will alter strategies in ways yet to be imagined." A passage like that is not wrong; but it only appears to be saying something.

Here is a different sort of example. After 100 pages the authors announce "six hypotheses that will be used as premises from here on in. First, technological

national Economy at the University of California, for falling into bad habits. They want to appear to be generalizing about a subject on which there are too few (or what is almost the same thing, too many) defensible generalizations. It is just a pity that they cannot be content with the odd insight, the occasional plausible and discussable hypothesis. They do, in fact, produce some of those. They are interesting, for example, on the need for flexibility and adaptability in modern manufacturing required to give a rich, knowledgeable and finicky market what it wants when it wants it, quite the opposite of the mass-production philosophy that made America great. There are other good moments. The trouble is that they do not know, any more than I do, exactly what let Japan and West Germany overtake United States industry. They should be content to tell a few good stories and give the reader furiously to think.

I do fault them for one cop-out. One of their central beliefs is that there has been a Revolution in manufacturing, its name is Programmable Automation, and that American industry has failed to capitalize on it. That may even be so. But then they go on, "We do not need to show that the new technologies produce a break with past patterns of productivity growth. . . . [That] would depend not just on the possibilities the technologies represent, but rather on how effectively they are

THE authors also put some emphasis on the organization of skilled work in factories, and on the education of production-oriented engineers and executives. They mention the intriguing possibility that inattention to quality is a hangover from the age of mass production. But these side remarks only undermine the claim to generality, to a grand scheme. I would have been happier with some well-deserved modesty.

On public policy, Mr. Cohen and Mr. Zysman have

Robert Solow: 1987

Bottlenecks

- There are usually several decades from **the first defining innovation** to the emergence of a **technological revolution** :
  - Technology needs to be standardized and adapted before it can be profitably impelented throughout all areas of society
  - Laws and instututions might need to adapt to the new realities
  - Labor markets need to respond to the need for new knowledge: winners and losers
- The time lags between innovation and effect are substatial:
  - Newcomen steam engine 1712 – industrial revolution around 1760
  - The first combustion engine and electrical patents from mid 1800 – Second industrial revolution some 40 years laters.
  - Microchip invented 1969 – ICT revolution in the 1990s.
- Today's technologies (automation, digitalization) might reach their full potential in decades to come

Ahead

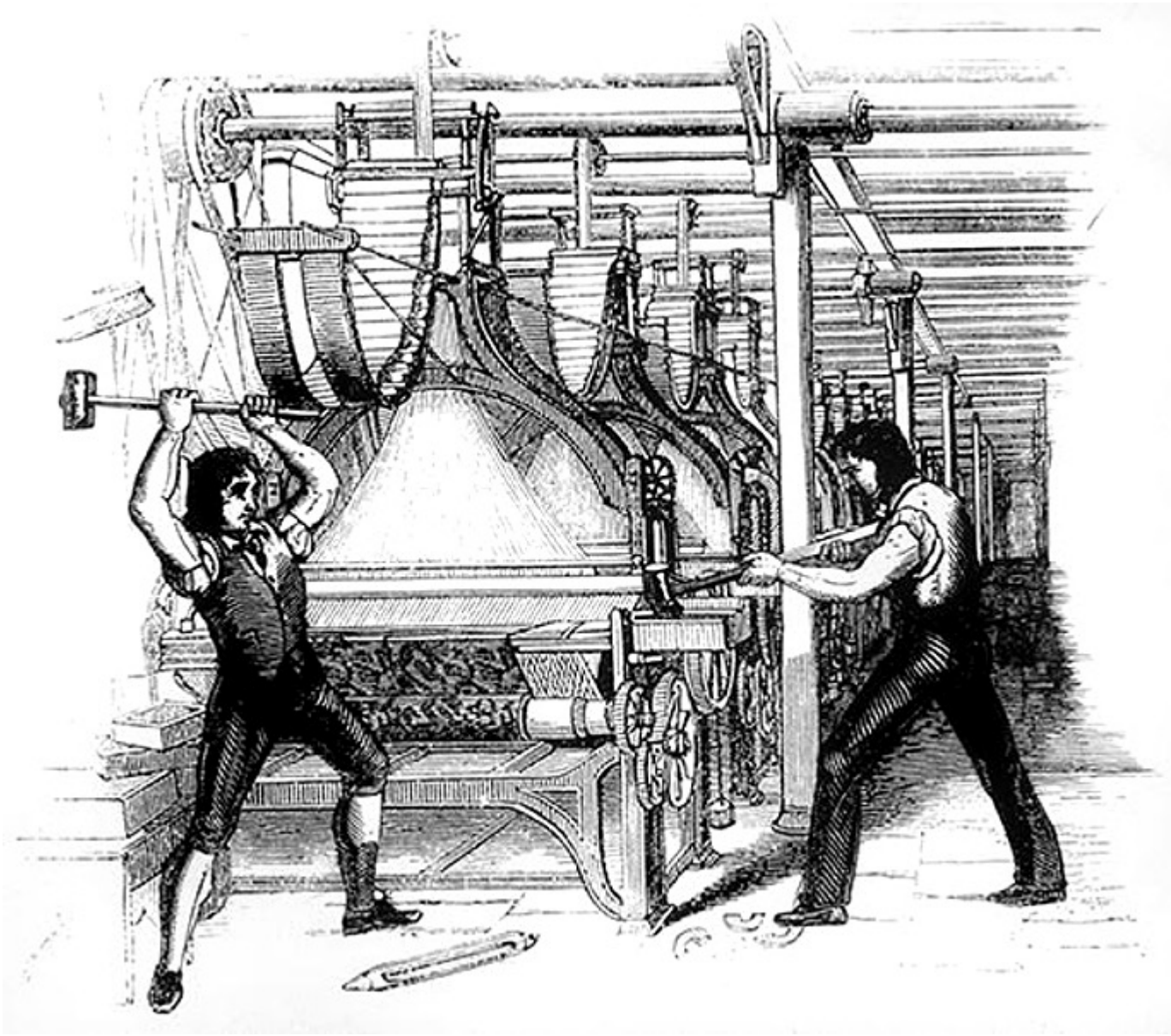
- Today: sluggish growth and low productivity figures, talk about the **secular stagnation** (a condition when there is negligible or no economic growth in a market-based economy).
- But history tells us to watch out, new technologies will change everything, not exactly now, but in a relatively short future.

What implications did previous technological revolutions have for the way we organize the economy?

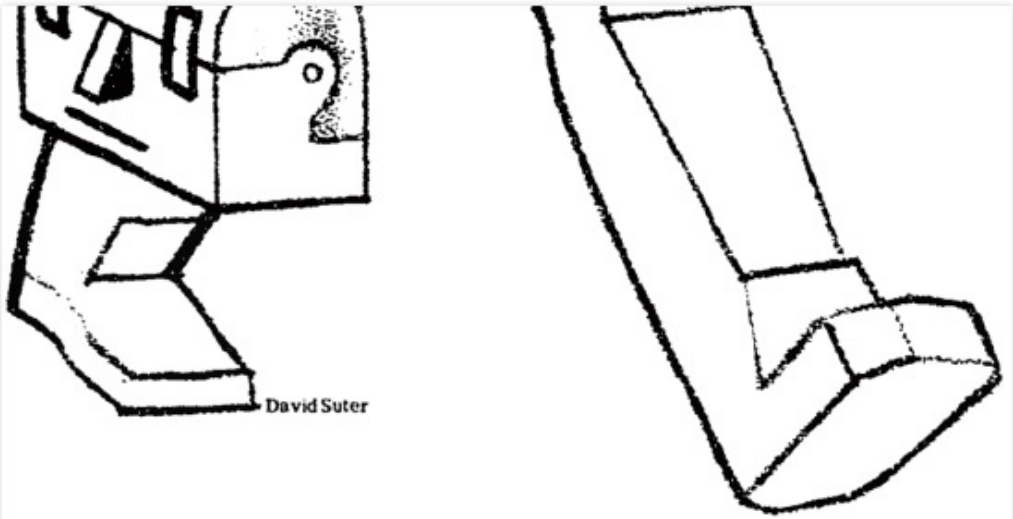
The fear of technological unemployment

Luddites, 1811–1813

Skilled weavers and craftsmen in textile workers who objected to the use of mechanized looms and knitting frames associated with the first industrial revolution.



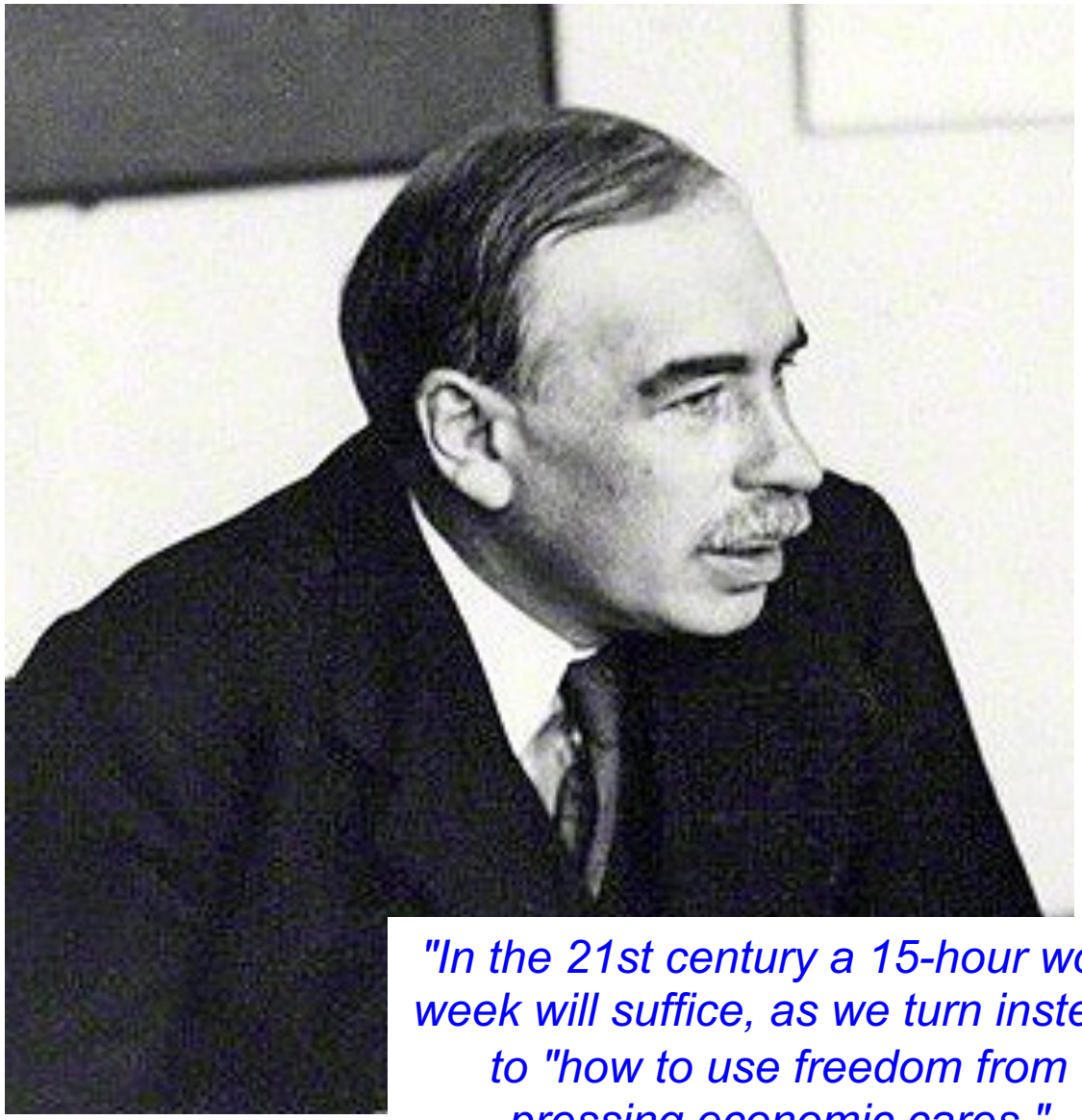
Threat?



DETROIT — Technological innovation is widely billed as a miracle cure for the United States' economic doldrums. Its aftereffects, however, may be far from benign. The introduction of revolutionary new technologies such as robots — versatile computer-controlled mechanical arms — raise two painful possibilities: sizeable losses of jobs and a deteriorated quality of working life.

A Robot Is After Your Job

New York Times, September 03, 1980

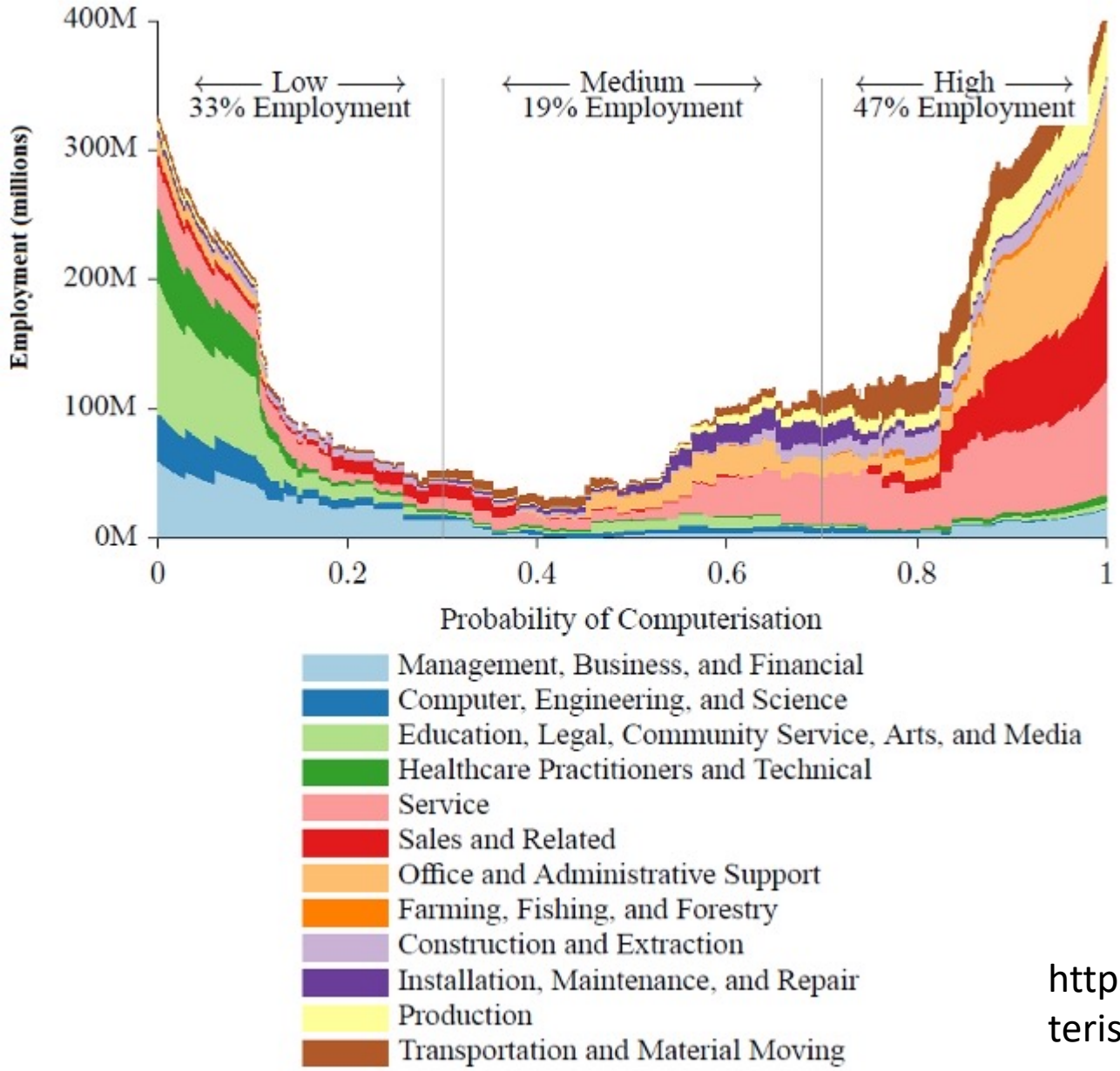


"In the 21st century a 15-hour work week will suffice, as we turn instead to "how to use freedom from pressing economic cares."

John Maynard Keynes (1930)

Or opportunity?

More often it is depicted as a threat: It was time again in 2014



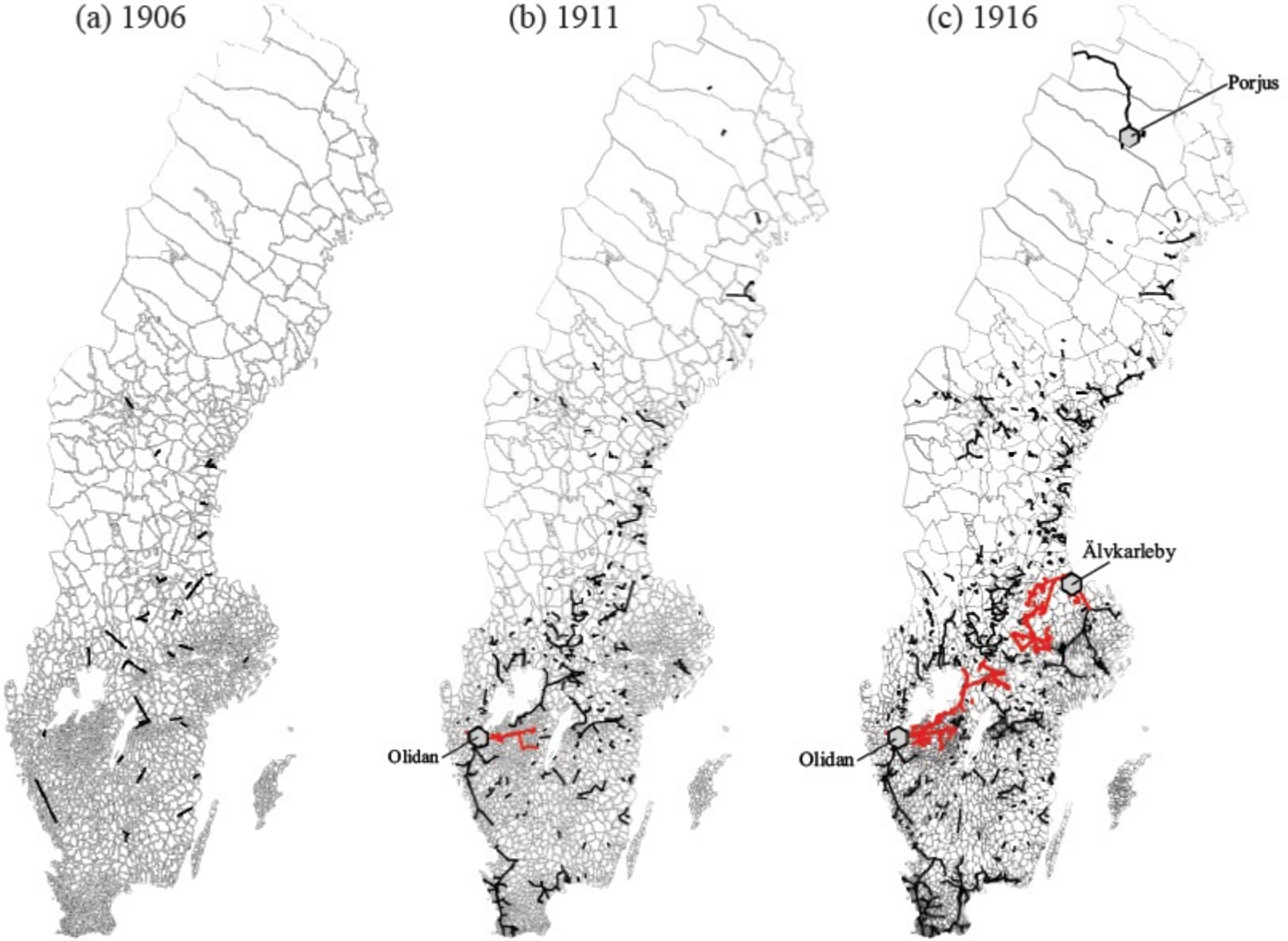
In a study of 700 US occupations, Carl Frey and Michael Osborne find that nearly 50 percent are threatened by computerisation.

Jobs requiring medium skills – most prominently Office and clerical work – were most vulnerable,

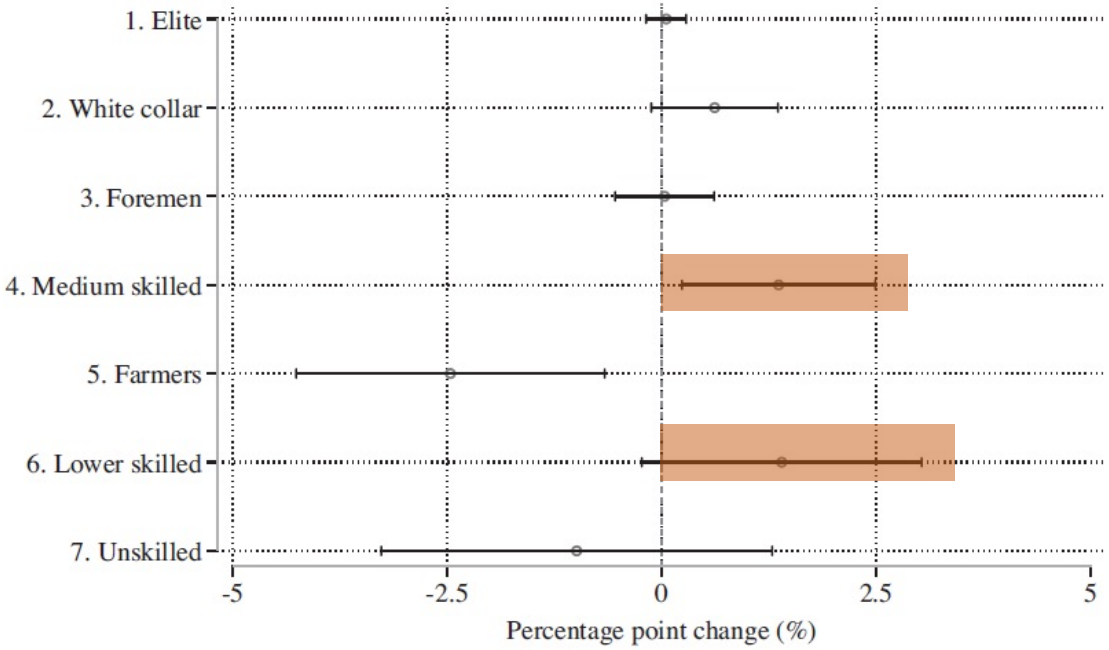
Suggesting a **hollowing out** of the labor market, with Only low skill and high skill jobs left.

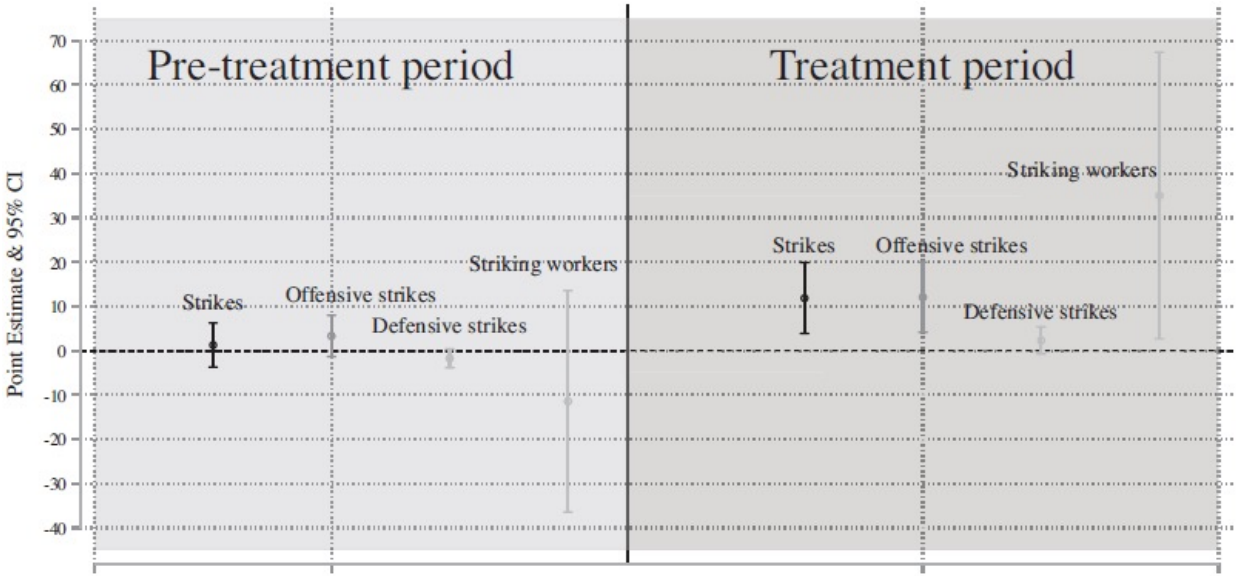
"The effect of today's technology on tomorrow's jobs will be immense—and no country is ready for it"
The Economist, 2014

https://blogs.lse.ac.uk/usappblog/2013/09/30/computerisation-50-percent-occupations-threatened/



Source: Molinder, J., Karlsson, T., & Enflo, K. (2021). More Power to the People: Electricity Adoption, Technological Change, and Labor Conflict. The Journal of Economic History, 81(2), 481-512.





Source: Graphs: Molinder, J., Karlsson, T., & Enflo, K. (2021). More Power to the People: Electricity Adoption, Technological Change, and Labor Conflict. *The Journal of Economic History, 81*(2), 481-512. Images: Wikicommons

Lessons from history

- A new technological paradigm has the potential to transform almost every aspect of society.
- But new technology also causes tension that can lead to lags in technology adoption and a delay in realization of productivity gains.
- There are likely to be **winners and losers** in this new situation.
- Acknowledging that winners should compensate the losers will pave the way for a smoother transition.
- Creating strong instutitions that take care of individuals as they make the transition into the new economy.