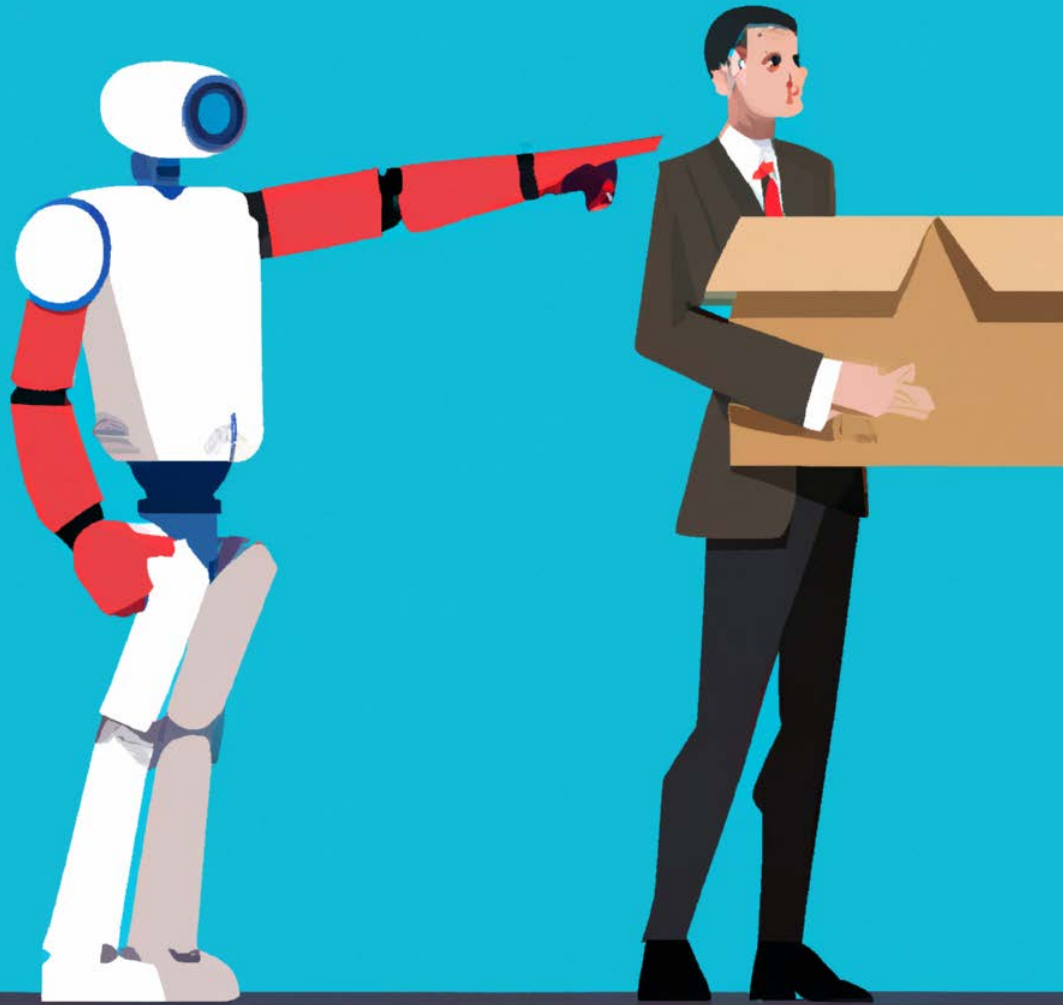


Robots, algorithms, and jobs

**Tommaso
Nannicini**
EUI-STG



Credit: DALL-E

Anxiety over automation: Yesterday

- “We are being afflicted with a new disease of which some readers may not have heard, but of which they will hear a great deal in the years to come, **technological unemployment**”
(Keynes, 1930)
- “Labor will become less important. **More workers will be replaced by machines.** I do not see that new industries can employ everybody who wants a job”
(Leontief, 1952)

THE GREAT DILEMMA OF U.S. LABOUR

Automation Might End Most Unskilled Jobs In 10 Years

From A STAFF CORRESPONDENT in New York

IN America today, when management and labour meet to plan their joint future, the time-honoured causes for haggling — strikes and shut-outs and increased wages — are likely to be settled amicably and in a hurry.

The union may be moderate in its wage demands and the company more willing to yield, for both are anxious to grapple with the complexities of automation, which are fast engulfing the nation's economy.

As the effects of economic recession become the problems of yesterday, so those of automation are being seen more clearly now than ever as a challenge that must be met today.

There are 500,000 fewer full-time jobs today than there were three years ago, and a recent survey of 500 manufacturers shows that increased emphasis on automation will displace about 325,000 factory workers next year. This pressure is effecting a drastic re-

vision in the long-range thinking and planning of many unions. Already it is nudging the precarious balance of industrial power between management and labour.

Although many unions are still immensely wealthy, each day there are compelling reminders that labour's strength is on the downgrade and that its leaders may soon be presiding over the dismantling of their empires unless they find new approaches to the challenges thrust upon them by automation.

Many major unions, including the Teamsters, Meat Packers, Auto Workers, Steelworkers and Electrical Workers, have indicated that the automation problem is dominating their contract

bulbs in the United States . . . it used to take 200 men to produce 1,000 radios a day. Now it takes only two. . . . In Texas, a computer controls an oil refinery.

Among responsible labour officials it would be difficult to find opinions comparable to those which led to the machine-wrecking riots of eighteenth-century England. There is a general awareness that automation's rush into a future swirling with social and economic changes, so far only hazily understood, imposes joint responsibilities on Government, management and organised labour.

RETRAINING

The United States Senate

One study group has estimated that 2,500,000 jobs will have to be created every year for the next decade merely to provide for new workers and those laid off by automation.

What may be the wave of the future for all labour already has swept over Mr John L. Lewis' United Mine Workers, the union that set the pattern for unionising the mass-production industries and for modern collective bargaining and the use of the strike technique. The miners are rich in memories and money—200 million dollars in their treasury and pension and welfare reserves—but their industry has become one of machines not of men.

Employment in the soft-coal field has gone down from

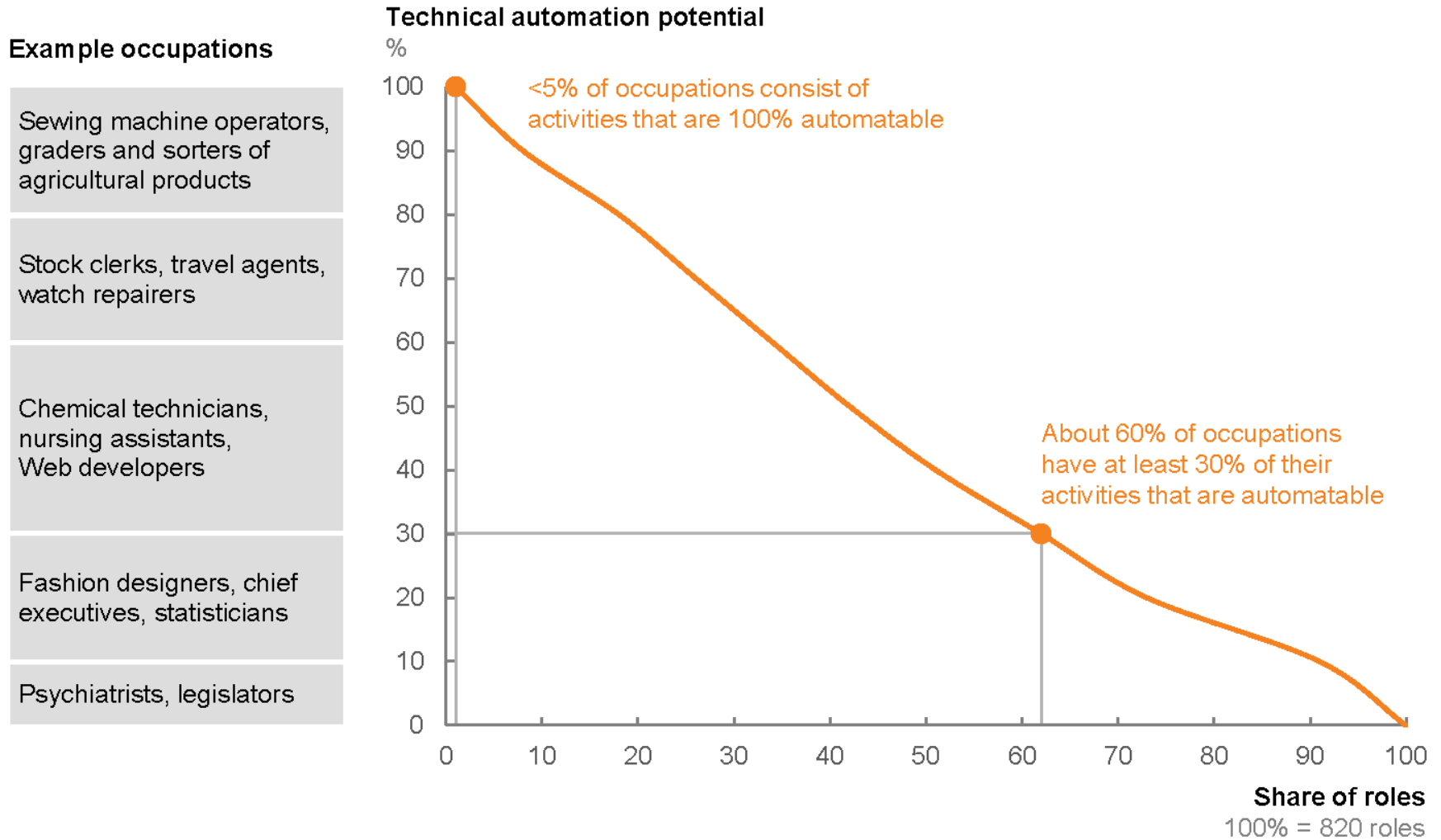


Anxiety over automation: Today

- Based on the tasks that workers perform, Frey and Osborne (2013) classify 702 occupations at risk of automation. Over the next two decades, **47 percent** of US workers are at risk of automation
- Using a related methodology, McKinsey (2017) puts the same number at **45 percent**
- Goldman Sachs (2023) estimates that **66 percent** of jobs (300 million) are at risk of automation because of generative AI. But AI might increase GDP by **7 percent**
- From 1990 to 2007, one more robot per thousand workers reduced employment by 0.2 percentage points and wages by 0.4 (Acemoglu and Restrepo, 2020).
Small effect but aggregate one

While few occupations are fully automatable, 60 percent of all occupations have at least 30 percent technically automatable activities

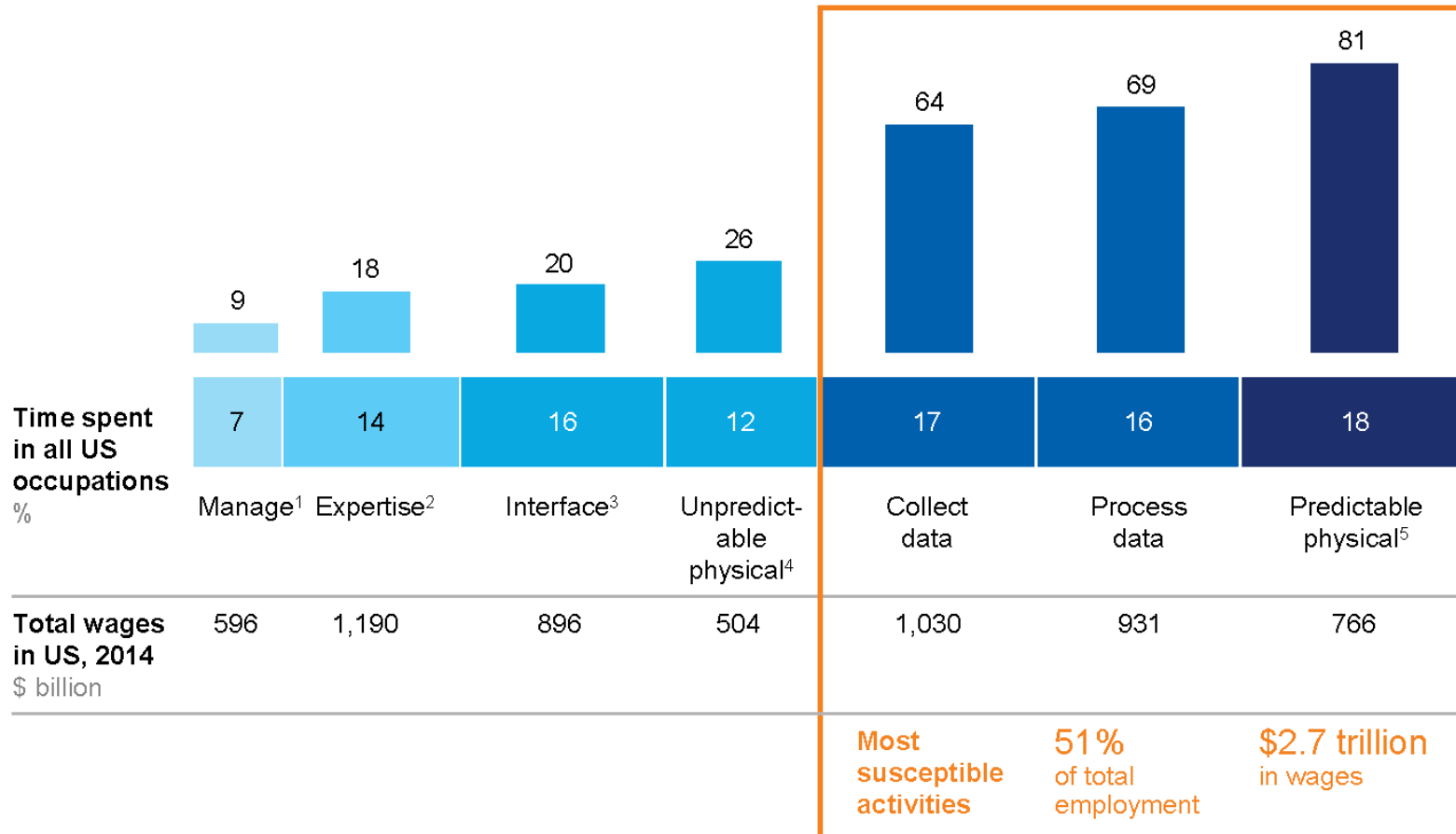
Automation potential based on demonstrated technology of occupation titles in the United States (cumulative)¹



¹ We define automation potential according to the work activities that can be automated by adapting currently demonstrated technology.

Three categories of work activities have significantly higher technical automation potential

Time spent on activities that can be automated by adapting currently demonstrated technology %



1 Managing and developing people.

2 Applying expertise to decision making, planning, and creative tasks.

3 Interfacing with stakeholders.

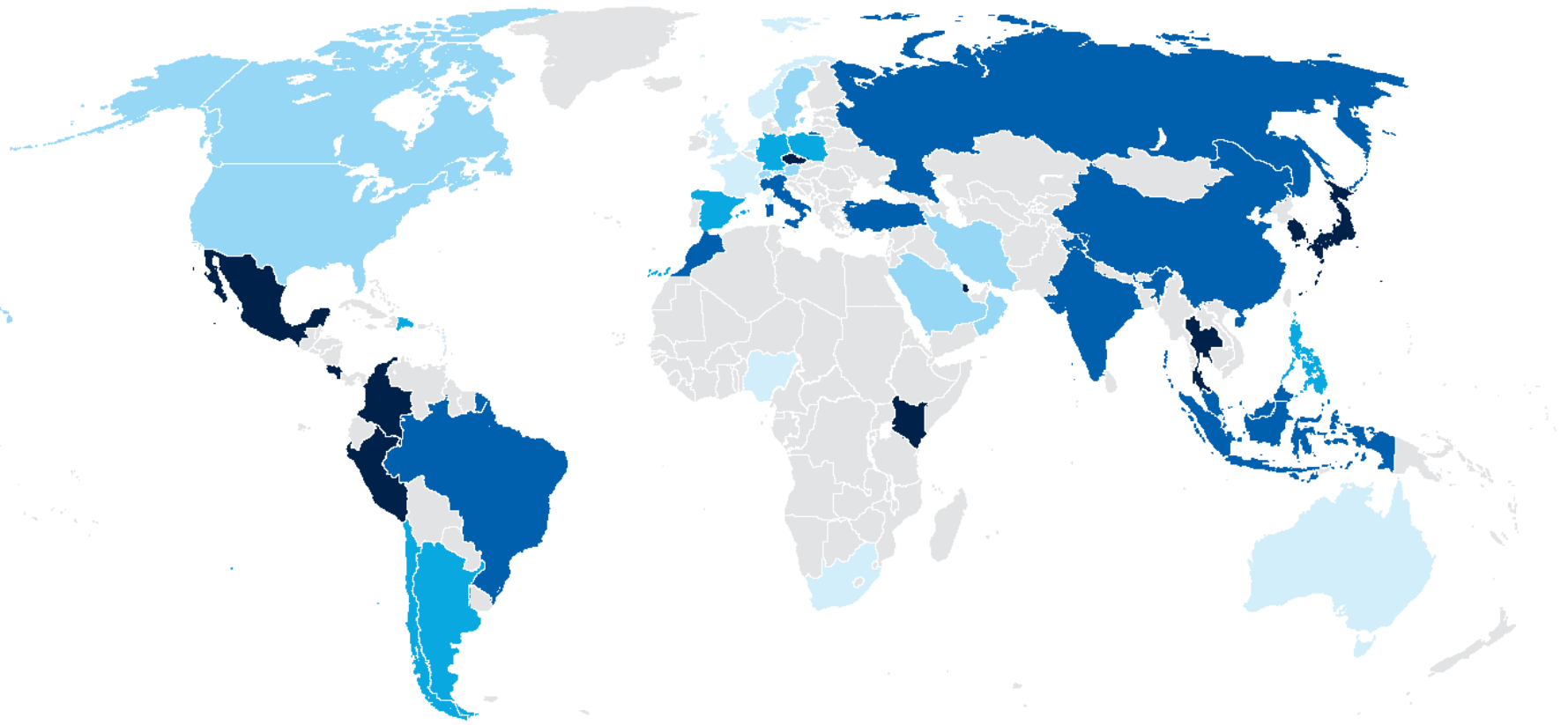
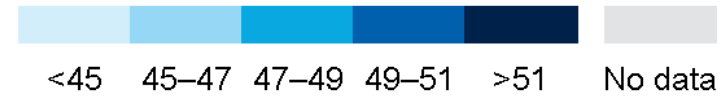
4 Performing physical activities and operating machinery in unpredictable environments.

5 Performing physical activities and operating machinery in predictable environments.

NOTE: Numbers may not sum due to rounding.

The technical automation potential of the global economy is significant, although there is some variation among countries

Employee weighted overall % of activities that can be automated by adapting currently demonstrated technologies



Is this time different?

- Clash between *optimists* and *pessimists*:
 - Lack of imagination vs structural break (paradox of prediction)
- *Partial vs general* equilibrium:
 - “Technological change (along with other forms of economic change) is an important determinant of the precise places, industries, and people affected by unemployment. But the general level of demand for goods and services is by far the most important factor determining how many are affected [...] **The basic fact is that technology eliminates jobs, not work**” (Bowen, 1966)
 - The labor market impacts of new technologies depend not only on where they hit, but also on the **adjustment in other parts of the economy**. Other sectors and occupations might expand to absorb the labor force made redundant by the automated tasks. And productivity improvements due to new machines may even expand employment in affected industries (Autor, 2015)

A tale of complementarities

- Many, perhaps too many, workplace technologies are designed to save labor. But machines both *substitute* for and *complement* human labor. Focusing only on what is lost misses a central economic mechanism by which automation affects labor demand and the equilibrium in the labor market
 - **Basic fact: Tasks that cannot be substituted by automation are generally complemented by it.** *Response:* what if they go?
 - **O-ring theory of production** (Kremer, 1993). Example: ATMs
- Workers are more likely to benefit directly from automation if they supply tasks that are complemented by automation, but not if they primarily or exclusively supply tasks that are substituted. Who decides **needed tasks**? Who chooses **training**?

A tale of elasticities

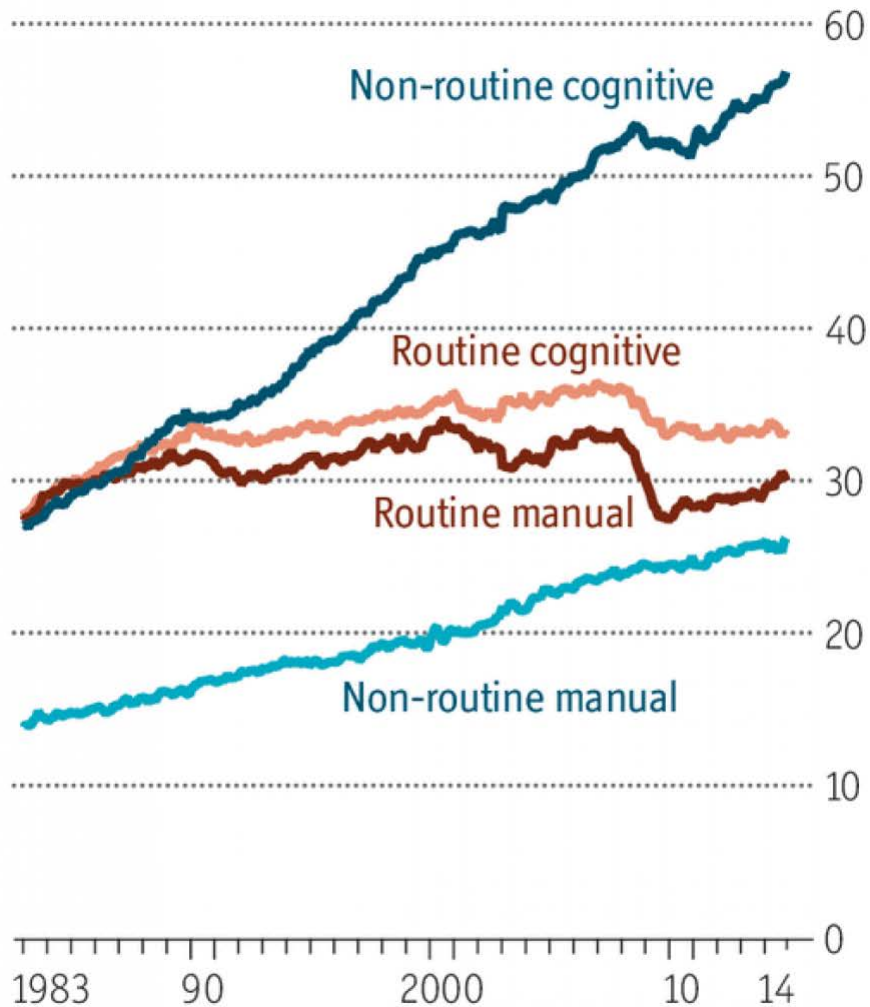
- The **elasticity of labor supply** can mitigate wage gains
- The **income elasticity of demand** can either dampen or amplify the effects of automation. Example: wedding planners
- Back-of-the-envelope example (Autor, 2015): An average US worker in 2015 wishing to live at the income level of an average worker in 1915 could roughly achieve this goal by working about 17 weeks per year
- Most citizens would not consider this tradeoff between hours and income desirable, however, suggesting that consumption demands have risen along with productivity
- Historically, we have experienced more leisure, but also more consumption of new goods and services

Labor market polarization

- Even if automation does not reduce the **quantity** of jobs, it may greatly affect the **quality** of available jobs
- Useful classification:
 - Jobs related to routine tasks
 - Jobs related to “abstract” non-routine tasks
 - Jobs related to “manual” non-routine tasks
- What’s the effect of automation on the employment levels of these jobs?
- What’s the effect of automation on their wages?
- Reference: Autor and Dorn (2013)

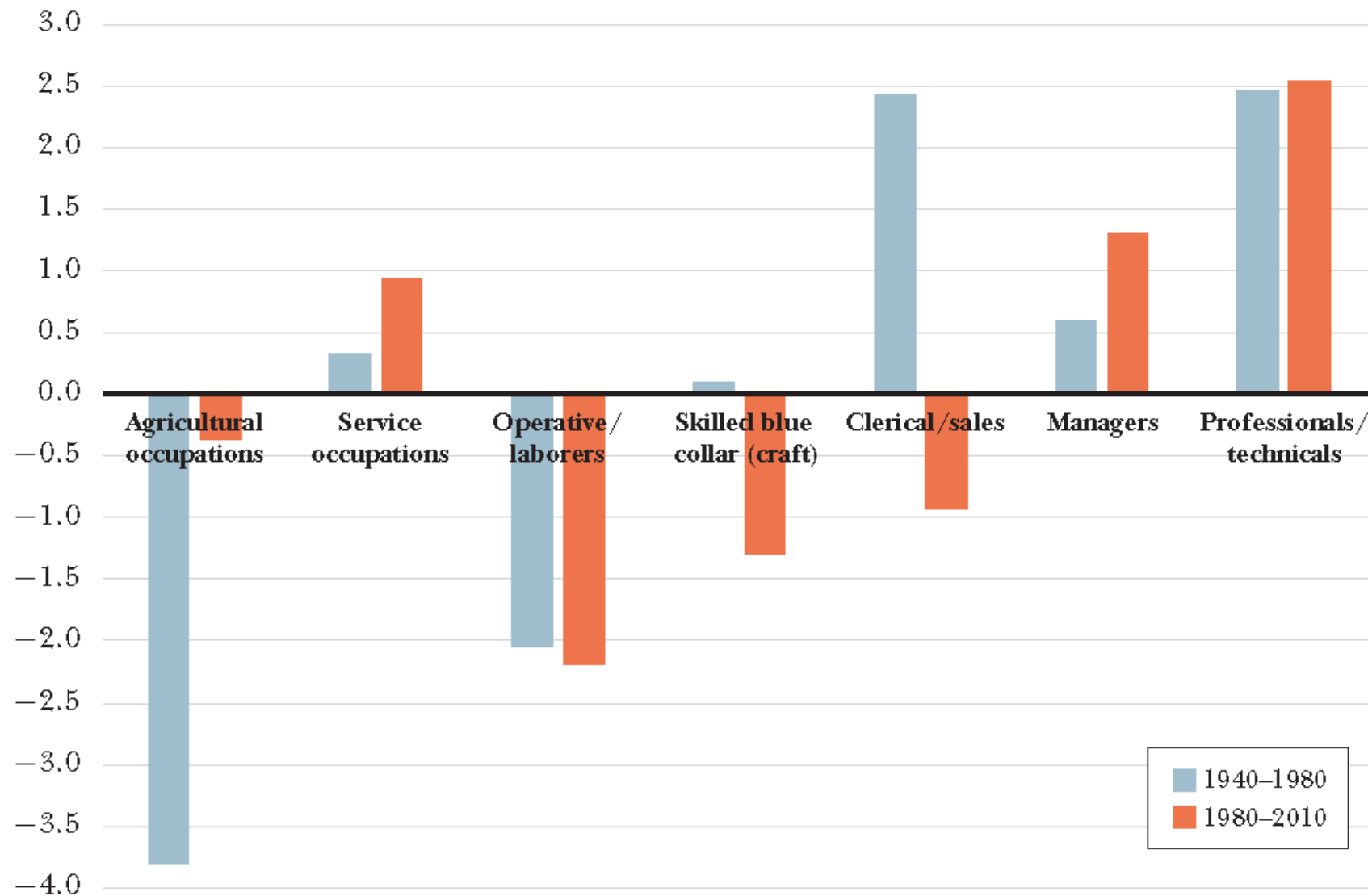
Think

United States employment, by type of work, m

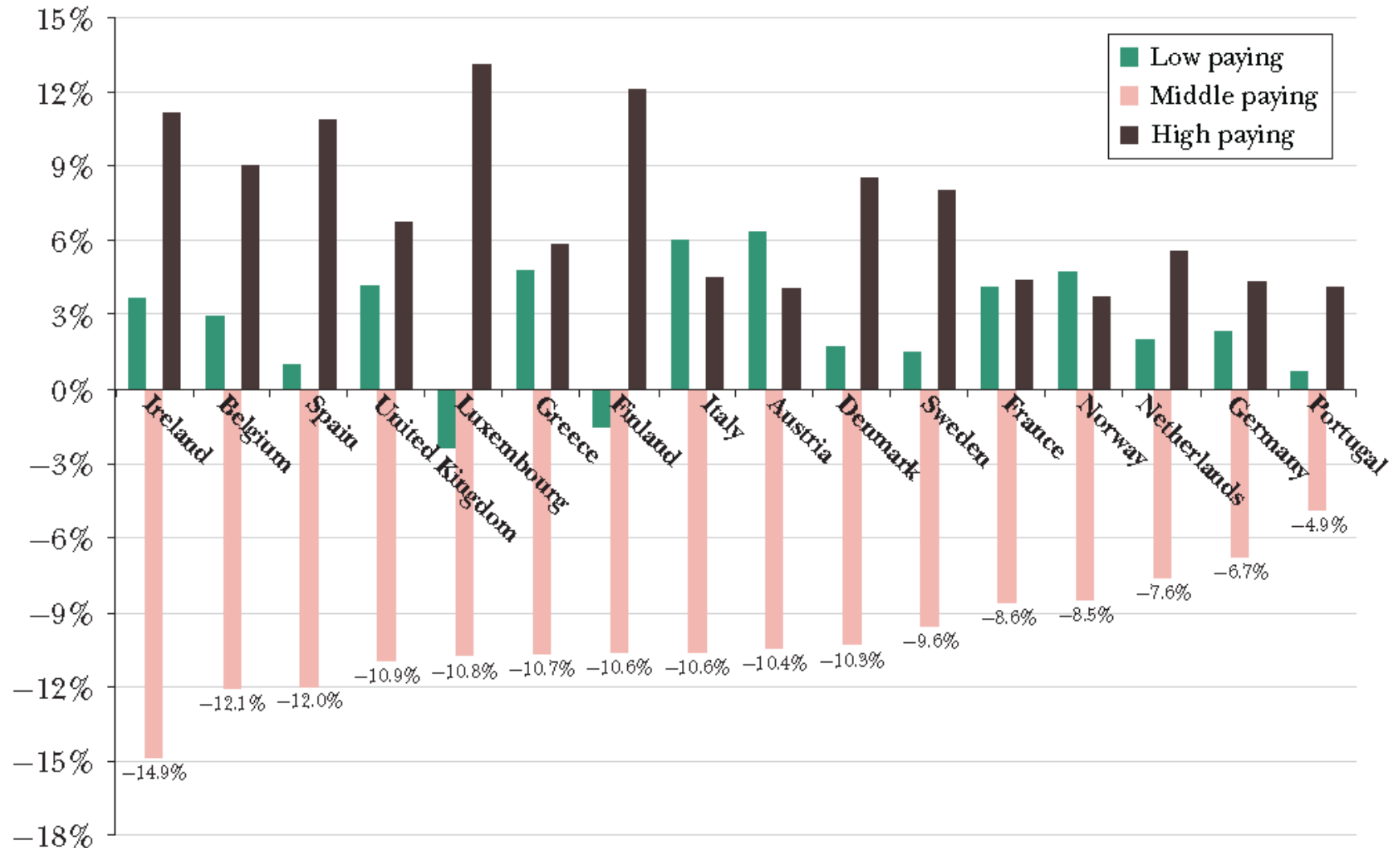


Sources: US Population Survey; Federal Reserve Bank of St. Louis

Average Change per Decade in US Occupational Employment Shares for Two Periods: 1940–1980 and 1980–2010

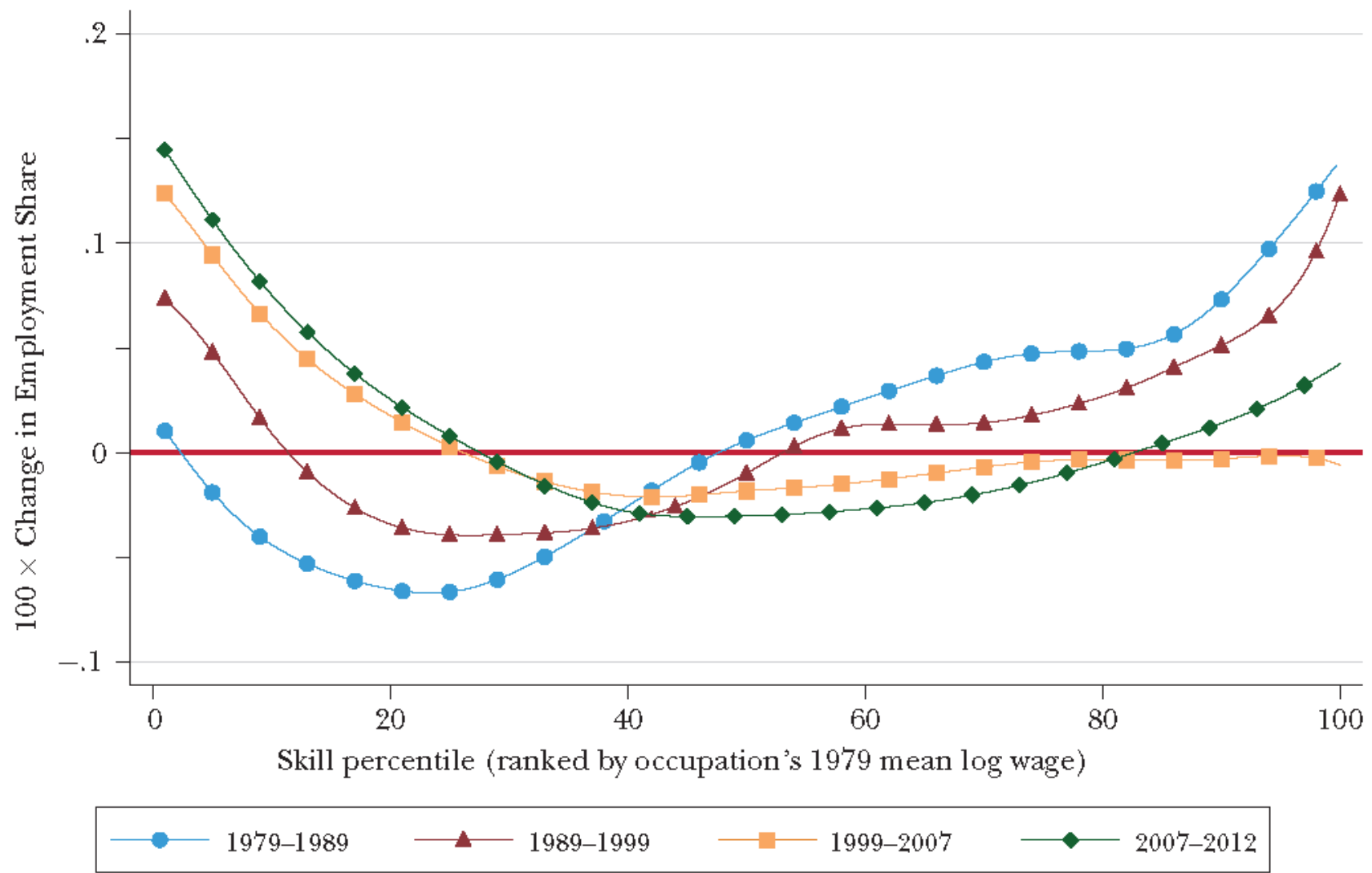


Change in Occupational Employment Shares in Low, Middle, and High-Wage Occupations in 16 EU Countries, 1993–2010



Source: Goos, Manning, and Salomons (2014, table 2).

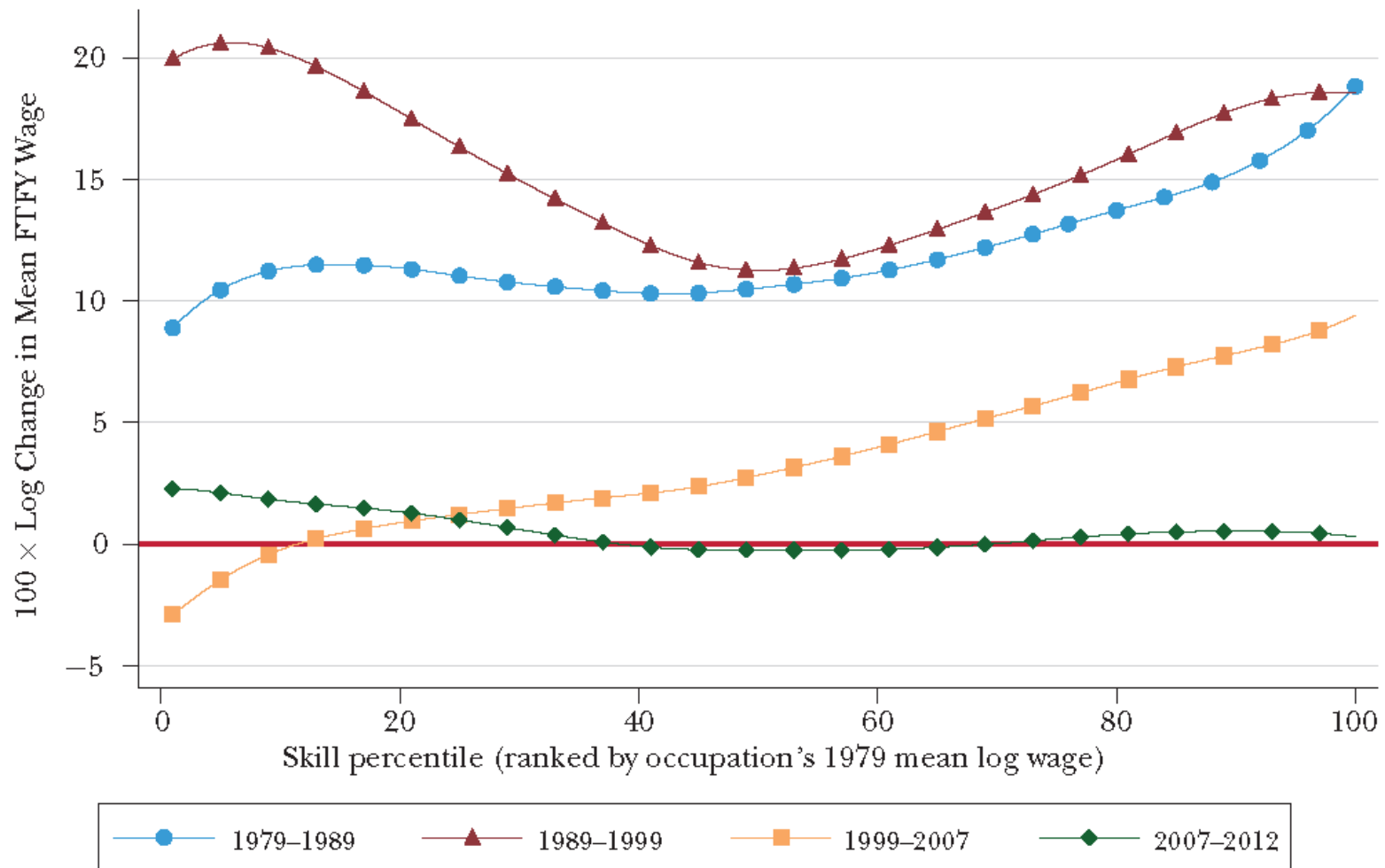
Smoothed Employment Changes by Occupational Skill Percentile, 1979–2012



Sources: Author, calculated using 1980, 1990, and 2000 Census Integrated Public Use Microdata Series (IPUMS) files; American Community Survey combined file 2006–2008, American Community Survey 2012.

Changes in Mean Wages by Occupational Skill Percentile among Full-Time, Full-Year (FTFY) Workers, 1979–2012

(the y-axis plots 100 times log changes in employment, which is nearly equivalent to percentage points for small changes)



Sources: Author, calculated using 1980, 1990, and 2000 Census IPUMS files; American Community Survey combined file 2006–2008, American Community Survey 2012.

More recent studies

- Susskind (2021) critically reviews the literature
 1. **Skill-Biased technical change** and inequality in the 2000s
 2. **Routine-Task-Replacing** technical change and labor market polarization in the 2010s
 3. **Task-Based Capabilities-Agnostic** approach and technological unemployment in the 2020s
- Key contributions in more recent wave: Acemoglu and Restrepo (2018, 2020, 2022). Boundaries of substitution are endogenous, but humans have comparative advantage in “new and complex” tasks (to avoid *horse equilibrium*)

Technological unemployment (reloaded)

- **Frictional technological unemployment**
 - Skill mismatch
 - Place mismatch
 - Identity mismatch
- **Structural technological unemployment**
 - Productivity mechanism
 - Bigger-pie mechanism
 - Changing-pie mechanism
- **Creativity of new needs and tasks creation**
 - Algorithms vs Humans
 - Public vs Private sector

Again: Is this time different?

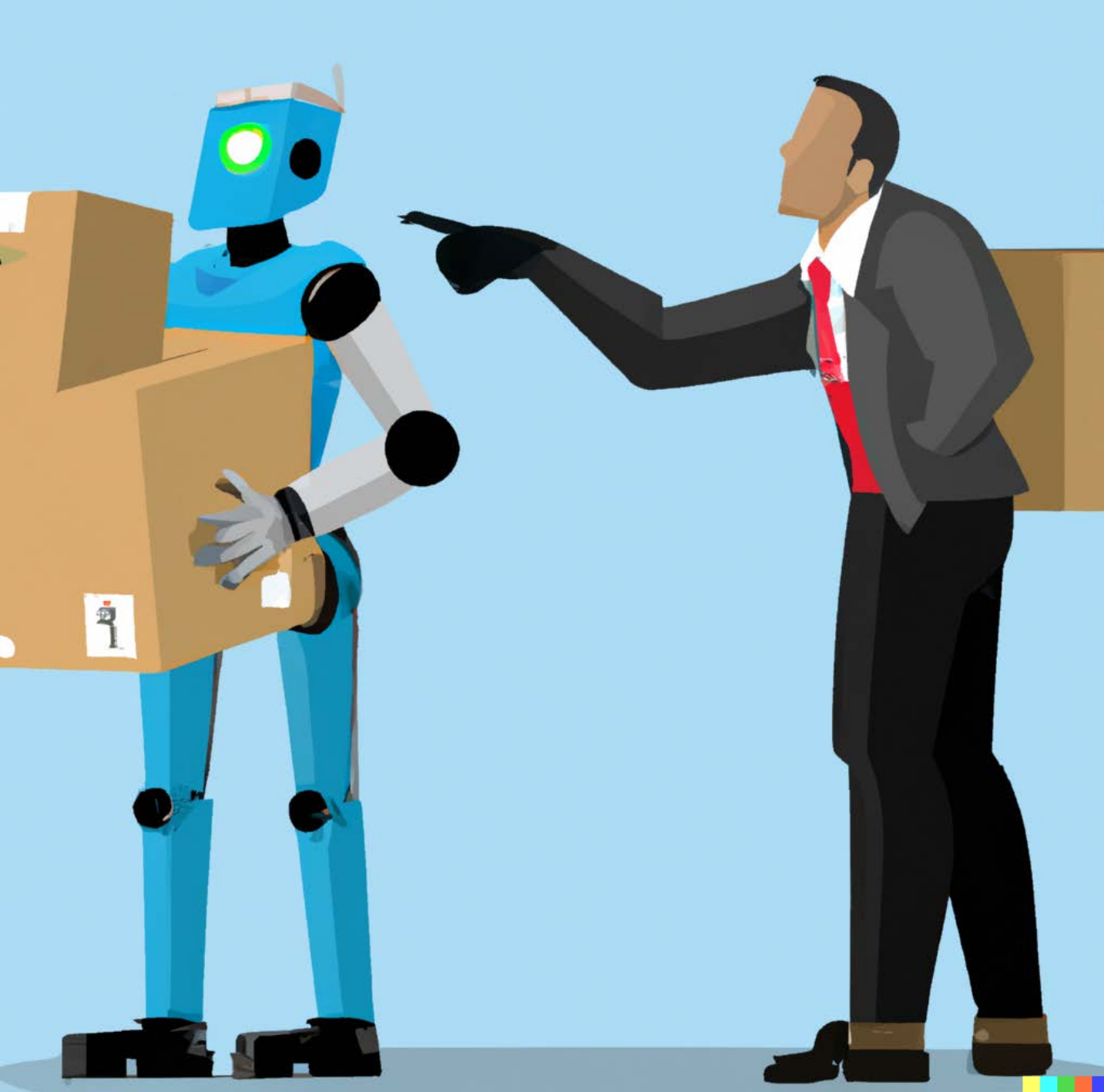
- *Change ain't easy*: Also in the past the road to riches was rockier than is often appreciated today. And sometimes too much (see Acemoglu and Johnson, 2023)
- Spatial dimension of adjustment costs and lack of geographical mobility (i.e., economic and social costs of labor mobility)
- Decline of the middle class & cultural challenges (“strangers in their own land”)
- Redistribution made more difficult by innovation and globalization. E.g., taxing multinational firms
- AI development in the “wrong” direction (Acemoglu and Johnson, 2023): 1) automation & surveillance vs 2) human complementarity. E.g., self-driving trucks (Pritchett, 2023)

A tale of institutions

- **Bowes Commission** took the reality of technological disruption as severe enough that it recommended:
 - “A guaranteed minimum income for each family; using the government as the employer of last resort for the hard core jobless; two years of free education in either community or vocational colleges; a fully administered federal employment service, and individual Federal Reserve Bank sponsorship in area economic development free from the Fed’s national headquarters”
- But today’s institutions are very different
- Size of **digital giants** is making more likely that they will shape democracy than the other way around

A tale of institutions (contd.)

- **The race between technology and education** (Goldin and Katz, 2008). Compulsory education and the XX century welfare state are big part of the complementary story by Autor and others
- **Policy implications** (Acemoglu, Autor, Johnson, 2023):
 - Tax code reform
 - More labor voice
 - Funding of human-complementarity research
 - Technology certification and adoption
 - Public employment



**DALL-E:
Mistake or
prediction?**

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