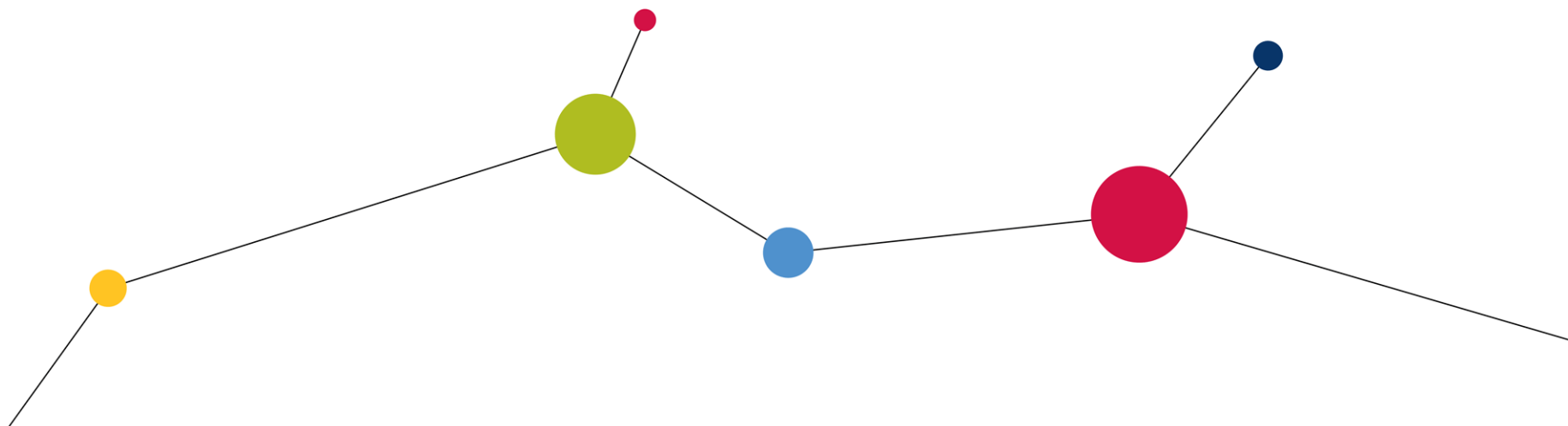# The Future of Work

Carl Benedikt Frey

The future of work: an old concern

Emperor Vespasian (69 AD)

"How will it be possible to feed the populace?

Queen Elizabeth I (1589)

"Thou aimest high, Master Lee. Consider thou what the invention could do to my poor subjects. It would assuredly bring to them ruin by depriving them of employment, thus making them beggars"
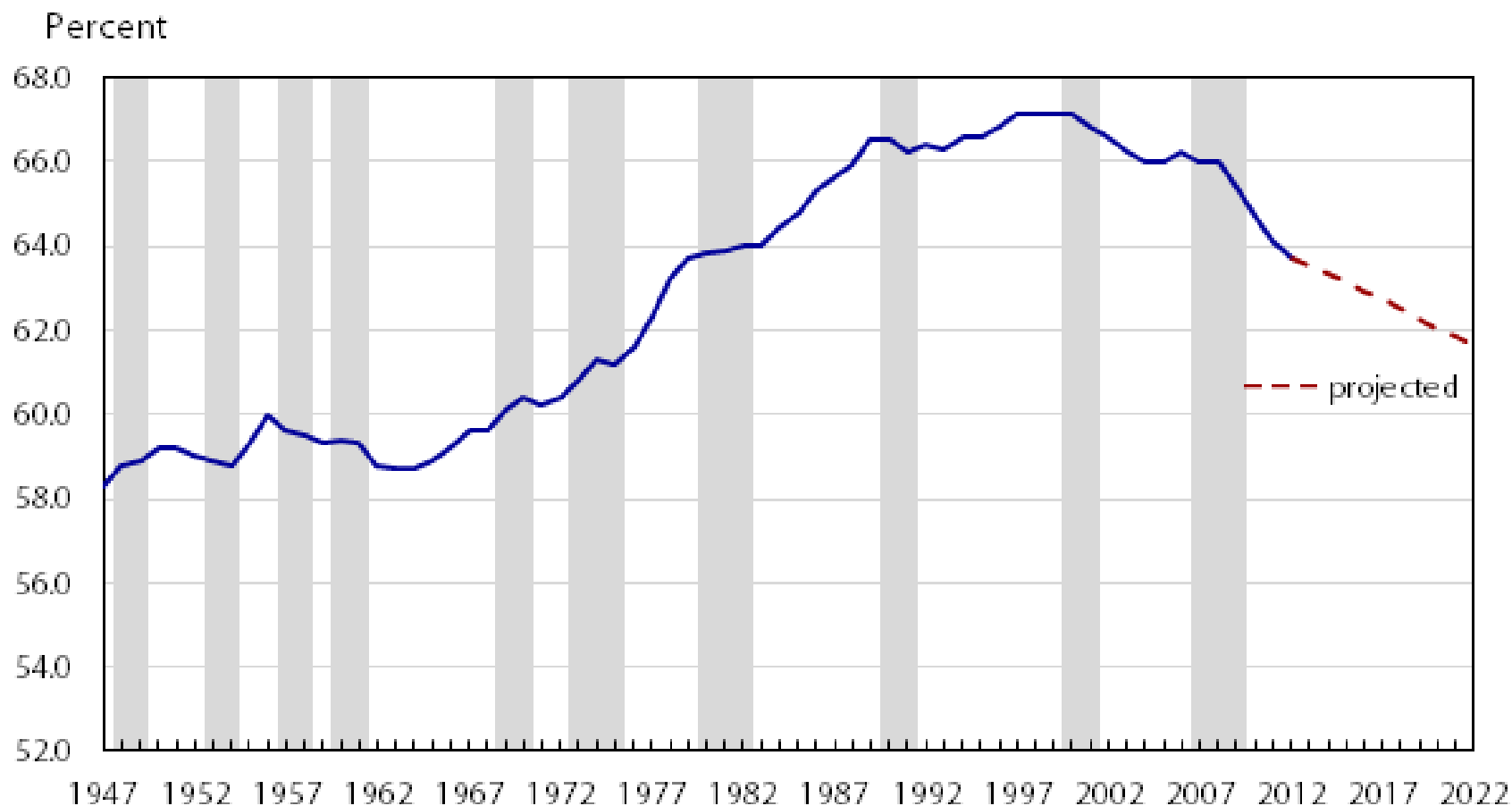
Bill Gates (2014)

"Software substitution, whether it's for drivers or waiters or nurses […] it's progressing […] Technology over time will reduce demand for jobs, particularly at the lower end of skill set."
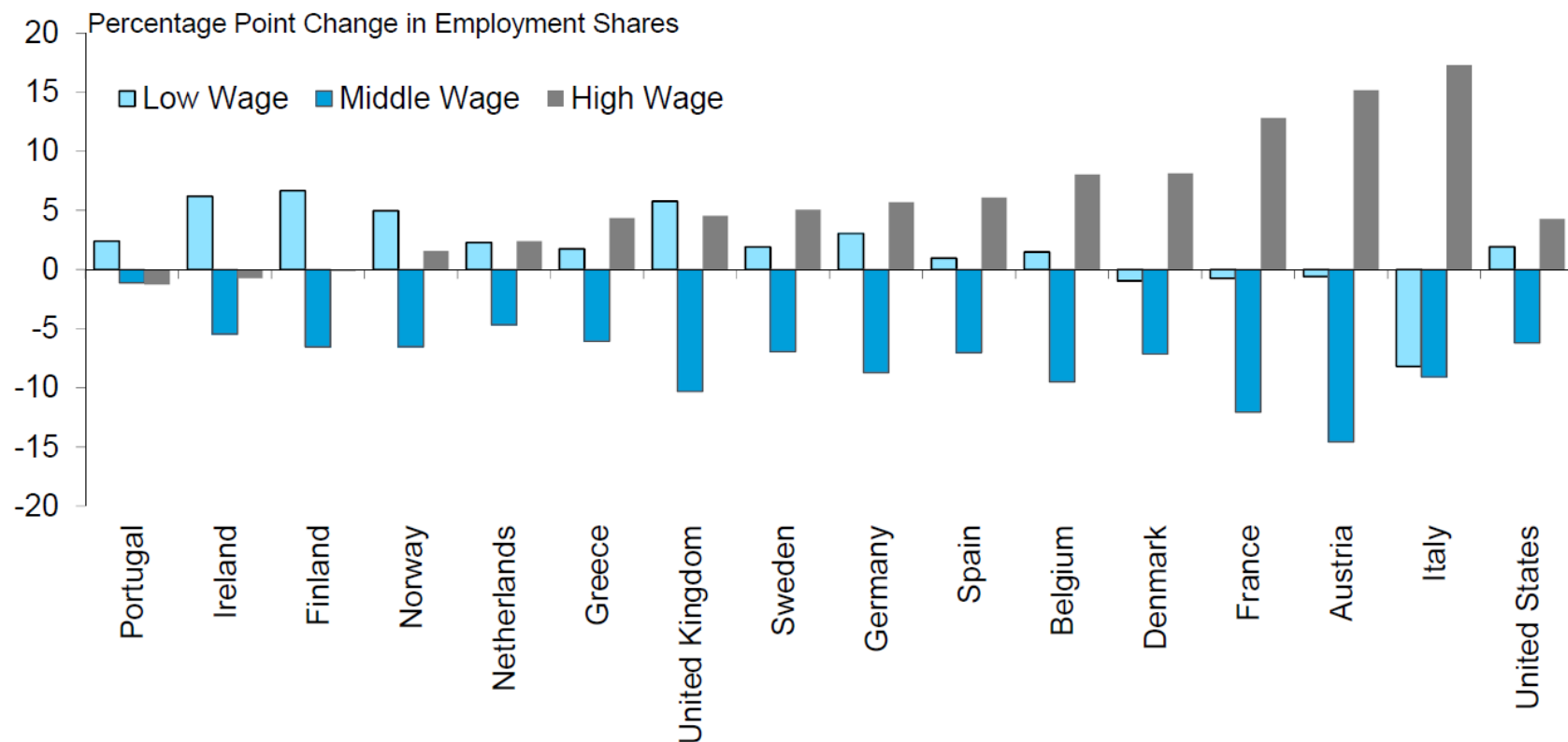
The declining cost of computers
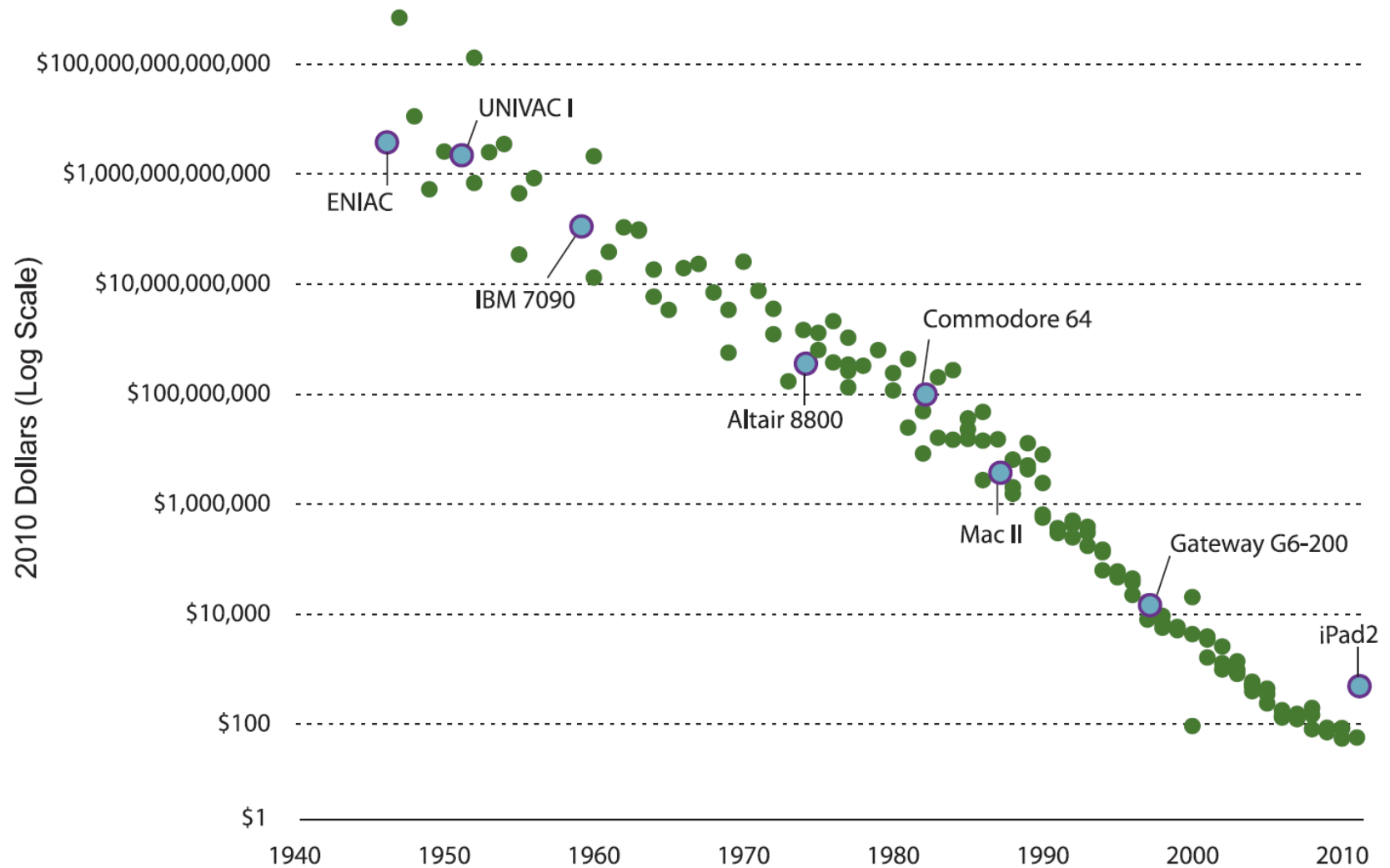
Is this time different?

## U.S. Civilian Labour Force Participation Rate

Source: US Bureau of Labor Statistics

Job polarization and wage disparities

Source: David Autor (2010), "The Polarisation of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings," Center for American Progress and The Hamilton Project. Wage categories are based on average wage levels at the start of the period measured

The end of industrialization?
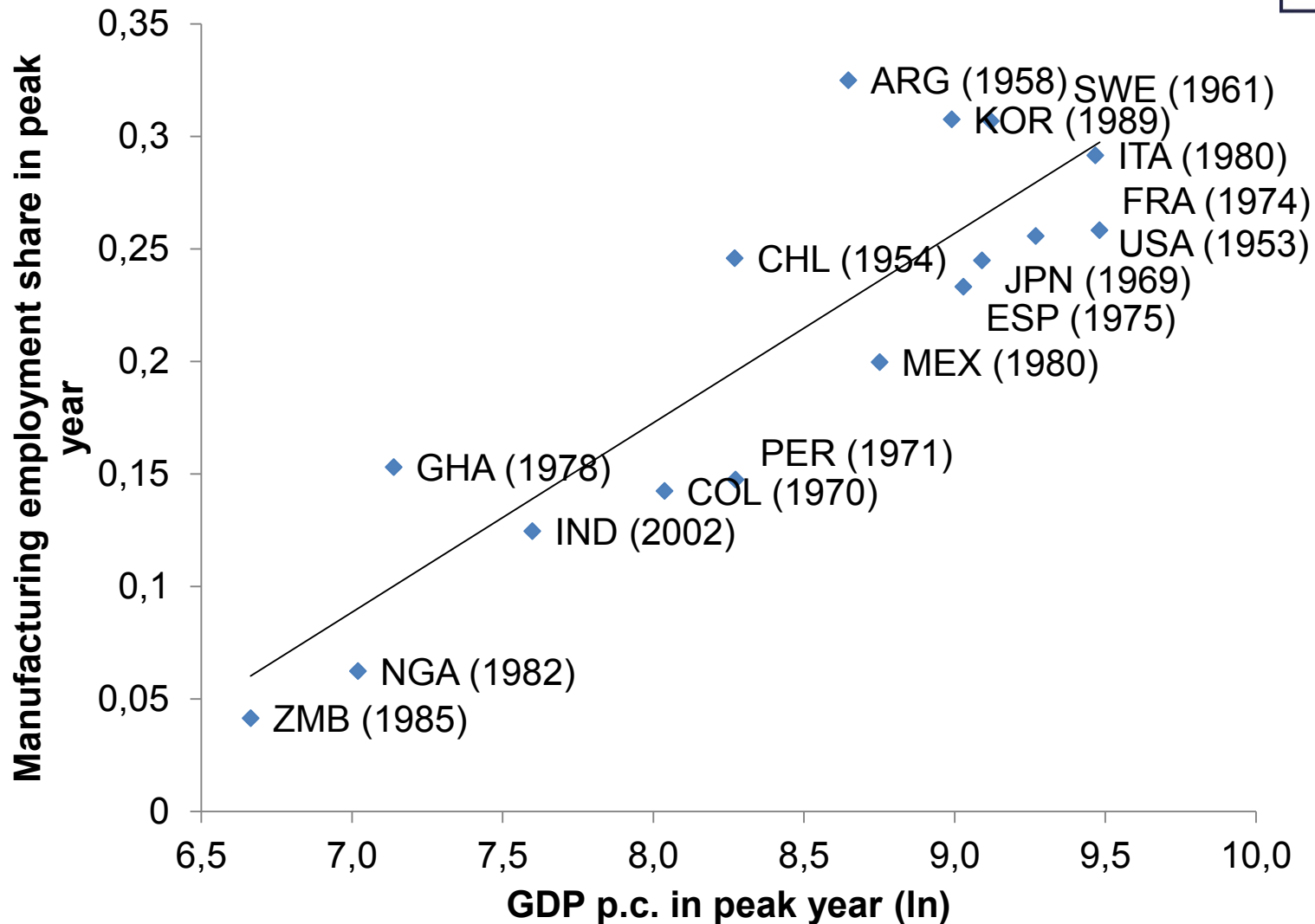
The expanding comparative advantage of computers

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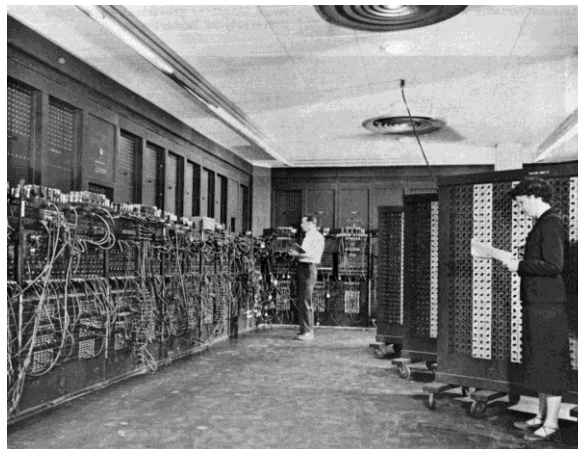
"The human computer is supposed to be following fixed rules; he has no authority to deviate from them in any detail." (Turing, 1950)

Electronic computers performing routine tasks:

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

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

- Medical diagnostics
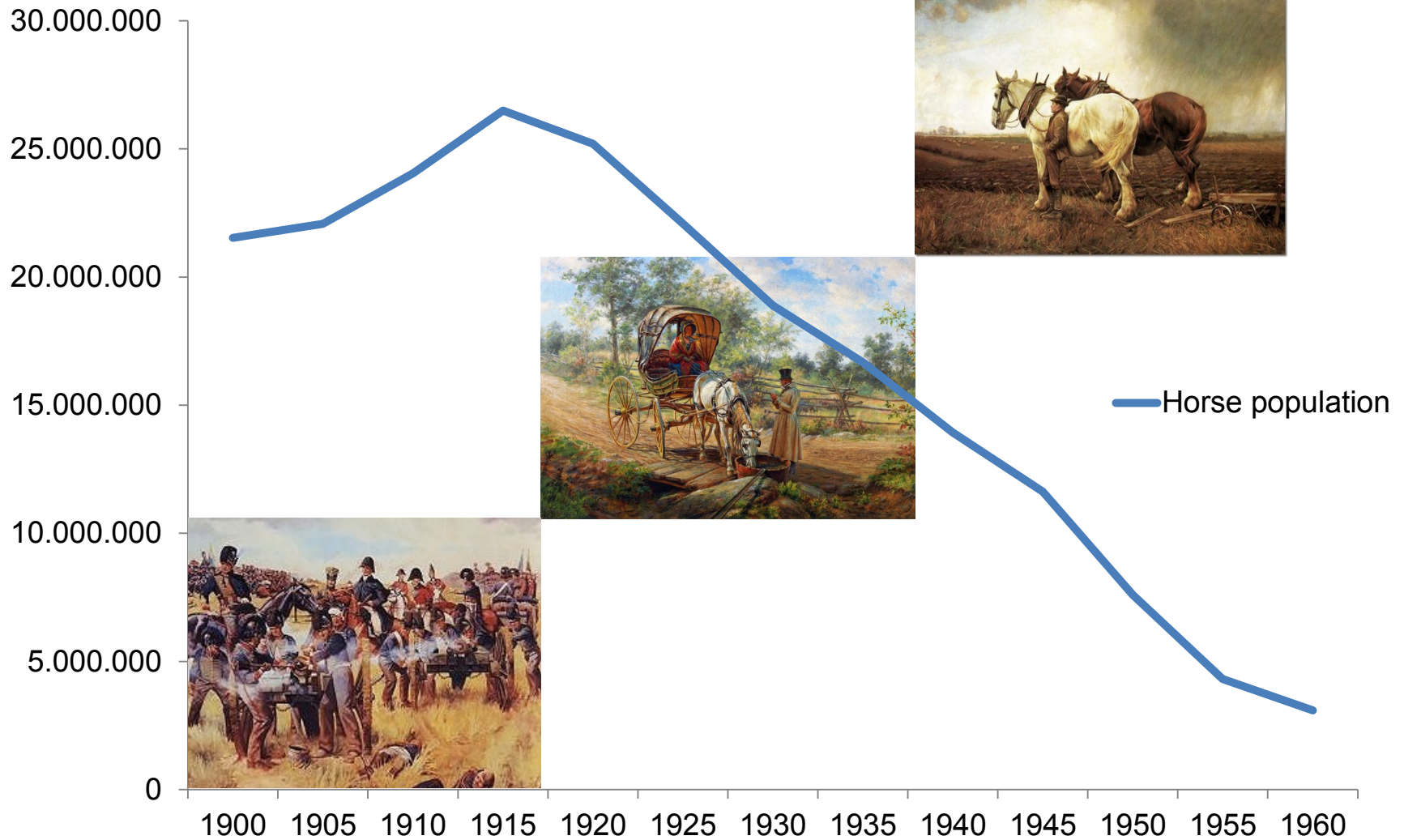- Document review
- Translation
- Driving

Google Translate
Break through language barriers.

Will automation cause a jobless future?

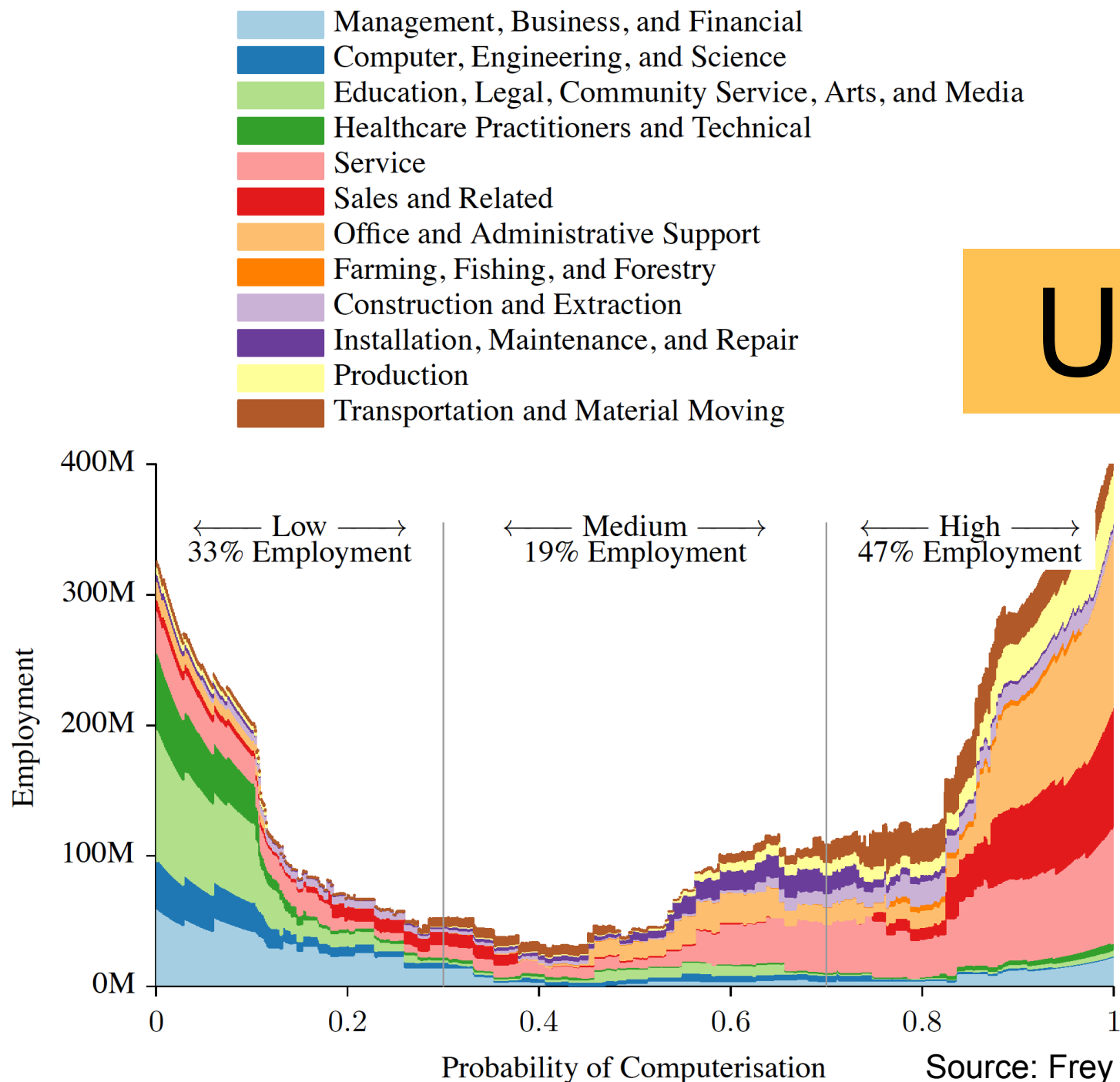*"I believe in the horse. Automobiles are a passing phenomenon."*
- Kaiser Wilhelm II

Where will human workers still hold the comparative advantage?

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Creativity

Social intelligence

Perception and manipulation

Source: Frey & Osborne (2013)

The exposure of low-income jobs
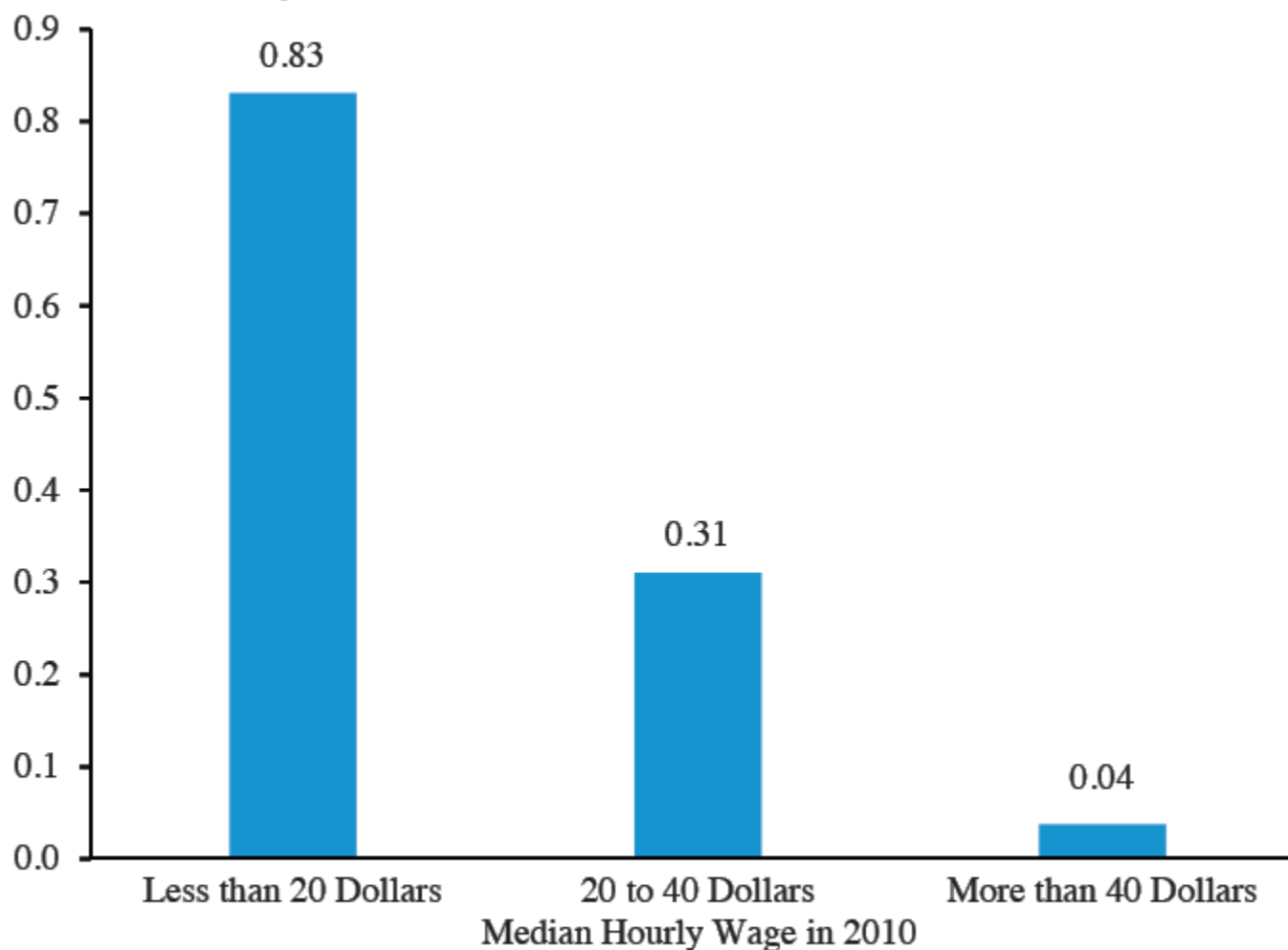
Source: Bureau of Labor Statistics; Frey and Osborne (2013); CEA calculations.

Automation by field of education

New jobs and skills since 1980

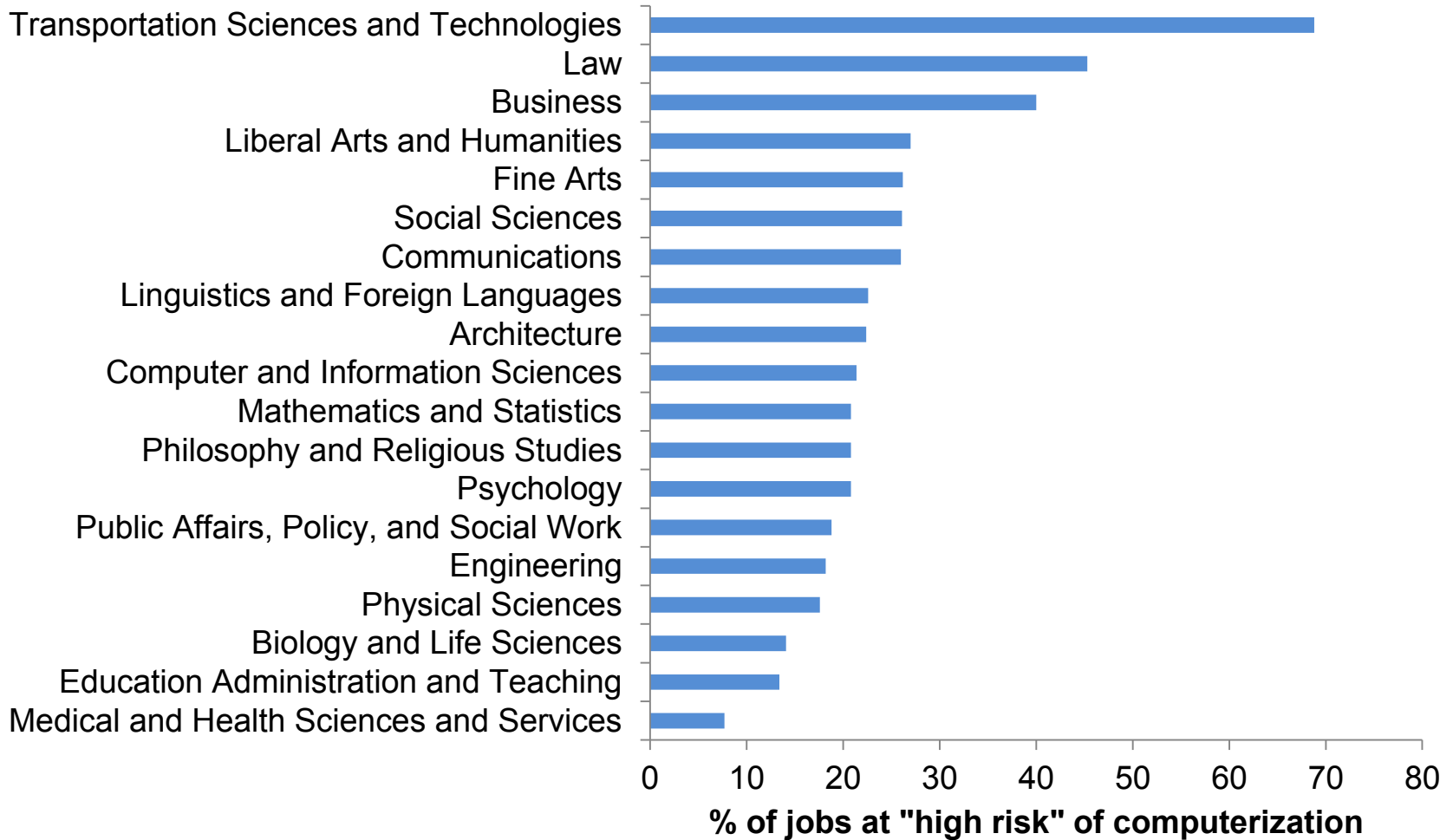| Occupations	New job titles (%)
Computer Software Engineers	80.0
Database Administrators	78.6
Network and Computer Systems Administrators	78.1
Computer and Information Systems Managers	76.5
Computer Support Specialists	71.4
Computer Programmers	59.1
Miscellaneous Personal Appearance Workers	50.0
Logisticians	50.0
Computer Hardware Engineers	50.0
Physical Therapists	50.0

Source: Lin (2011); Berger & Frey (2015)

New jobs and skills since 2000

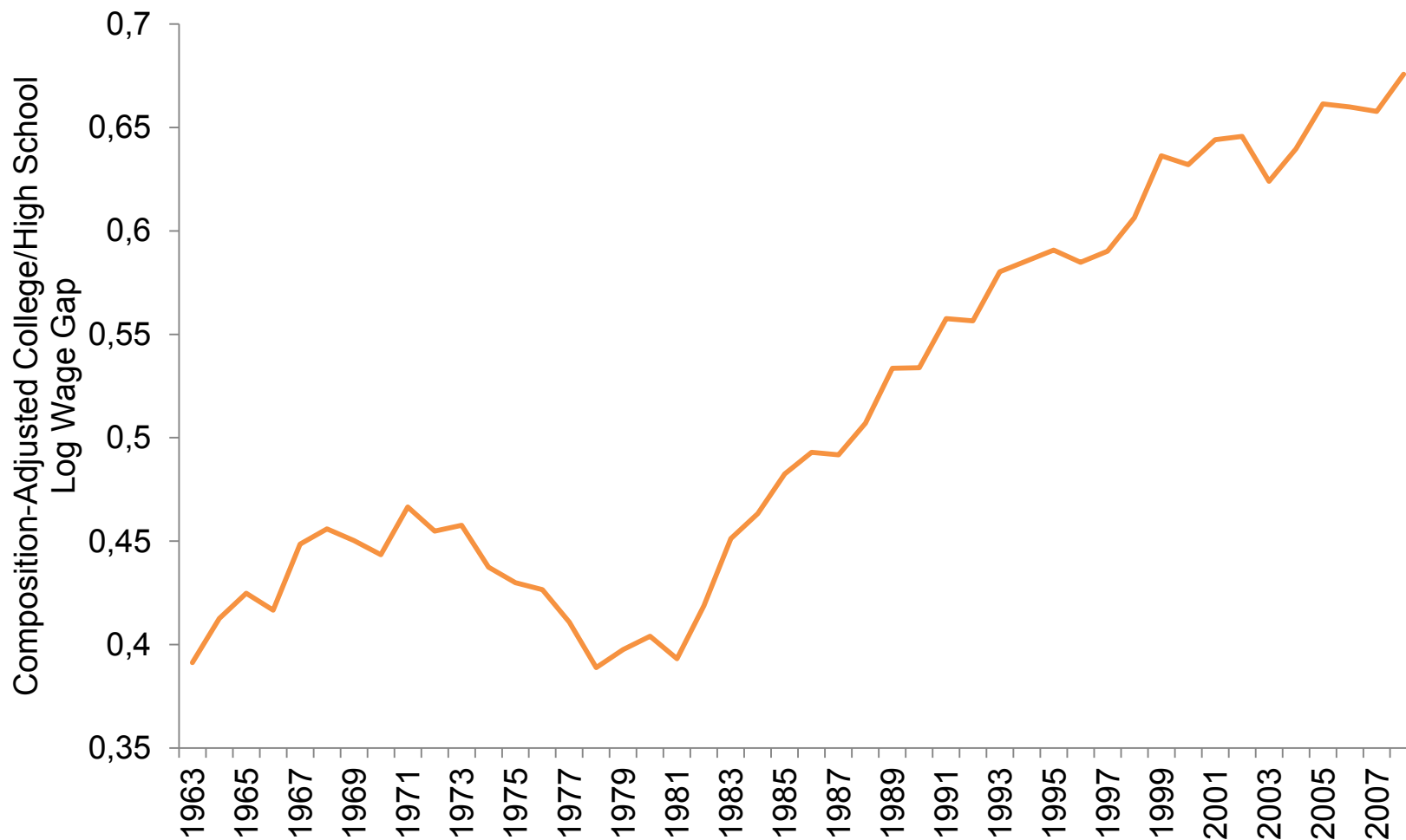| Detailed industry (examples)	% of US Employment	% with college degree	Avg. Wages ($)
Internet publishing and broadcasting	0.06	69.6	81,138
Electronic shopping	0.08	49.7	45,372
Data processing, hosting, and related services	0.08	48.0	64,729
Electronic auctions	0.01	52.2	47,257

Source: Berger & Frey (2015)

Who gains from technological progress?
The growing regional divide

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Chart: Scatter plot with x-axis "Share of jobs at "high risk" of computerization, 2010" (ranging 0,35 to 0,6) and y-axis "Percentage of employment in new industries, 2010" (ranging 0 to 2). A downward trend line shows a negative relationship.
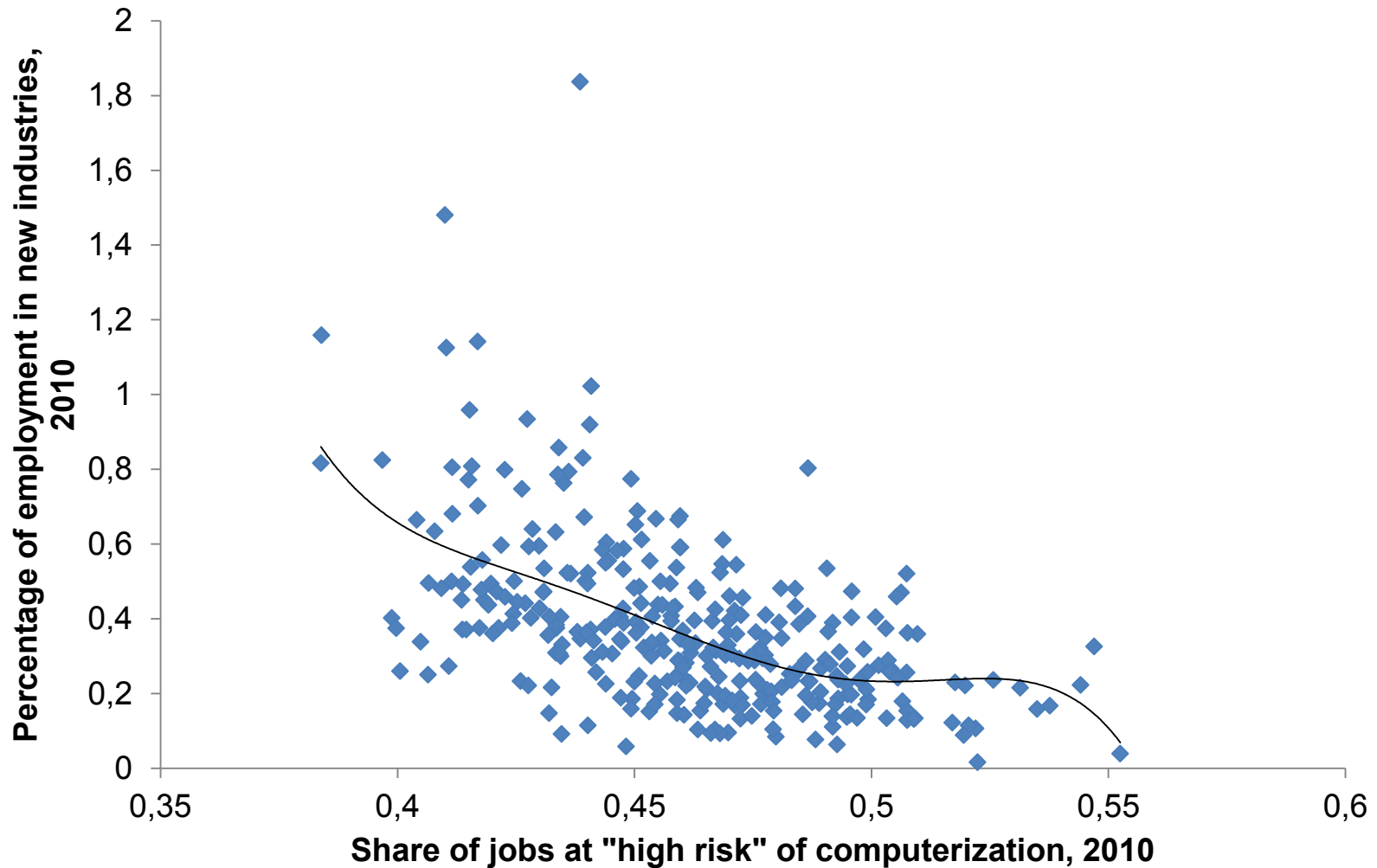
Who gains from technological progress?

The college wage premium

The role of universities and government

- Make university lectures accessible online to everyone

- Shift towards tutorial style teaching

- Make universities more academic; not less

ETHICS AND GOVERNANCE

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