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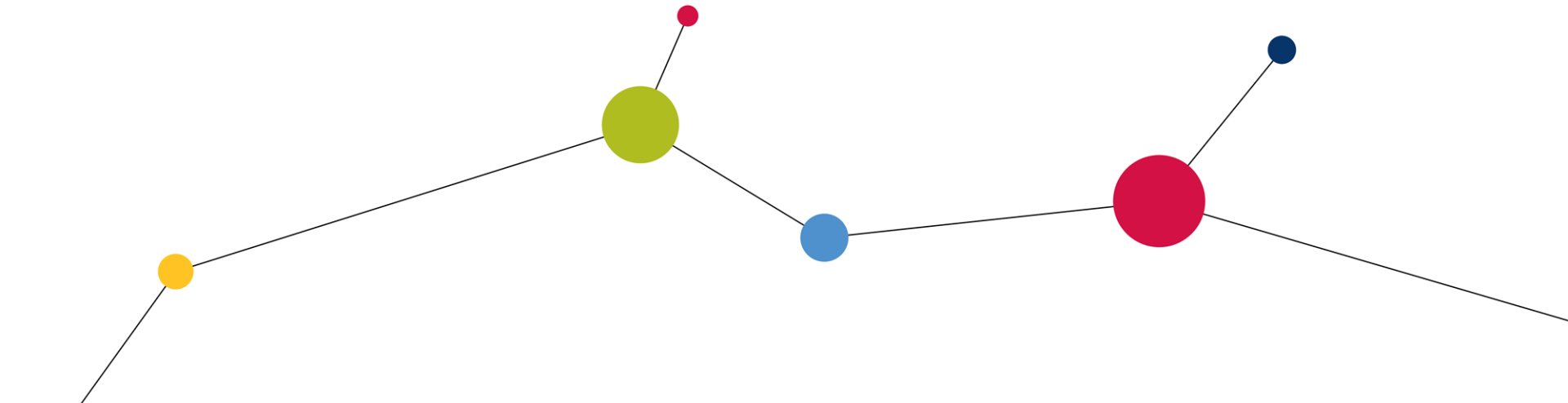
Technology and Labour Markets

Carl Benedikt Frey



The declining cost of computers

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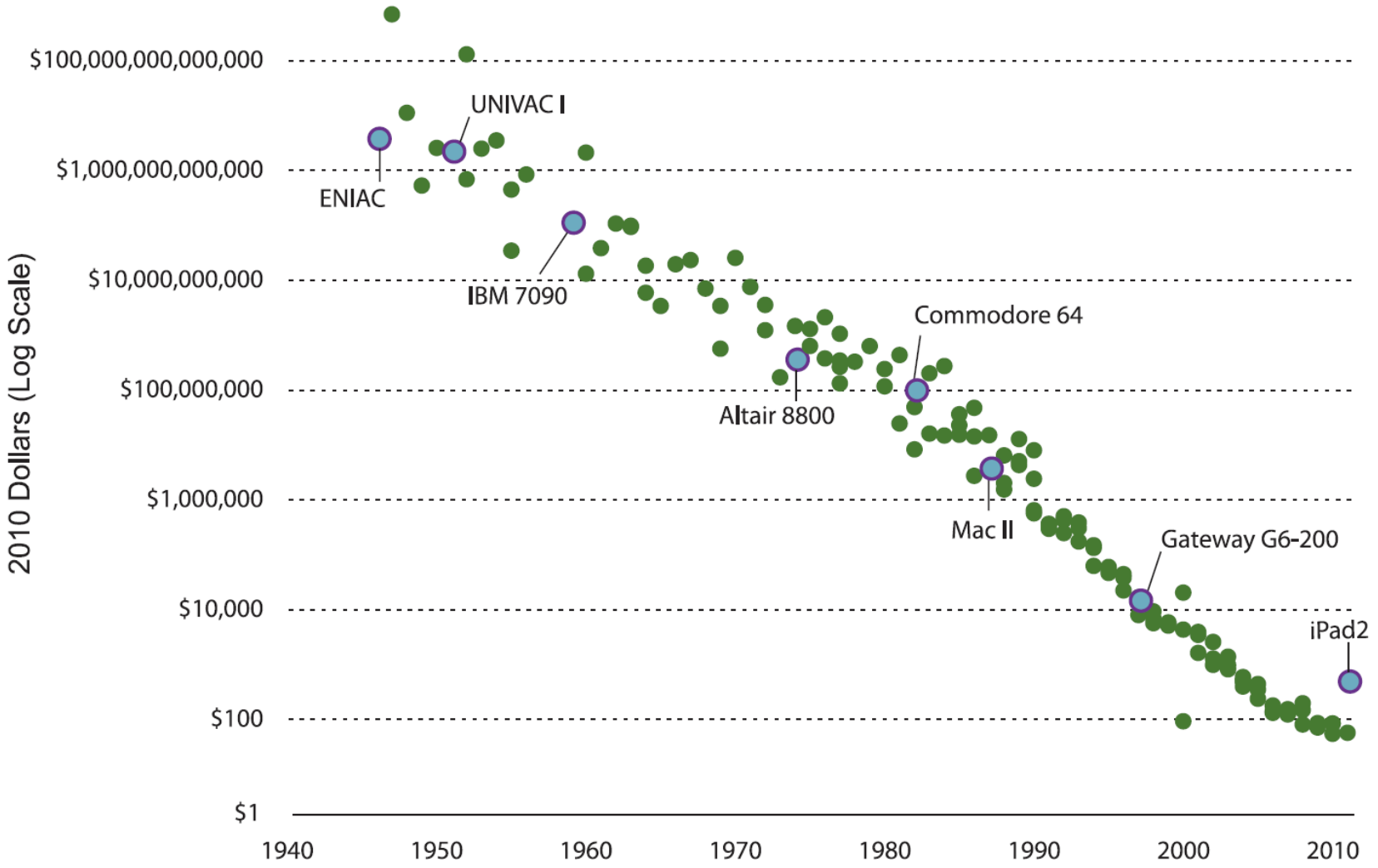

Is this time different?

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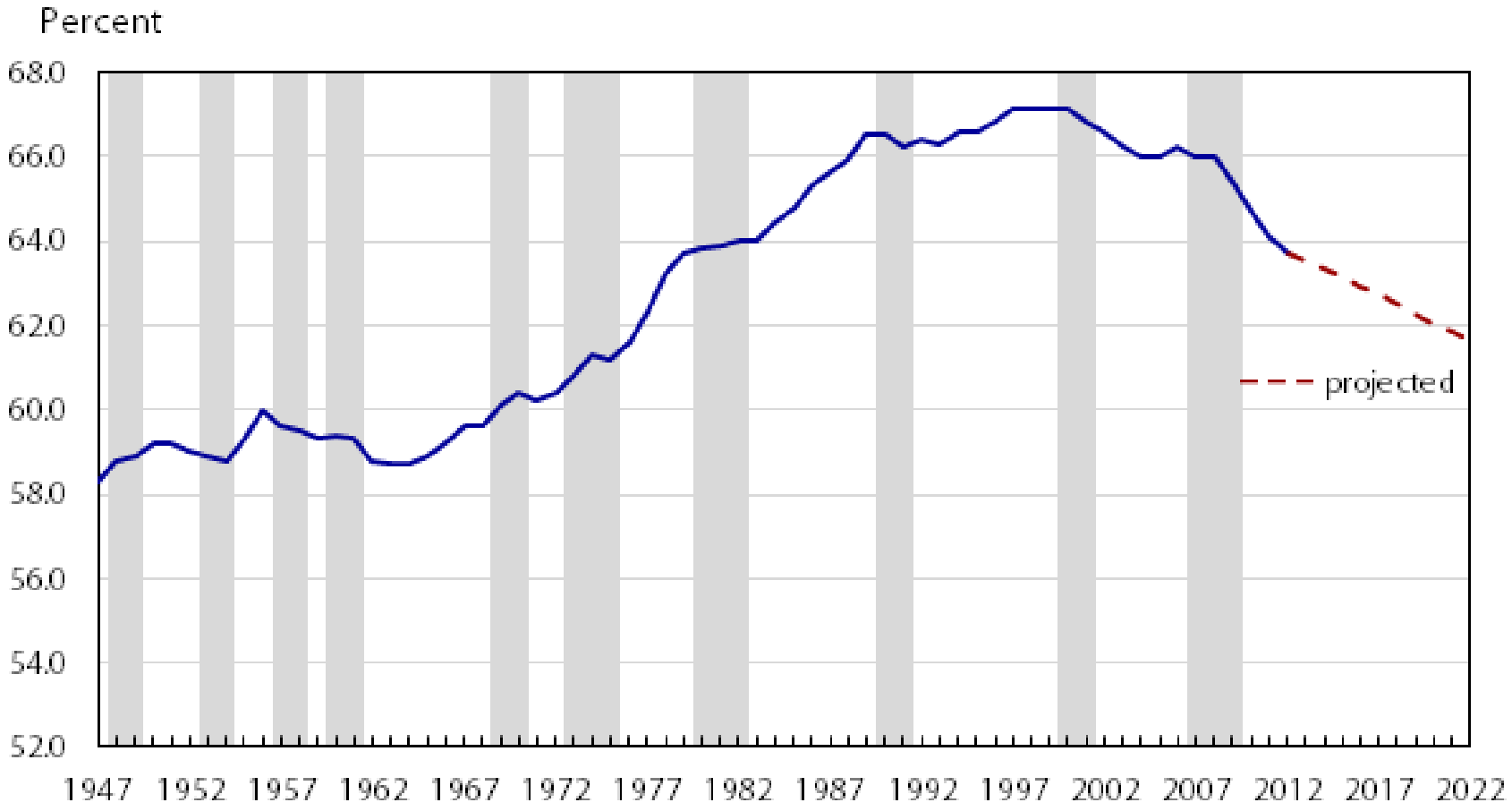
U.S. Civilian Labour Force Participation Rate



Source: US Bureau of Labor Statistics

Untangling Trade and Technology

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Autor, Dorn and Hanson (2015):

- Chinese import competition has caused unemployment and non-employment
- Automation has caused job polarization and growing wage disparities

Cortes, Jaimovich and Sui (2016):

- Unemployment and non-employment among low skilled routine workers

Job polarization in advanced economies

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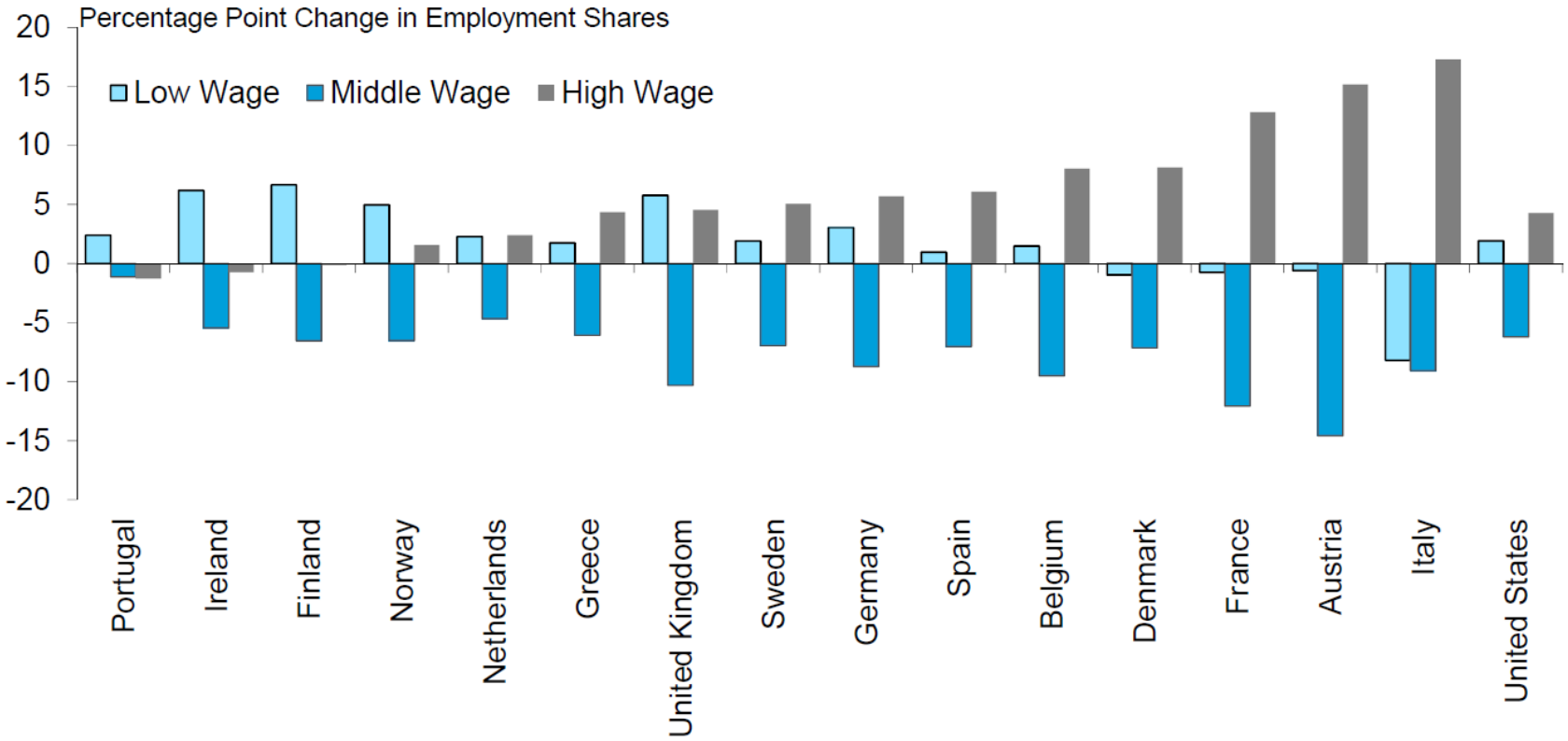

Source: David Autor (2010), "The Polarisation of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings," Center for American Progress and The Hamilton Project. Wage categories are based on average wage levels at the start of the period measured

Job polarization in developing economies

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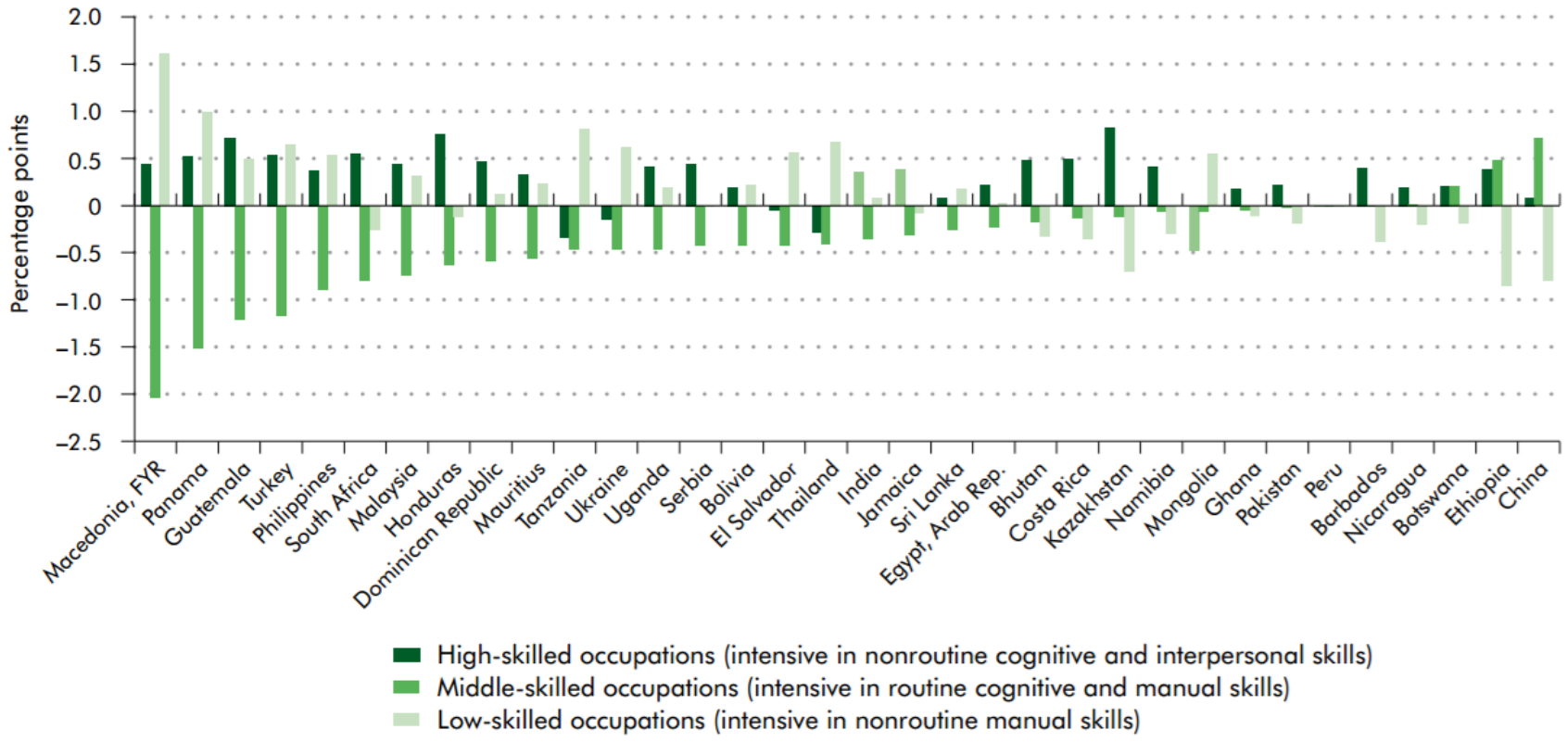
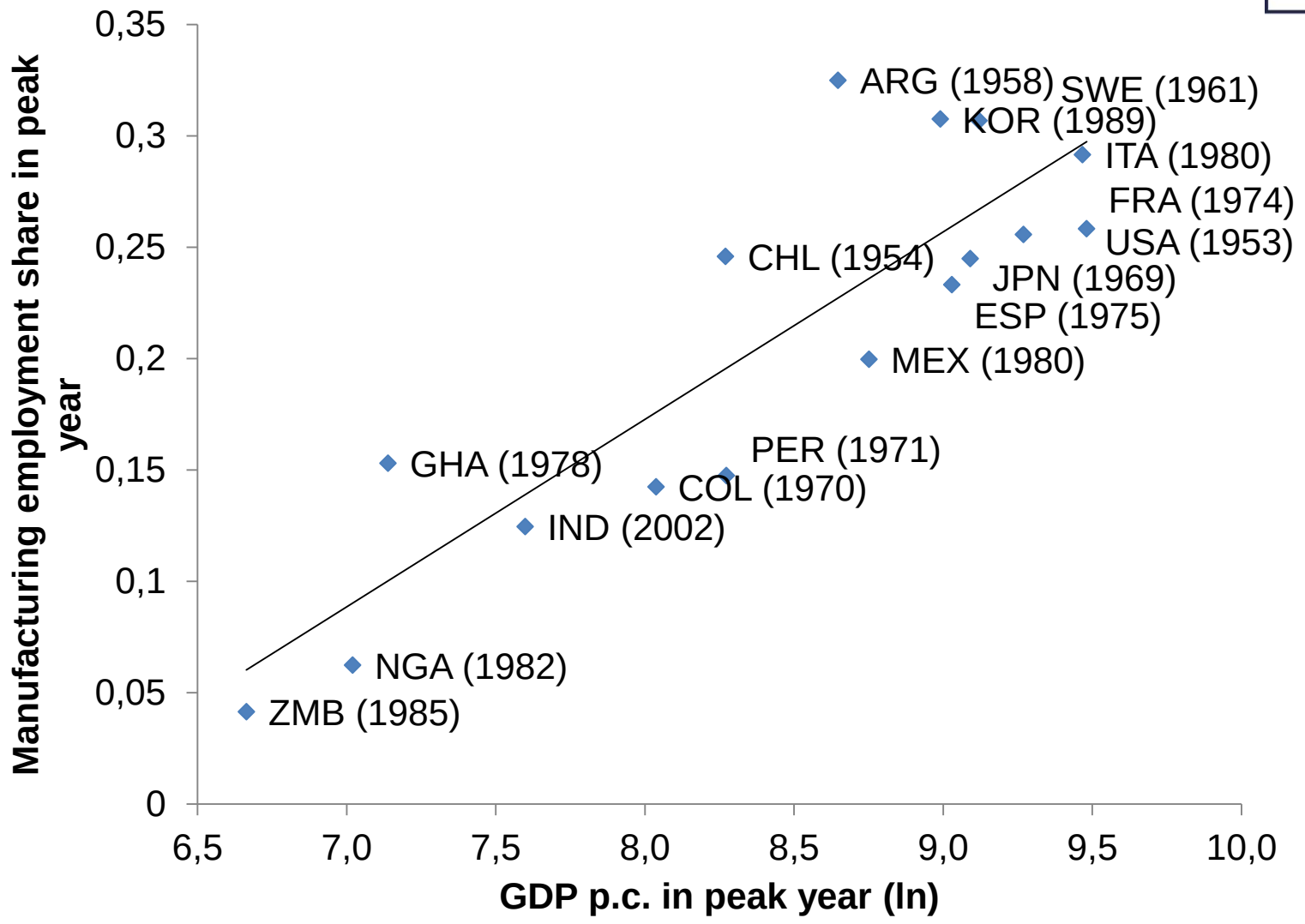


The end of industrialization?



The expanding comparative advantage of computers

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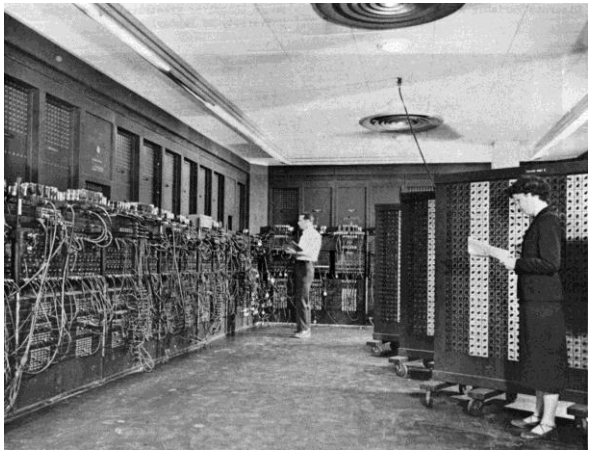
Human computers performing mathematical calculations

"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.

Where will human workers still hold the comparative advantage?

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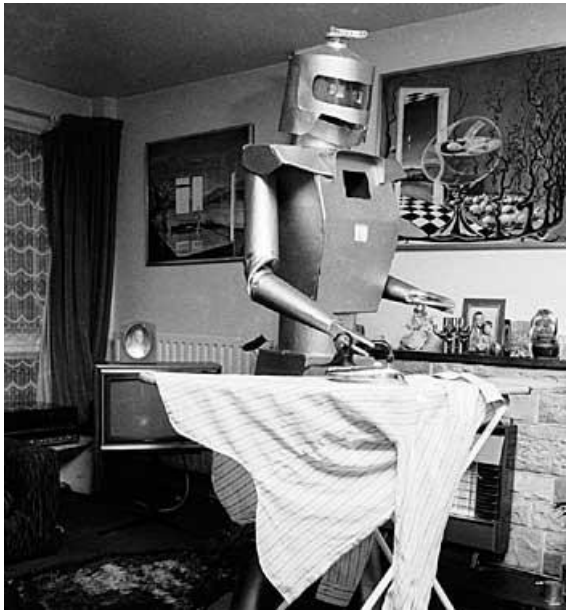
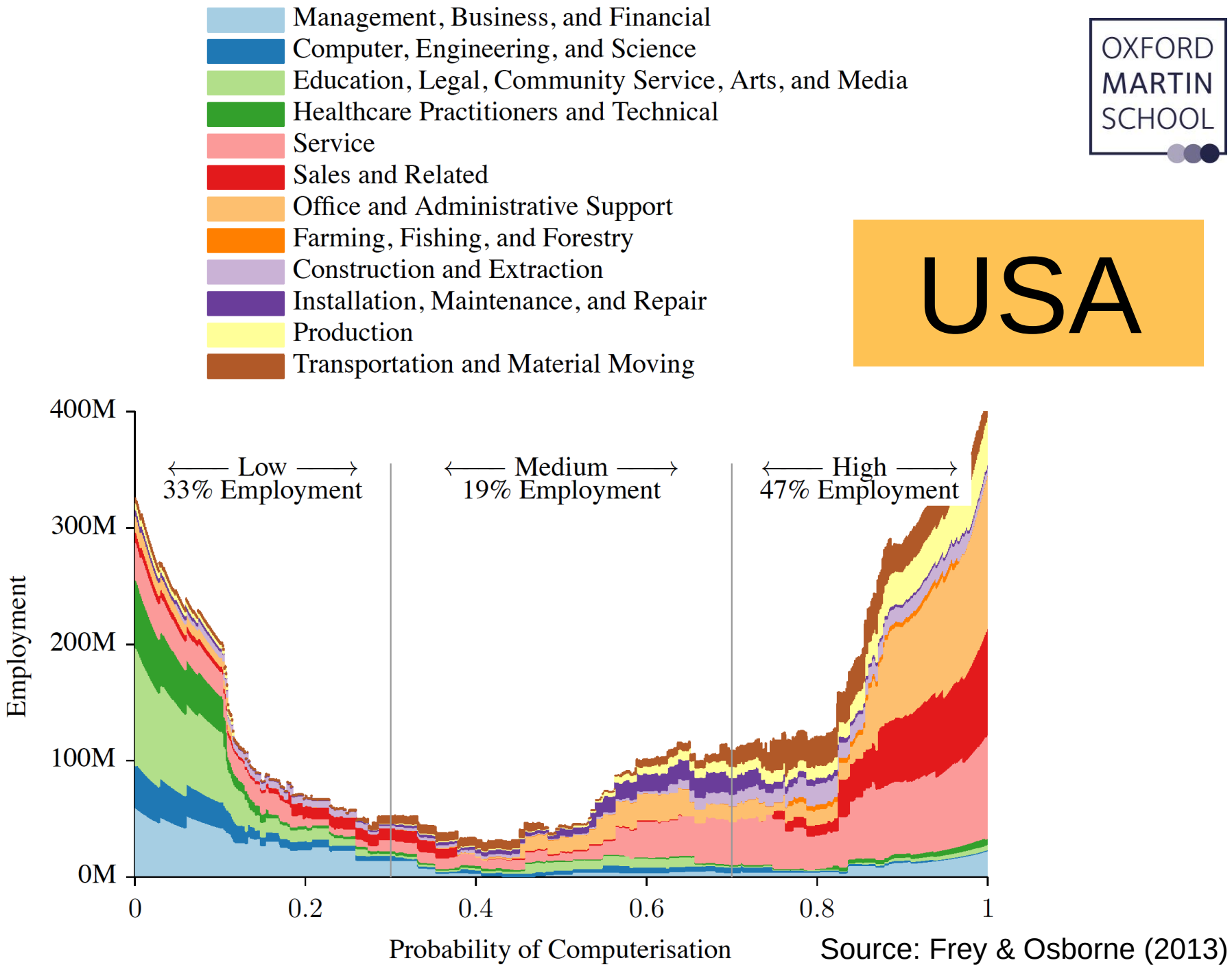
Creativity

Social intelligence

Perception and manipulation




Management, Business, and Financial
Computer, Engineering, and Science
Education, Legal, Community Service, Arts, and Media
Healthcare Practitioners and Technical
Service
Sales and Related
Office and Administrative Support
Farming, Fishing, and Forestry
Construction and Extraction
Installation, Maintenance, and Repair
Production
Transportation and Material Moving
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USA
400M
300M
200M
100M
0M
Employment
Low
33% Employment
Medium
19% Employment
High
47% Employment
0
0.2
0.4
0.6
0.8
1
Probability of Computerisation
Source: Frey & Osborne (2013)

Who gains from technological progress?

The exposure of low-income jobs

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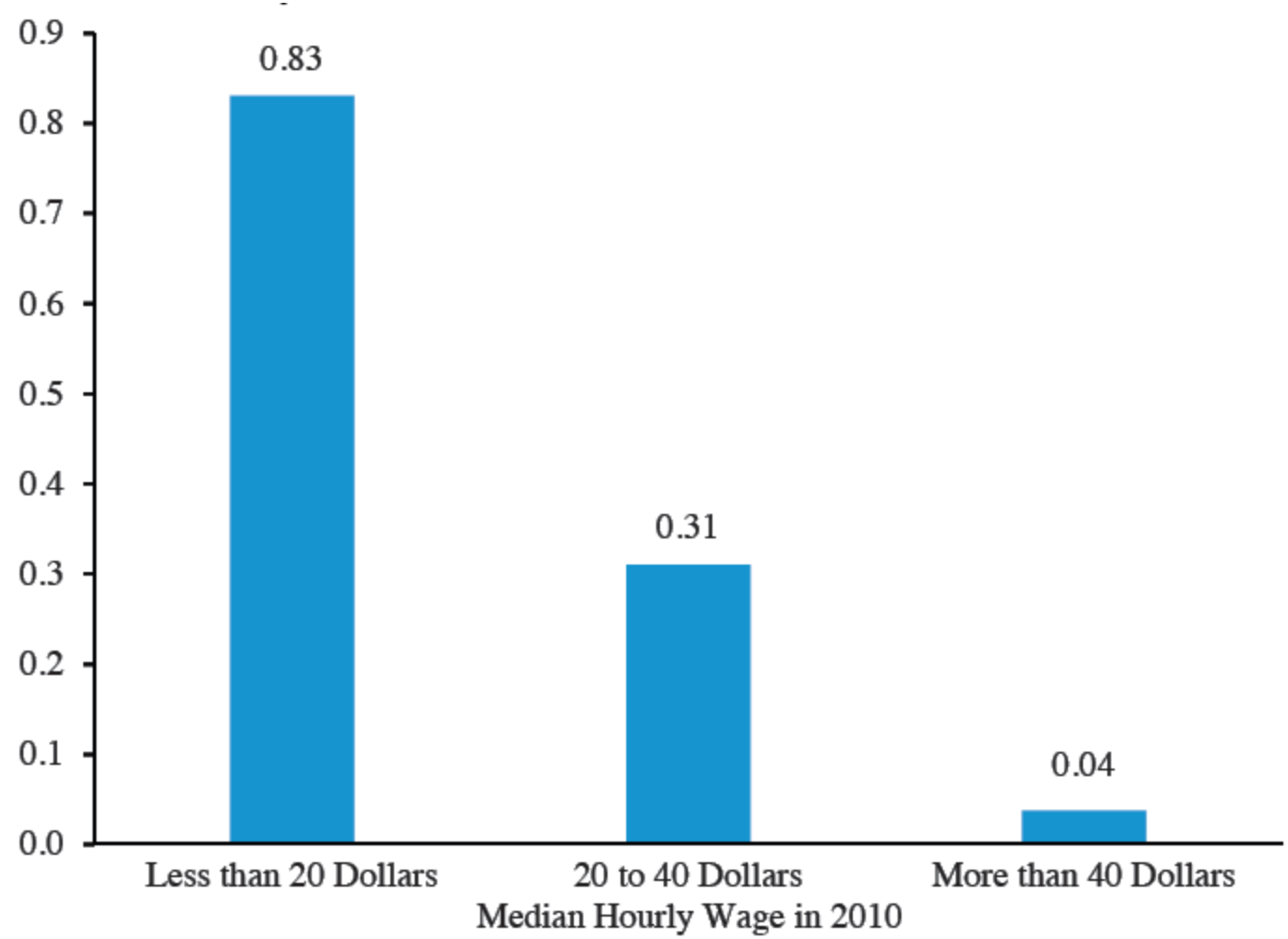

Source: Bureau of Labor Statistics; Frey and Osborne (2013); CEA calculations.

Who gains from technological progress?

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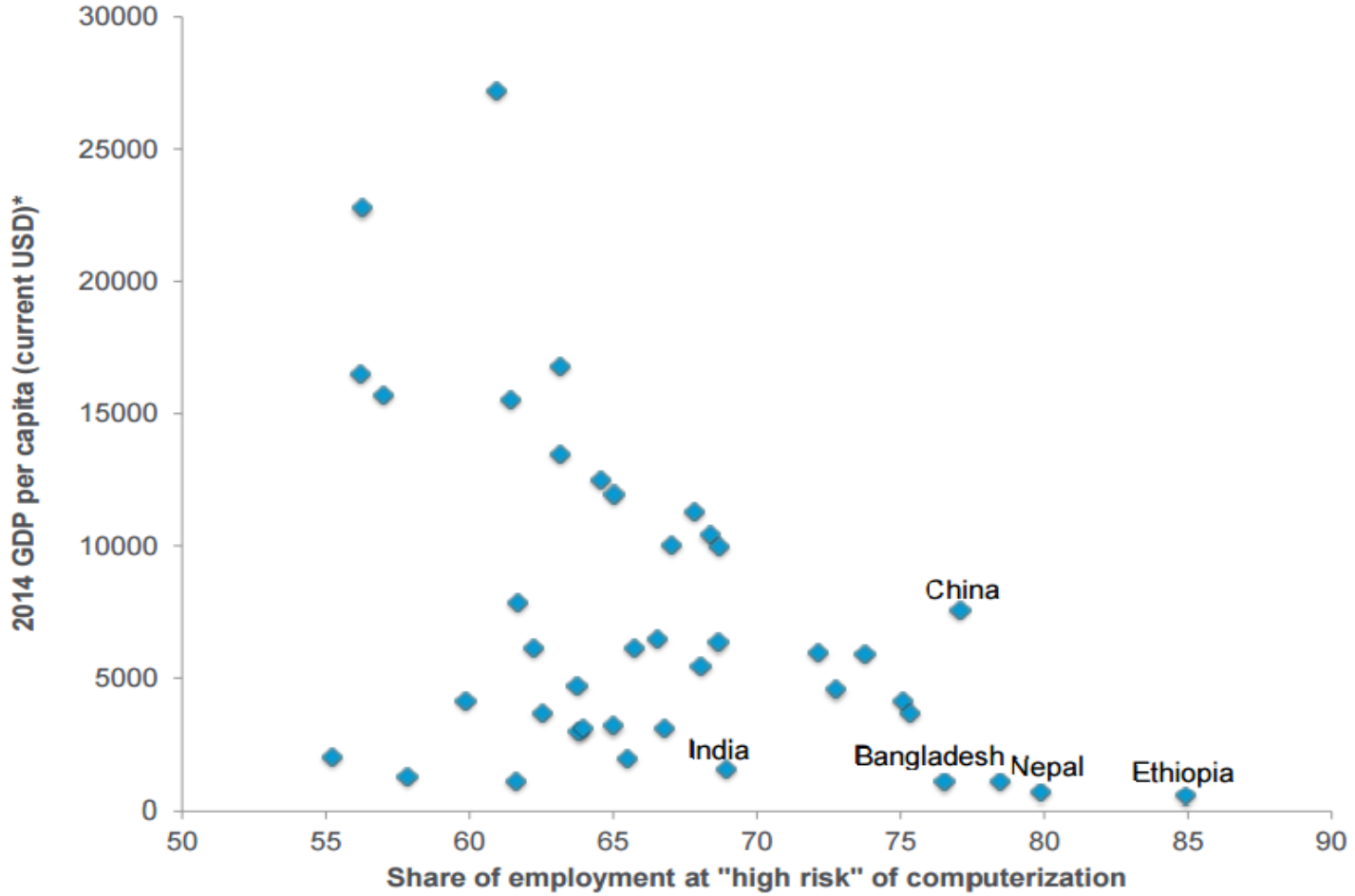
The exposure of low-income countries



Source: World Bank Development Report 2016; World Bank national accounts data.
Note: For Angola and Malta 2013 GDP per capita figures were used, Citi Research

The falling costs of automation

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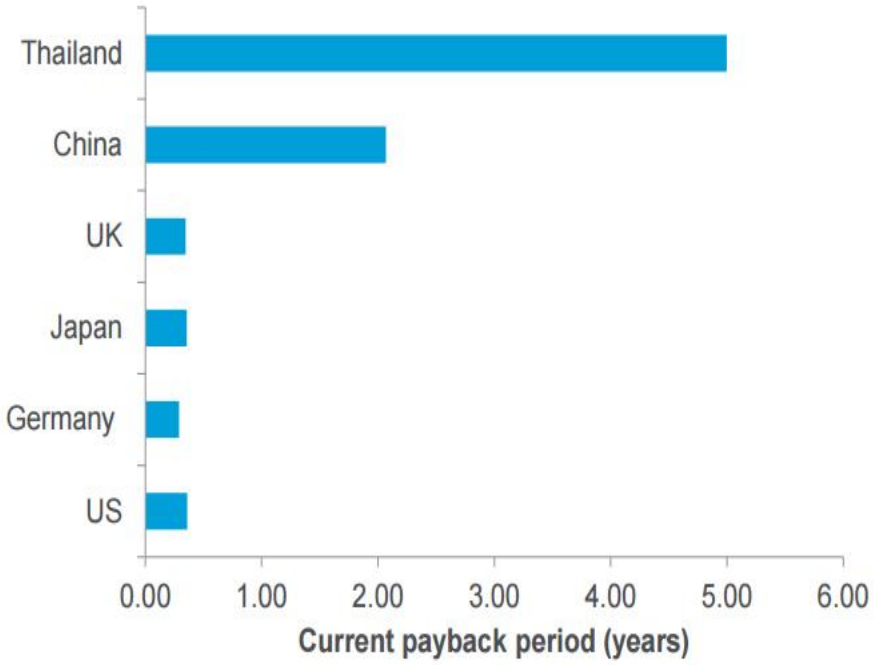

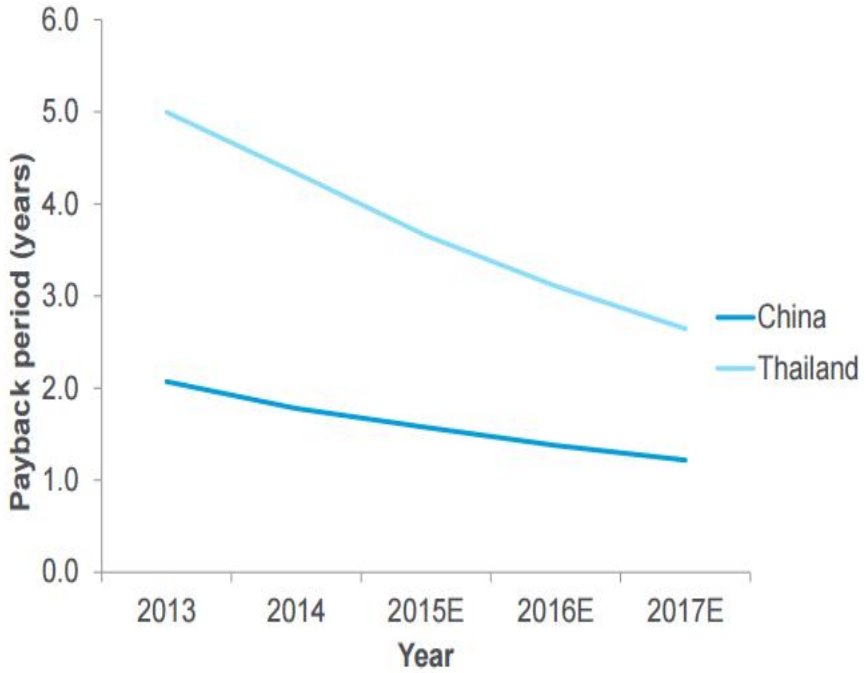

Source: Citi Research

The payback period is based on the cost of the robot system, average wages for metal manufacturing (for China and Thailand average manufacturing wages were used) and replacement labour based on 2 shifts. The costs also take into account a 5% additional potential savings through reduced staff welfare costs, optimised energy consumption, increased throughput and reduced wages.

Who gains from technological progress?

The exposure of low-income countries

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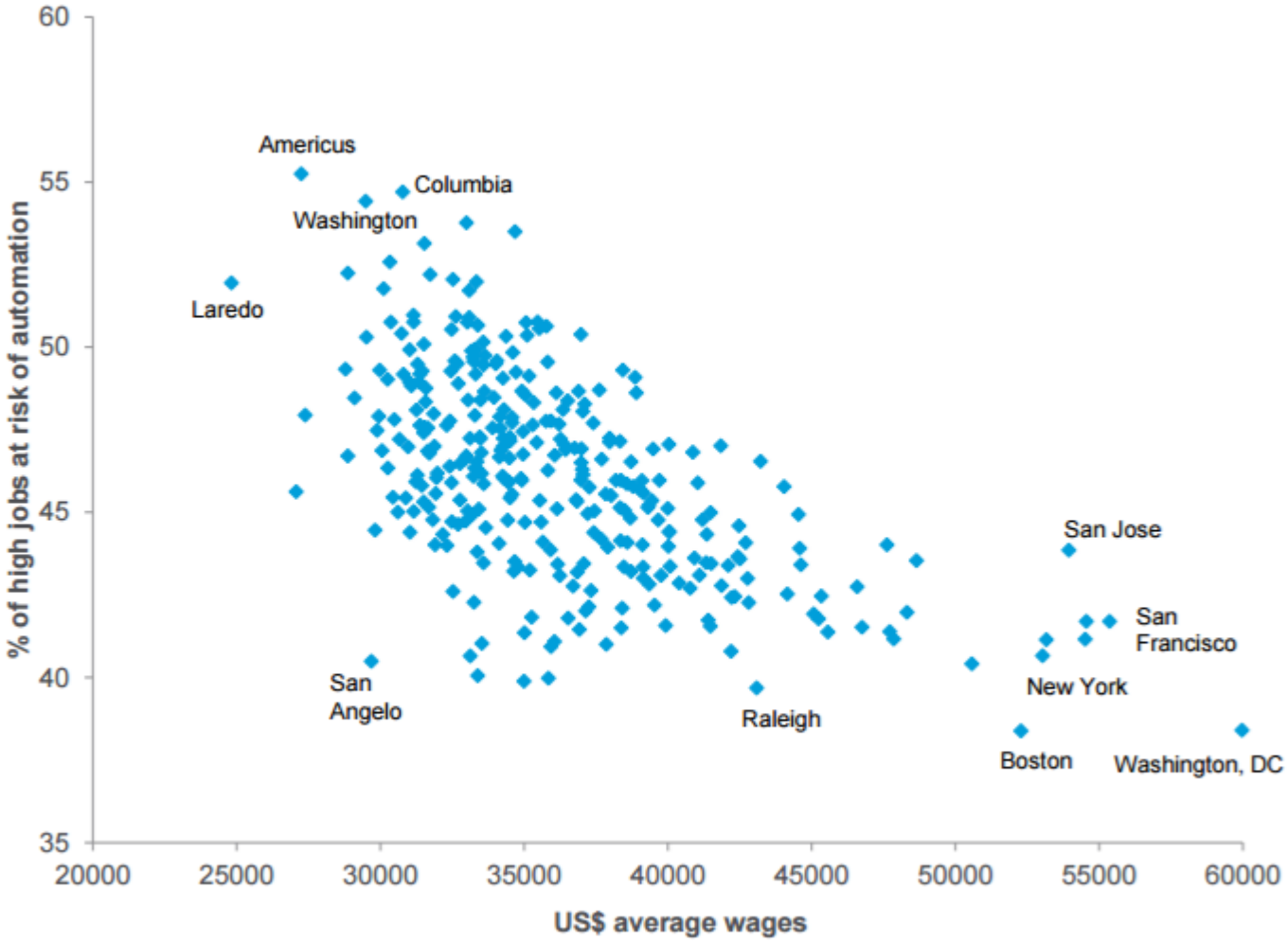
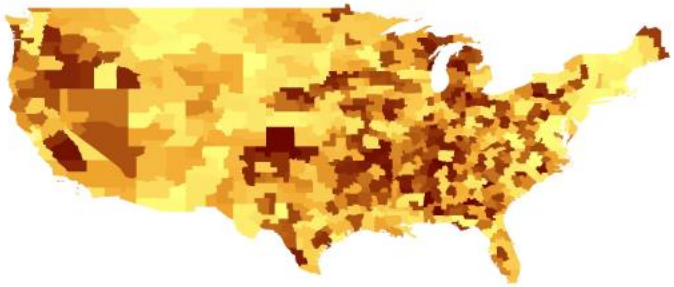
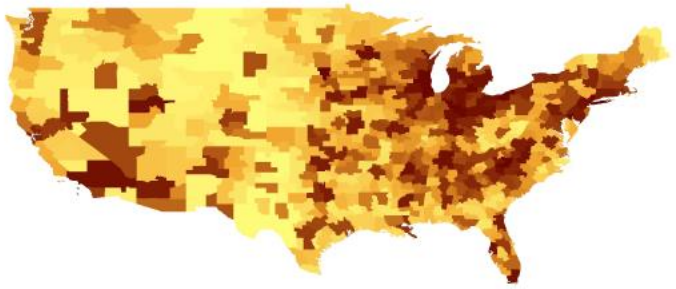


Who gains from technological progress?

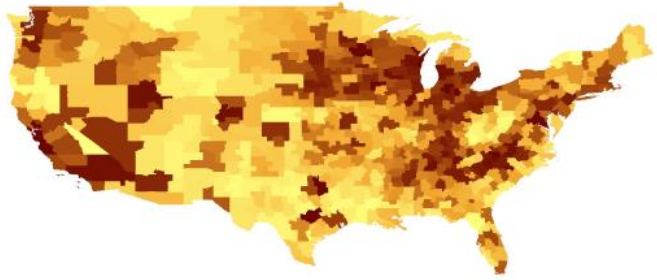
Past and present patterns of automation



Exposure to automation



Routine share

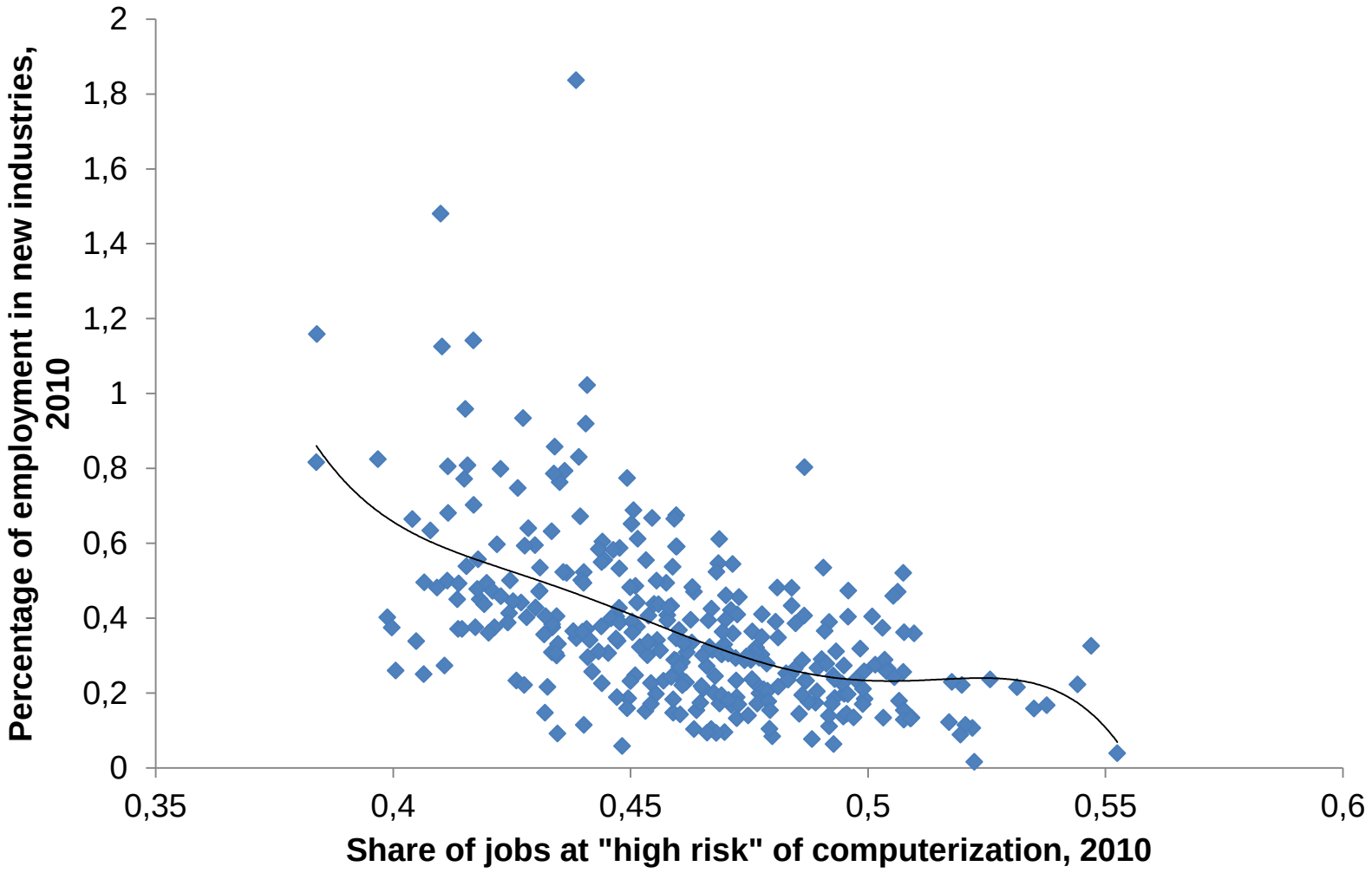


Exposure to offshoring

Source: Berger & Frey (2014)

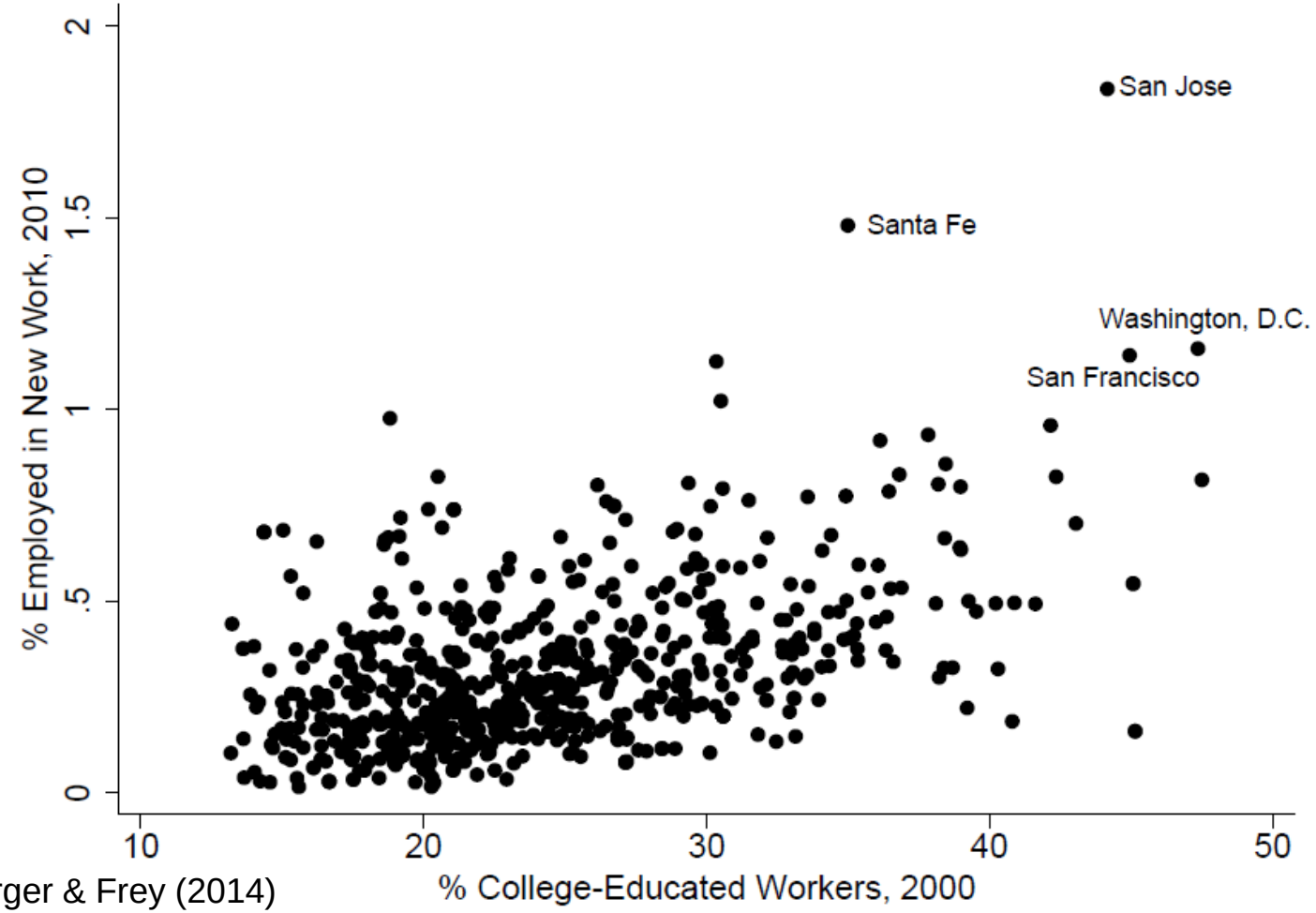
Who gains from technological progress?

The growing regional divide



Who gains from technological progress?

New jobs cluster in skilled cities…



Source: Berger & Frey (2014)

… and they have a multiplier of around 5 (Moretti, 2010)

Who gains from technological progress?

New jobs, but only for the highly skilled

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

0.5 % of the US workforce is employed in new industries created since 2000

Source: Berger & Frey (2015)

Summary

- Automation has (and is likely to continue to have) negative impacts on certain skill groups
- The impacts of automation are seemingly distinct from those of trade (although hard to disentangle)
- There is so far little evidence on that automation has had any impact on the aggregate demand for jobs
- There is pervasive evidence that technology has had impacts on the growing regional divide
- Technology has seemingly not been a key driver of job creation directly (although indirectly)

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