

The Economic Ramifications of Future Trends in Technology

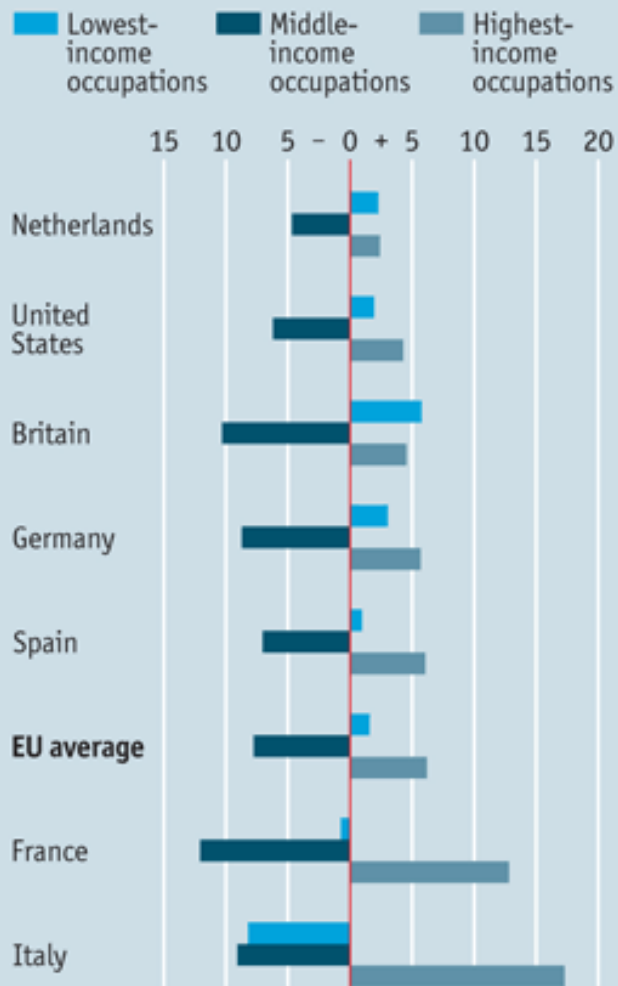
UNITED NATIONS COMMISSION ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT
2014-2015 Inter-sessional Panel, Geneva

Carl Benedikt Frey



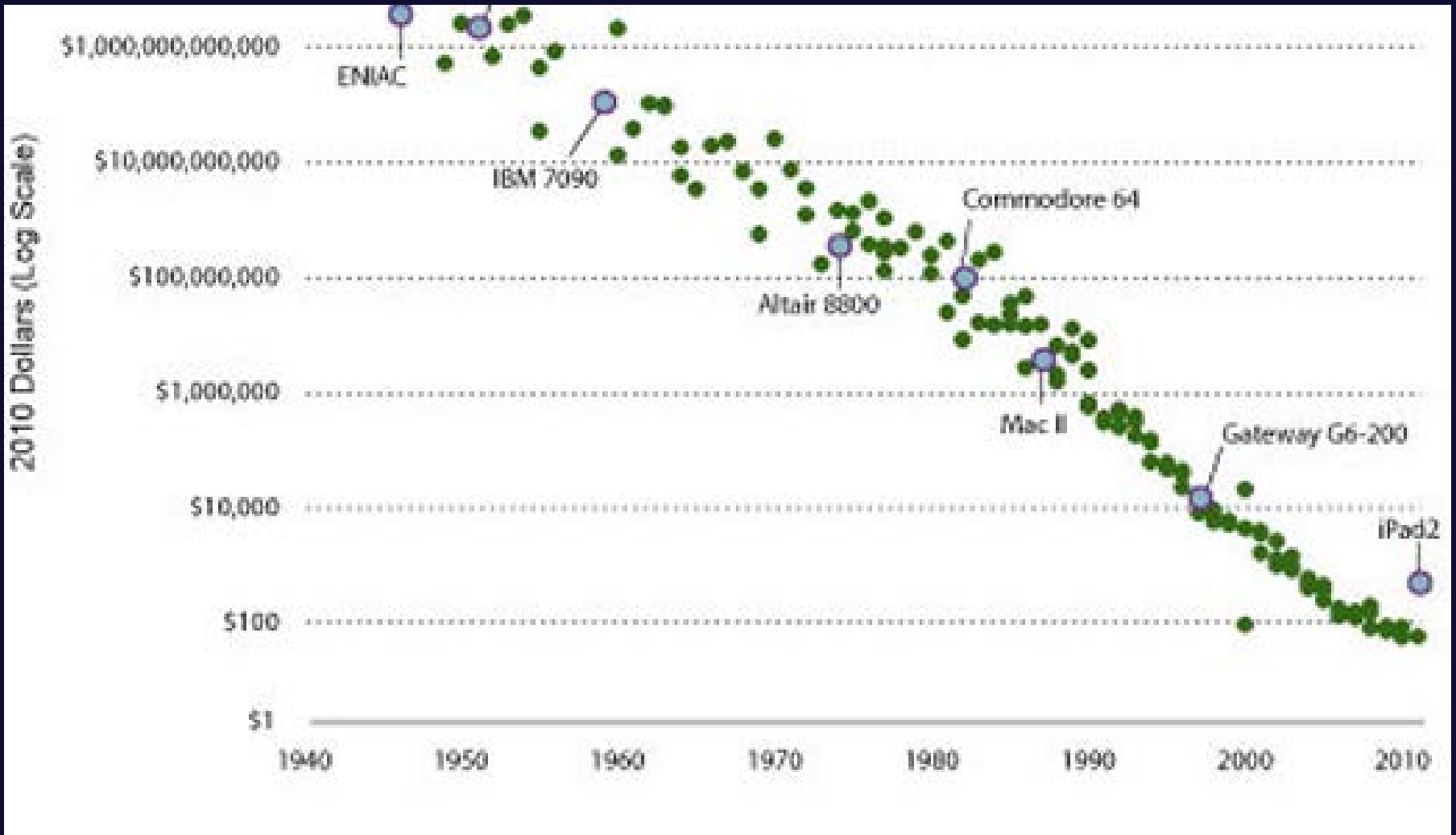
The disappearing middle

Share of total hours worked, change between 1993 and 2006, percentage points

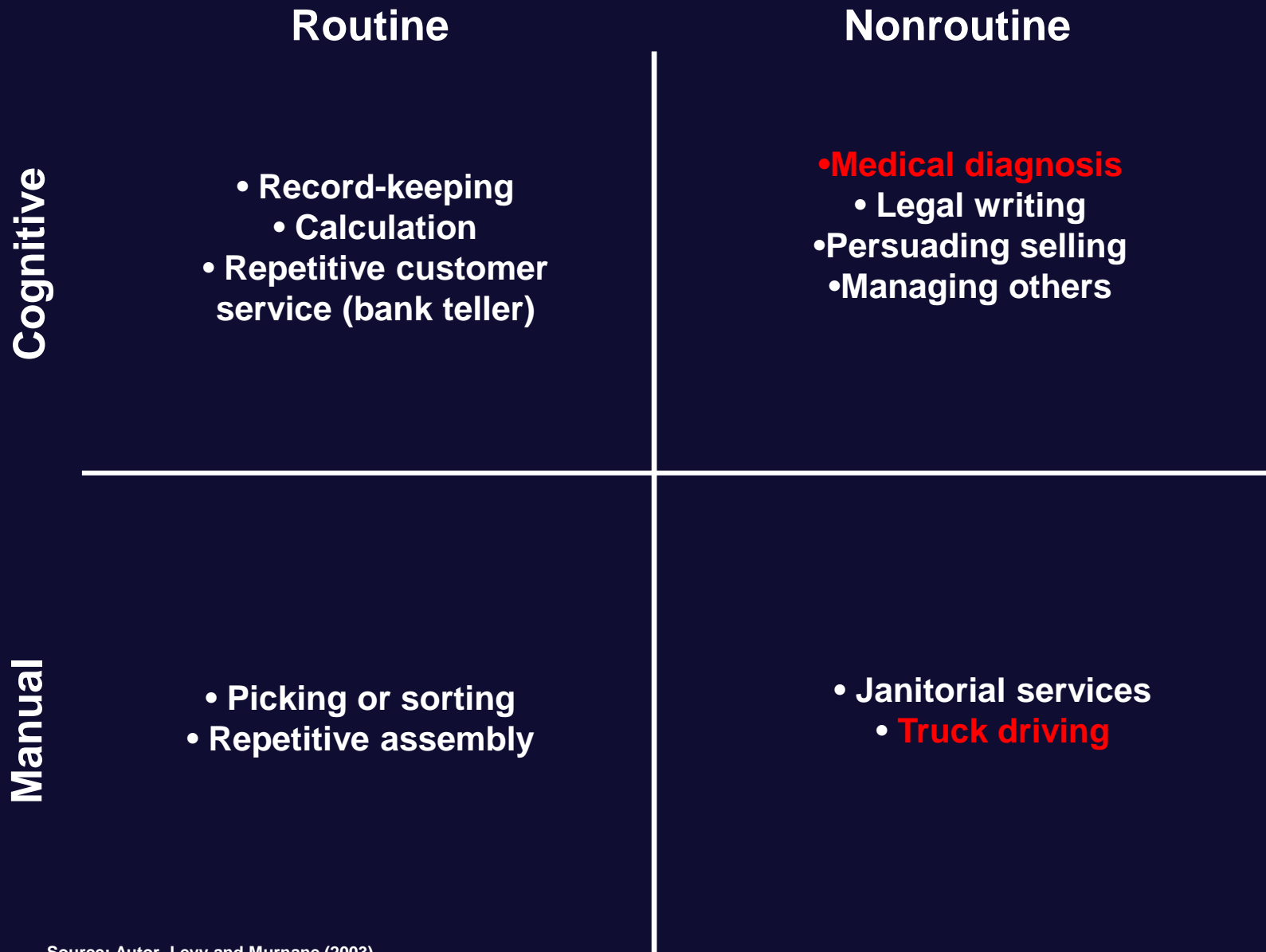


Source: "Job Polarisation in Europe", by Maarten Goos, Alan Manning & Anna Salomons, *American Economic Review*, 2009

With the declining costs of computing, **computers are increasingly a cheaper alternative** to human workers.



The Expanding Scope of Computerization



A consequence of cheaper computing (and sensing) is that we are entering the age of **big data**.

All printed material
in the world

200 petabytes
(2×10^{17} bytes)

All words ever spoken by
human beings

5 exabytes
(5×10^{18} bytes)

Total stored information in
1999

12 exabytes
(1×10^{19} bytes)

**Predicted internet traffic in
2015**

**960 exabytes
(1×10^{21} bytes)**



Big data is leading to the automation of jobs that were traditionally seen as secure from automation.

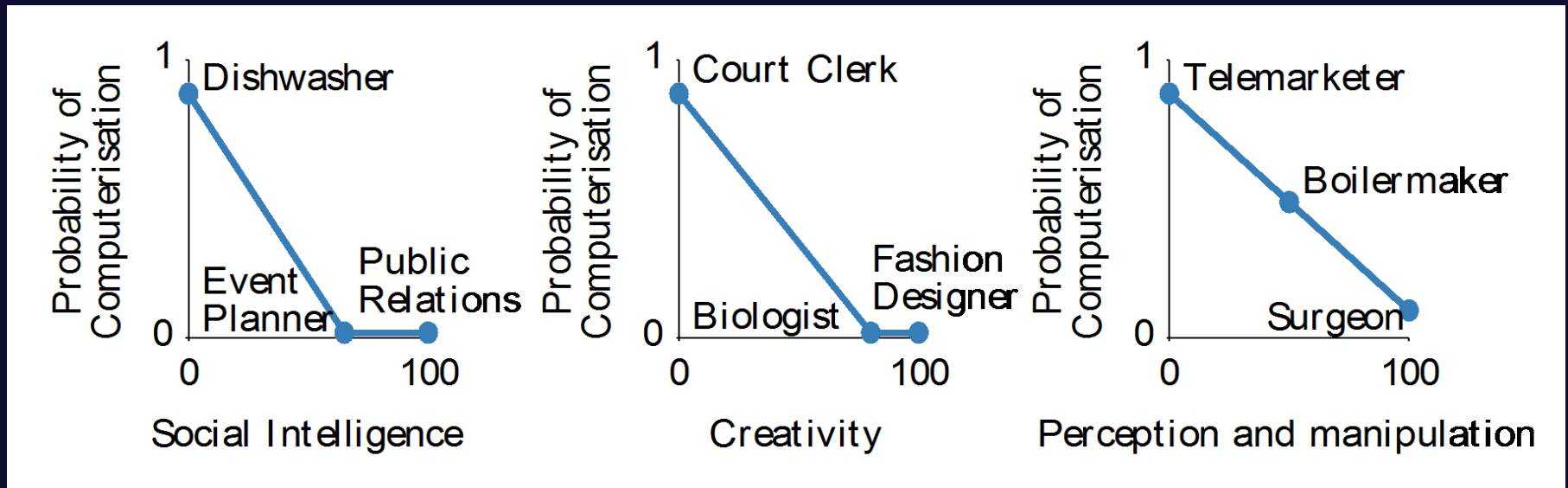


Levy and Murnane (2004): “executing a left turn against oncoming traffic involves so many factors that it is **hard to imagine** discovering the set of rules that can **replicate a driver's behaviour**”.



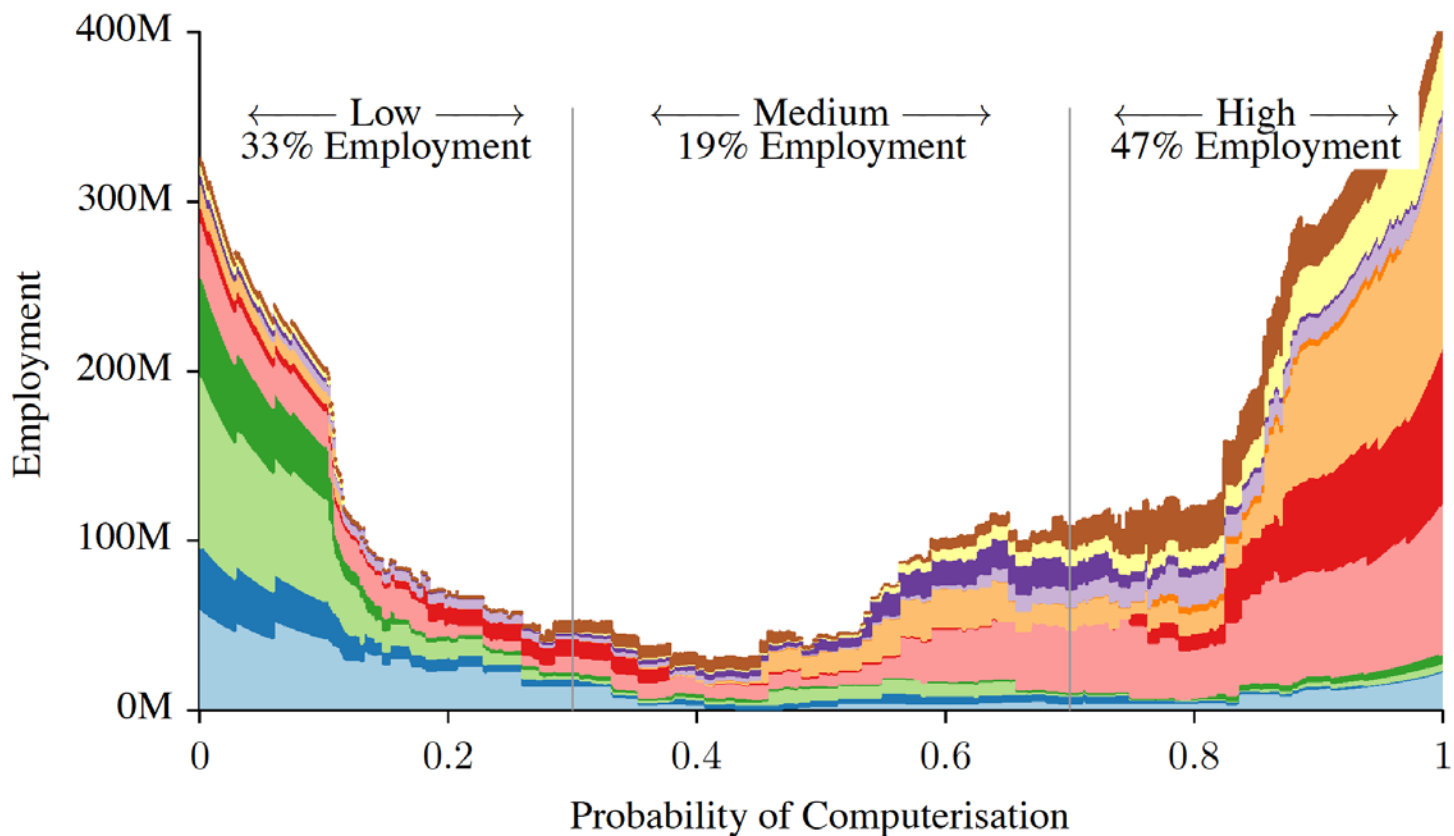
In 2012, Nevada issued a driving license to a **fully autonomous Google car**.

We expect social intelligence, creativity and perception and manipulation to be **bottlenecks to computerisation**.

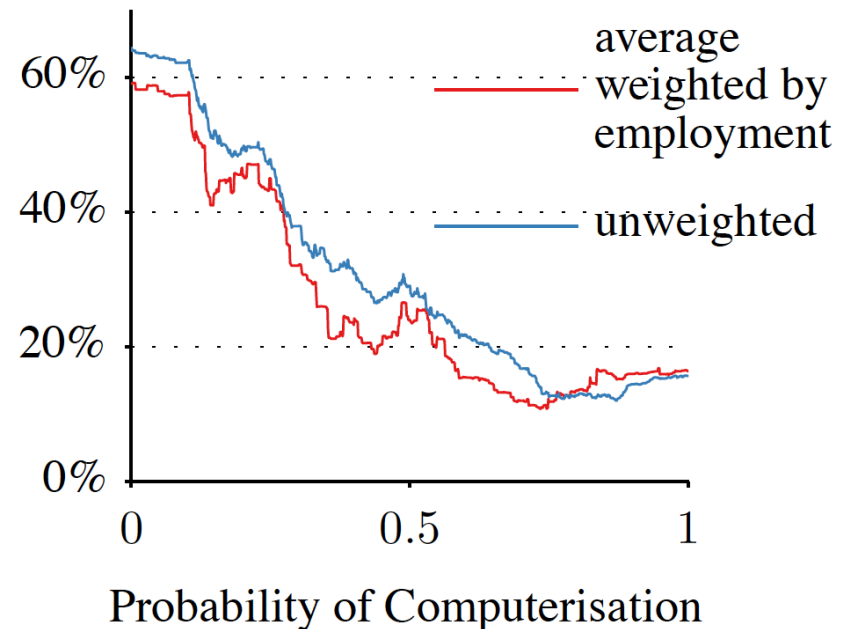
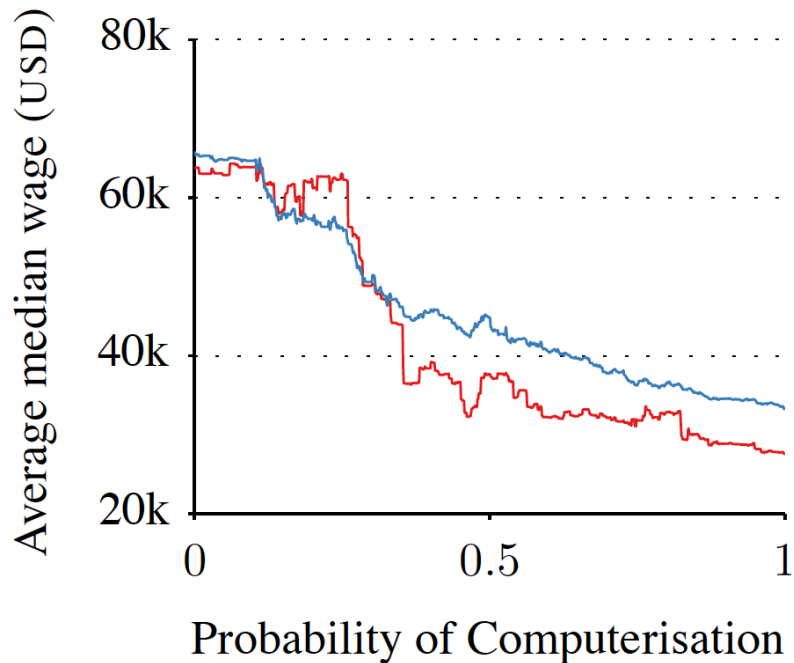


We used a **dataset of 702 occupations**, for which we have employment, income and occupation features related to automatability (e.g. finger dexterity and persuasion).

- 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



We predict that **high-skilled jobs are relatively resistant** to technological unemployment.



The Computer Revolution and New Work

1990		2000	
Top-10 Three-Digit Occupations	% New Titles	Top-10 Three-Digit Occupations	% New Titles
Computer systems analysts and scientists	80,0	Network Systems and Data Communication Analysts	96,7
Radiologic technicians	70,0	Computer Support Specialists	86,4
Pharmacists	66,7	Network and Computer Systems Administrators	83,3
Tool programmers, numerical control	66,7	Computer Software Engineers	80,0
Parking lot attendants	66,7	Database Administrators	76,9
Engineers: Nuclear	60,0	Computer and Information Systems Managers	76,5
Peripheral equipment operators	50,0	Radiation Therapists	75,0
Health record technologists and technicians	50,0	Computer Programmers	59,1
Urban planners	50,0	Logisticians	50,0
Archivists and curators	47,1	Computer Hardware Engineers	50,0

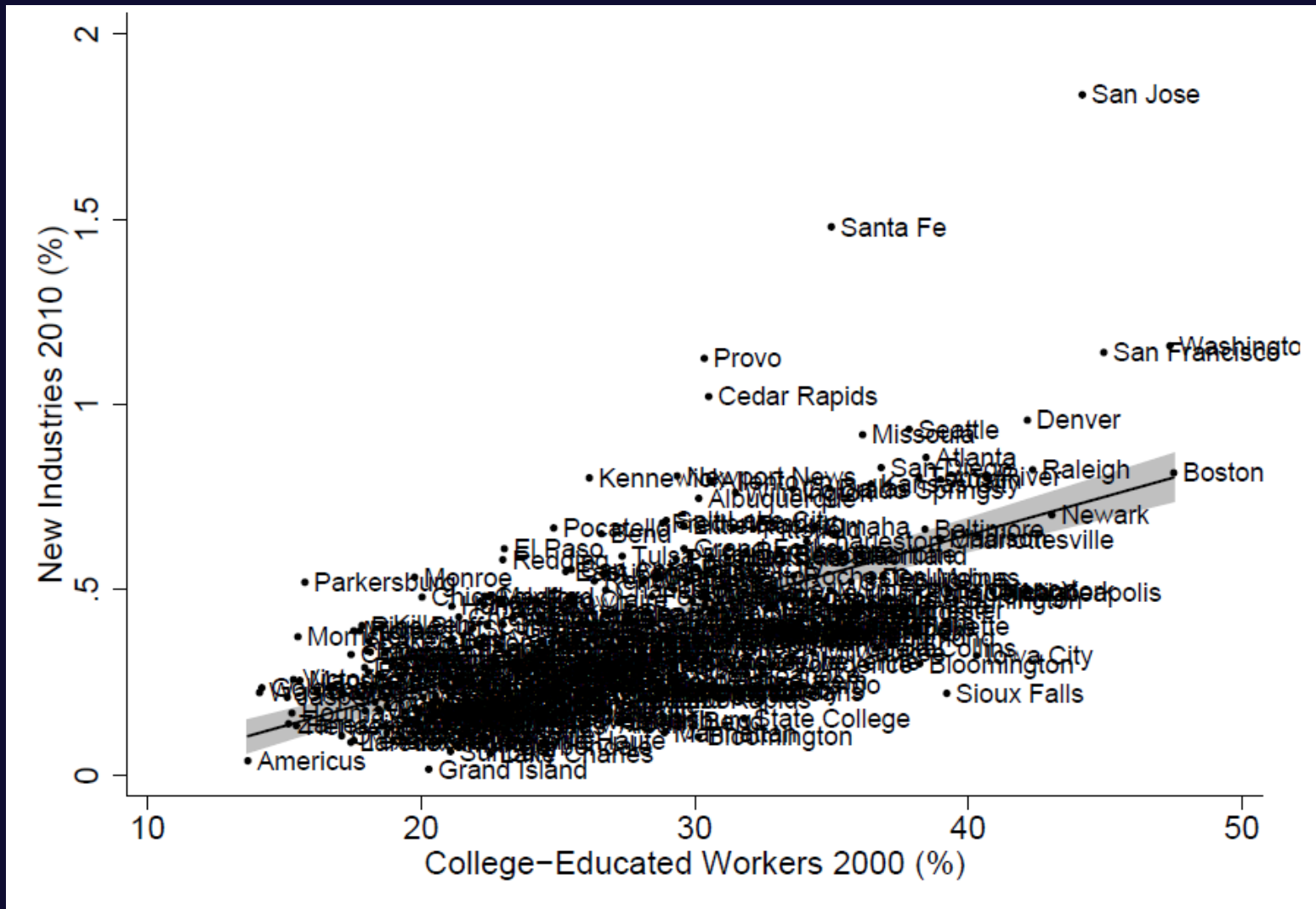
Source: Berger & Frey “Technology Shocks and Urban Evolutions: Did the Computer Revolution Shift the Fortunes of US Cities”

New Industries of the 2000s

0.5 % of the US workforce is employed in new industries

Industry (3-digit code) (1)	New Industry Titles (%) (2)	% of U.S. Empl. (3)	College (%) (4)	Avg. Wage (\$) (5)	Examples of New Titles (6)
Internet publishing and broadcasting and web search portals (6672)	85.7%	0.06%	69.6%	\$81138	Internet video broadcast sites Social Networking Service Internet game sites
Electronic auctions (5591)	66.6%	0.01%	52.2%	\$47257	Internet auction sites
Computer systems design and related services (7380)	7.1%	1.34%	69.9%	\$80324	Computer programming service Logistics services Web page designing, exc. internet
<i>Avg. Across U.S. Industries</i>	1.27%	-	28.6%	\$44333	-

Labour Force Education and New Industries



Source: Berger & Frey "Industrial Renewal in the 21st Century: Evidence from US Cities