The Evolving Role of ICT in the Economy

Global Trade and Innovation Policy Alliance

Mexico City

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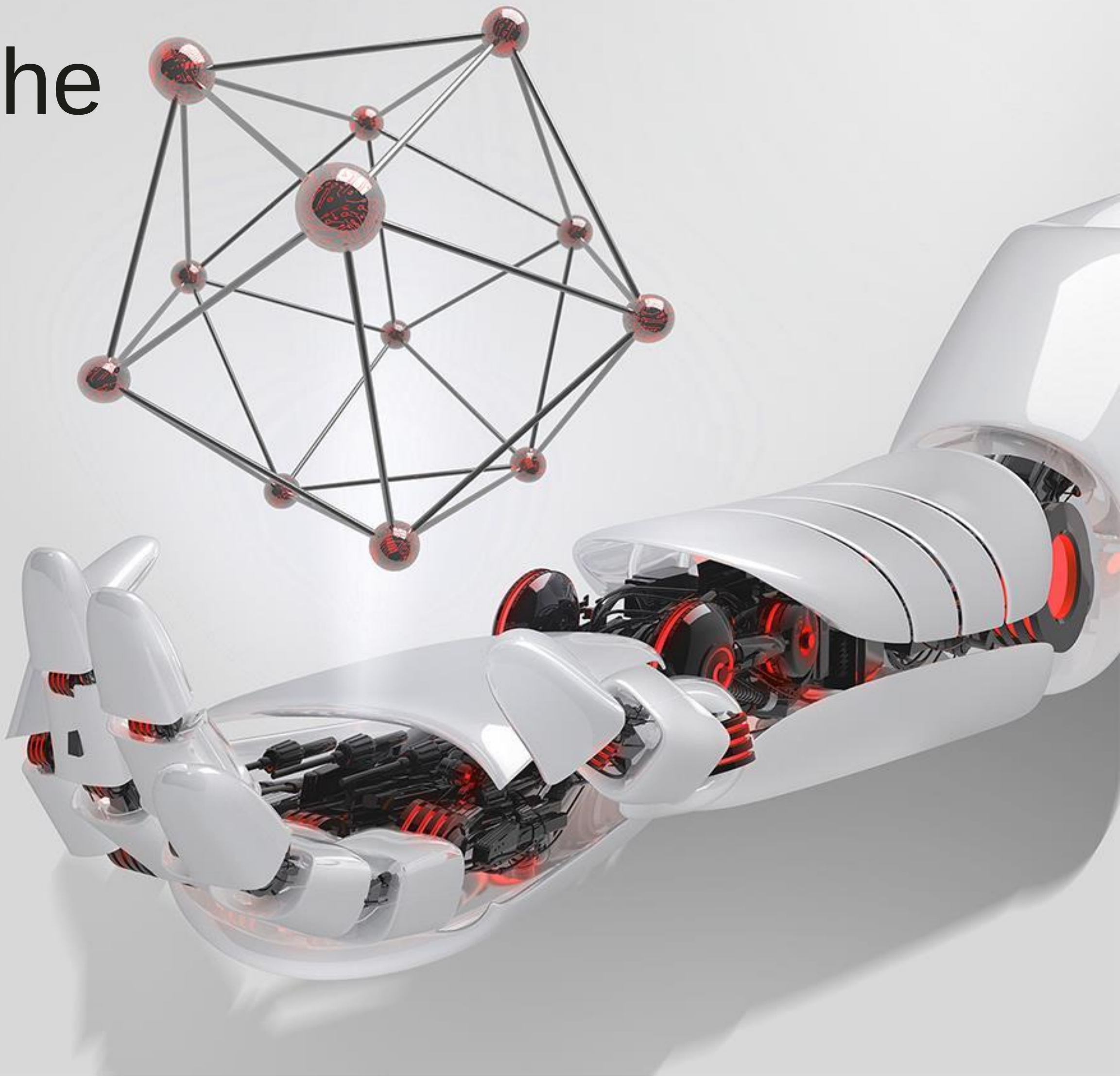

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Three questions from Huawei Technologies to the London School of Economics and Political Science

1. If information communication technologies are everywhere, why the low productivity growth (return of the Solow Paradox)?

2. Can we (better) measure the power of ideas?

3. Automation and the future of work – will the robots take our jobs?

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

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Personalized mobile computing is ubiquitous

St Peter's Square, The Vatican comparison 2005 and 2013 (NBC News)

Passengers look at smartphones on a subway train on April 6, 2017 in Chengdu, China.

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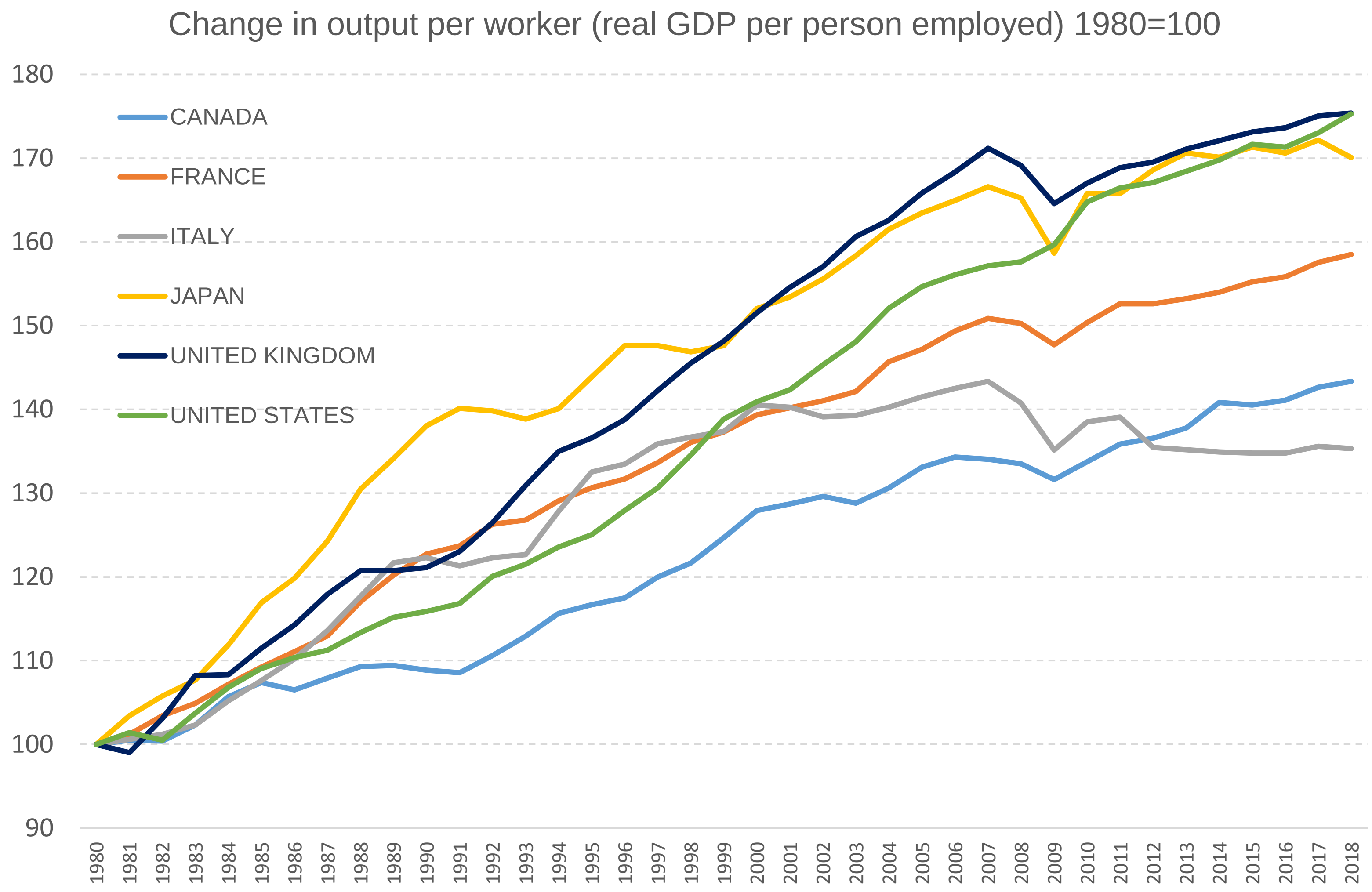
The productivity puzzle – in charts



	2007	2018	Change +/-
CANADA	134	143	9
FRANCE	151	159	8
ITALY	143	135	-8
JAPAN	167	170	3
UNITED KINGDOM	171	175	4
UNITED STATES	157	175	18

	1995	2007	Change +/-
CANADA	117	134	17
FRANCE	131	151	20
ITALY	133	143	10
JAPAN	144	167	23
UNITED KINGDOM	137	171	34
UNITED STATES	125	157	32

Source: Economist Intelligence Unit Country Data; National Statistical Offices; Huawei calculations

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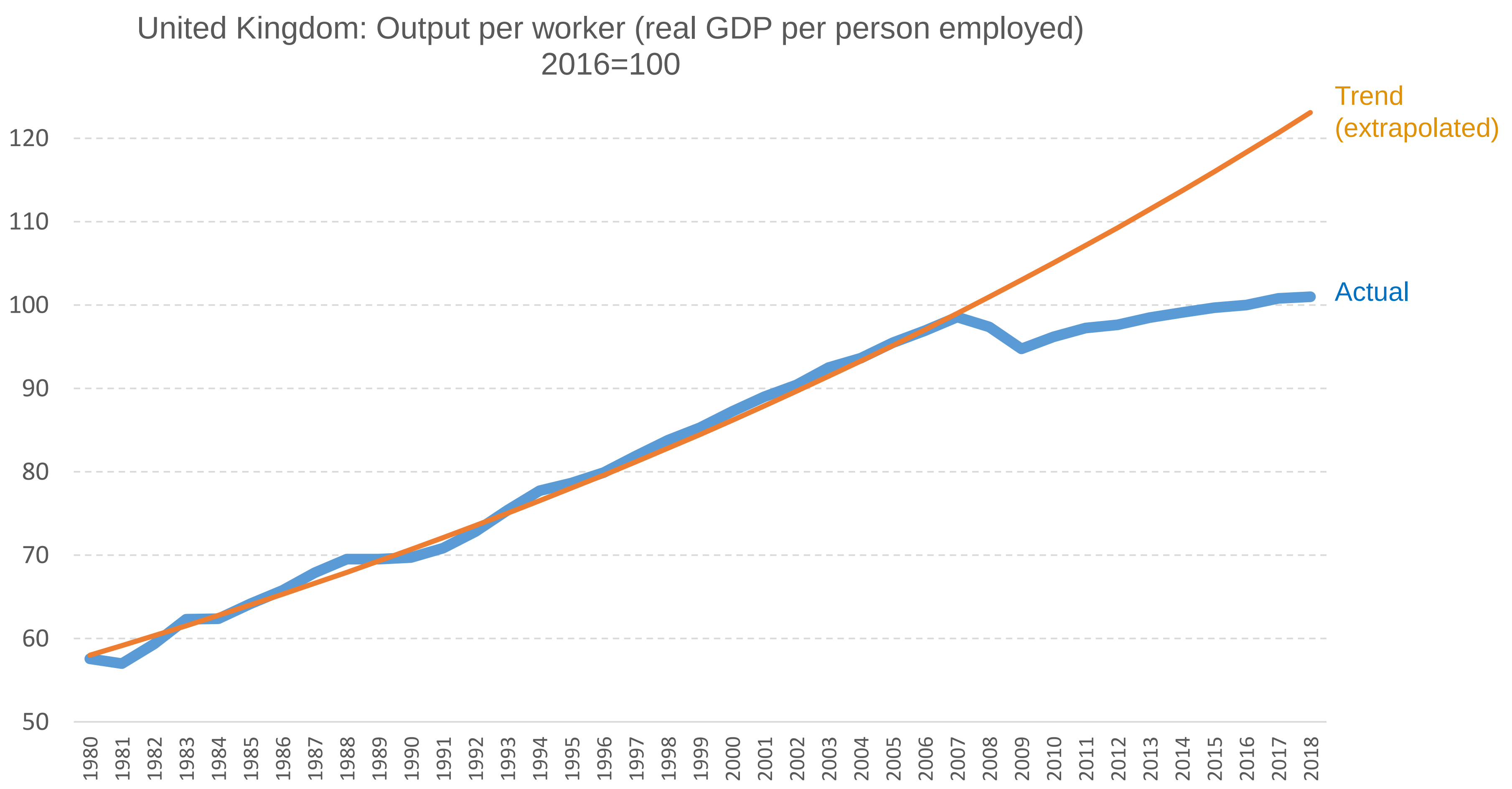
The productivity puzzle – in charts

The productivity slowdown has been particularly marked in some countries



Source: Economist Intelligence Unit Country Data; Huawei calculations

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ICT – not that new

- ICT is still perceived as a ‘new’ technology in most discussions.

- But the history of ICT as a technology in general usage is now long.

- PCs first emerged into the mass market in the early 1980s and the Internet now has a 25 year history.

An evolving role?

➢We therefore need to frame ICT as an evolving technology with shifting impacts.

➢This stems from its character as a General Purpose Technology (GPT).

➢The ingredients are (1) rapid change; (2) pervasive application; and (3) acting as a platform for multiple innovations (‘swarms’).

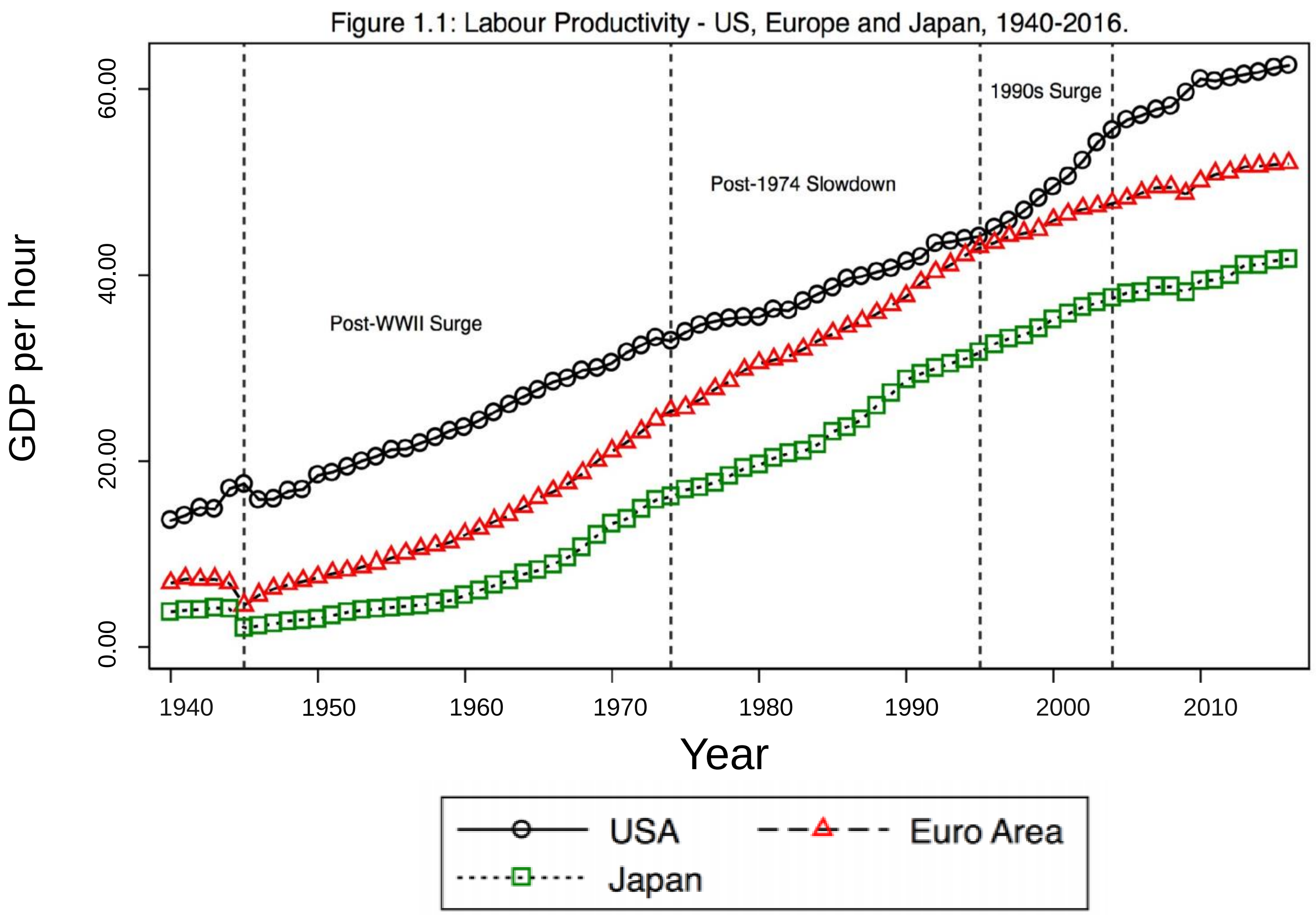
General purpose in practice

- This ‘general purpose’ character has become clearer with the passing of time.

- Think of this as ‘short’ and ‘long’ cycles in the impact of technology.

- In terms of the short cycle, a puzzling productivity growth slowdown was finally broken by the surge of the 1990s...

Post-war labour productivity



Notes: Data from Bergeaud et al (2016) Long-Term Productivity Database. GDP Per Hour calculated as PPP-adjusted in 2010 US dollars (thousands)

ICT contributed significantly to the productivity spurt in 1995 to 2004

- The ICT industry has played an important role in shaping the productivity pattern. **ICT capital investment promotes TFP growth and further drives productivity growth. From 1995 to 2004, ICT contributed as high as 49% of productivity growth.**
- **Capital investment:** In the period of significant productivity increase from 1995 to 2004, the contribution rate of ICT investment to productivity growth increased from 0.41 pct to 0.78 pct, and **the proportion of ICT capital contribution of total capital contribution was 64% in 2004.** More specifically, **hardware** (0.18 - > 0.38 pct) and **software** (0.16 -> 0.27 pct) contribution rates both **almost doubled.**
- **TFP:** The average contribution rate of ICT advancement to TFP increased from 0.36 pct in 1974–1995 period to 0.72 pct in 1995–2004 period, and **the proportion of ICT contribution of all sectors' contribution was 44% in 2004.**

Total Factor Productivity (TFP) measures the rate of technological progress. It refers to the productivity growth brought by improvements in education, technical training, economies of scale, and organizational management, in addition to the growth generated by tangible factors of capital, labor, land, etc.

1974–2012 US Labour Productivity Growth (LSE)

Name (%)	1974–1995	1995–2004	2004–2012
(A) Growth of Labour Productivity	1.56	**3.06**	1.56
Capital Deepening	0.74	**1.22**	0.74
Labour Composition	0.26	0.22	0.34
TFP	0.56	**1.62**	0.48
(B) Capital Deepening Contributions			
ICT Capital (Total)	**0.41**	**0.78**	**0.36**
Computer hardware	0.18	0.38	0.12
Software	0.16	0.27	0.16
Communication Equipment	0.07	0.13	0.08
Non-ICT Capital Deepening	0.33	0.44	0.38
(C) TFP Contributions			
ICT Producing Sectors (Total)	**0.36**	**0.72**	**0.28**
Semi-conductors	0.09	0.37	0.14
Computer hardware	0.17	0.17	0.04
Software	0.06	0.1	0.08
Communication Equipment	0.05	0.07	0.02
Other Sectors (Total)	0.13	0.9	0.06

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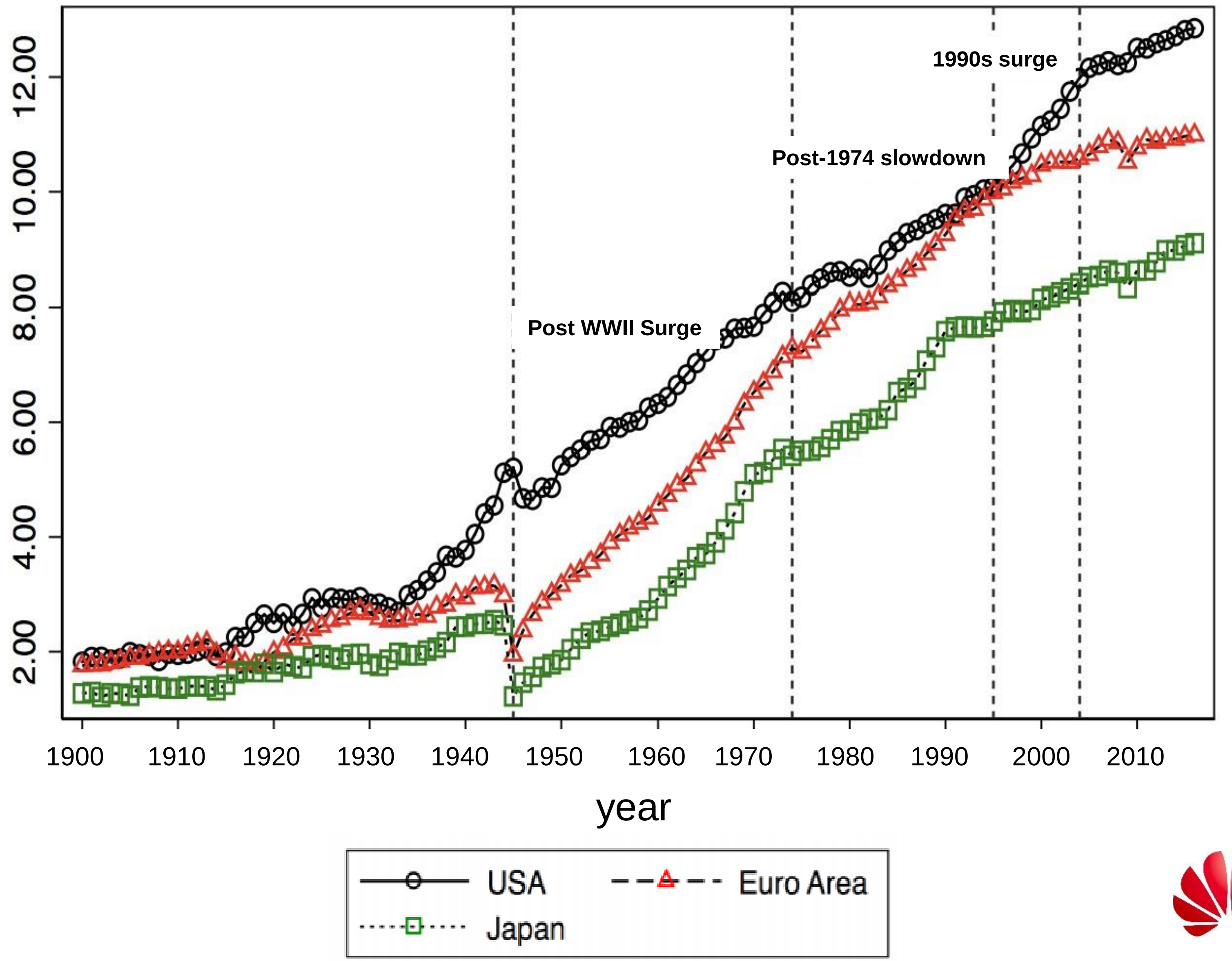
Notes: Based on information from Byrne et al. (2013). Rates measured as 100 times annual log difference for the indicated years. US non-farms business sector.

The long-run picture on TFP tells us that this has happened before...



Cycles versus mismeasurement?

- The big gains were made from PCs and initial commercialization of the internet.

- Mismeasurement (the ‘consumer surplus’ explanation) doesn’t stack up as a source of all the missing output.

- Our current era of mobile tech, fast broadband and social media doesn’t actually measure up to the radical 1990s.

The next ICT revolution?

- Current thinking (Brynjolffson and MacAfee 2014) points to another major ICT revolution based on AI and robotics.

- If you were in the prediction game you would bet on a productivity surge in 10-15 years.

In fact the timing of the ICT waves matches those of mass-scale electricity...

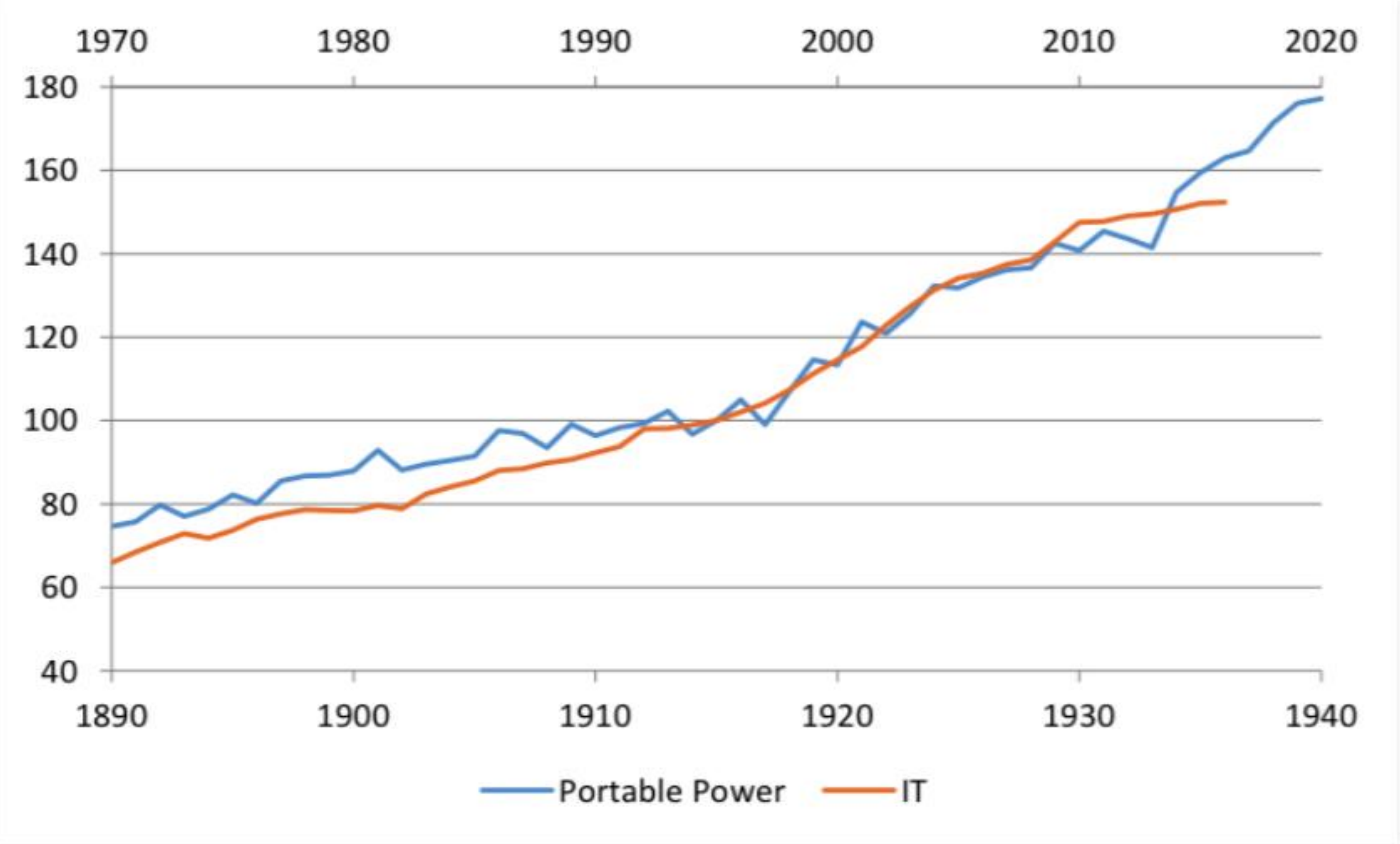


Figure 8. Labor Productivity Growth in the Portable Power and IT Eras

"The late-1990s acceleration was the (at least partial) resolution of the Solow Paradox.

We imagine that the late 1910s acceleration could have similarly answered some economist's query in 1910 as to why one sees electric motors and internal combustion engines everywhere but in the productivity statistics."

Source: Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics, Erik Brynjolfsson, Daniel Rock, Chad Syverson. in The Economics of Artificial Intelligence: An Agenda, Agrawal, Gans, and Goldfarb. 2019

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Knowledge spillovers (question 2)

- LSE team develop a new measure of the knowledge created by patents, based on the network of citations.

- The principles follow Google’s Page Rank algorithm and count the importance of indirect citations.

- This allows us to measure ‘high impact’ innovations that have the biggest multiplier effects on knowledge creation.

- ICT-related fields have an enduring knowledge premium...

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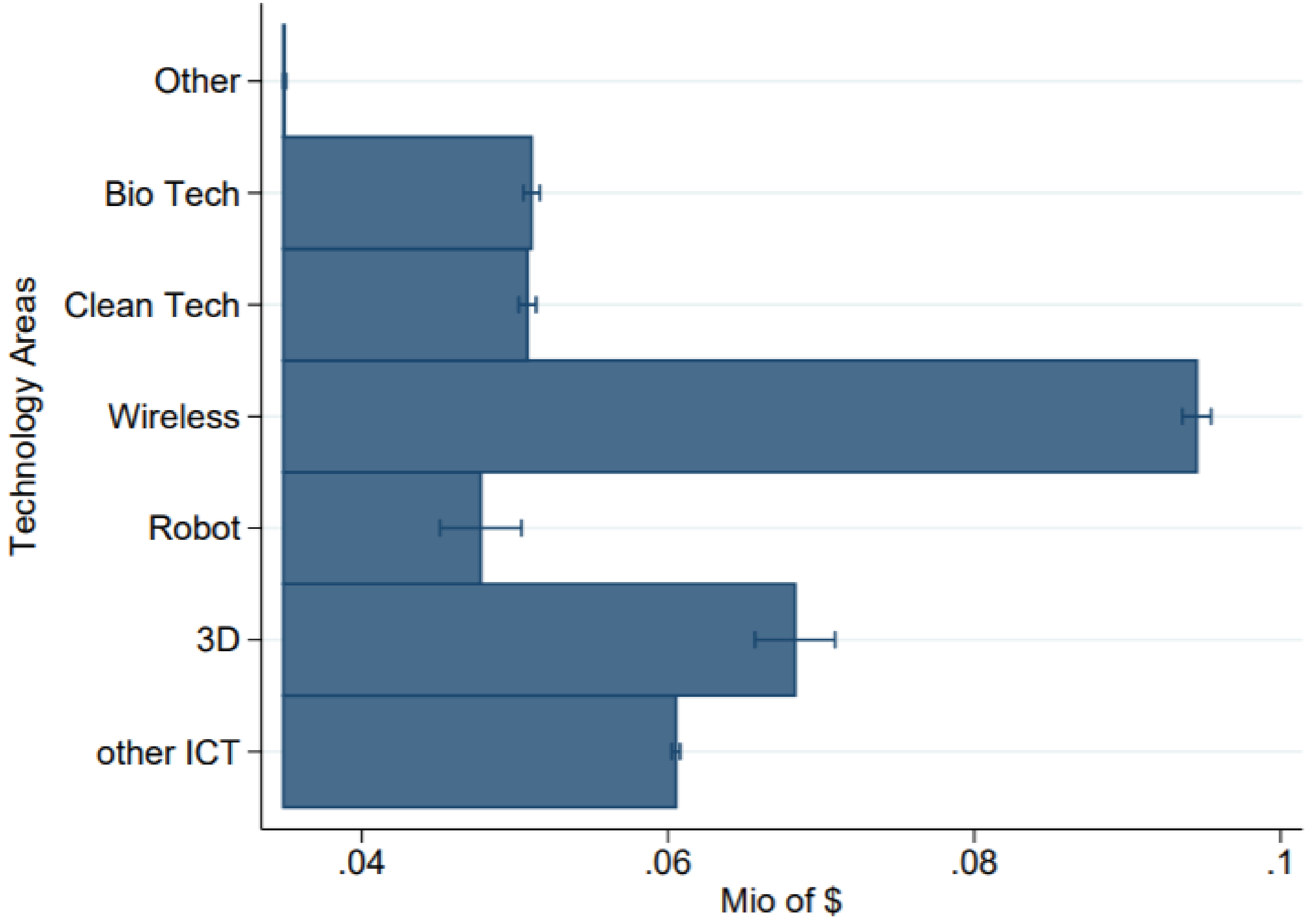
Patent rank estimated value across technology groups (1990-2010)



Notes: This figure reports Patent Rank measures of knowledge spillovers by technology area.
We report Patent rank measures based on the full global profile of citations relating to a given innovation.

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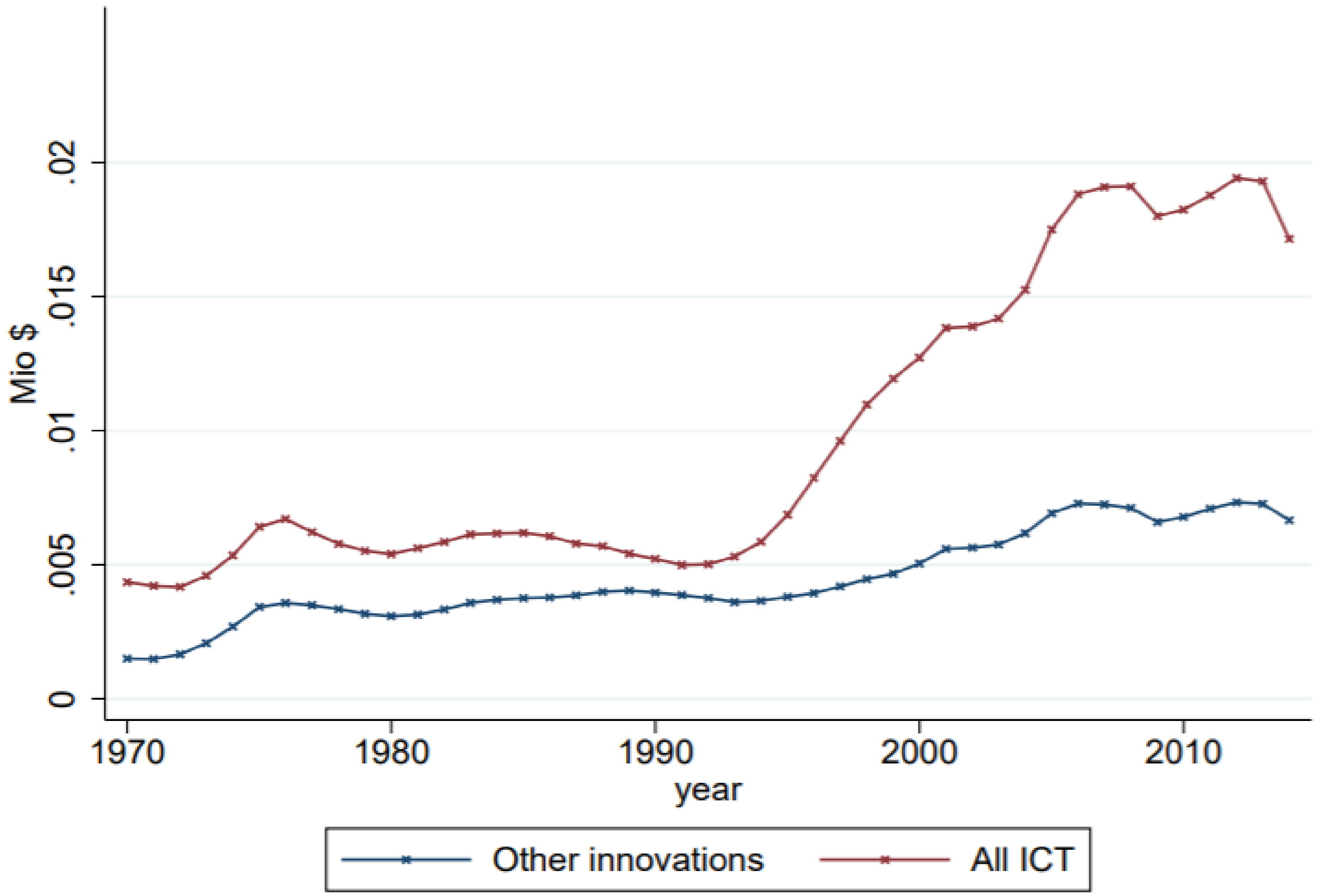
Average global spillovers (1970-2014)



Notes: Average per innovation is calculated according to the full global profile of citations relating to a given innovation. We report the time series for all ICT innovations across sub-categories versus the pooled set of all other innovations.

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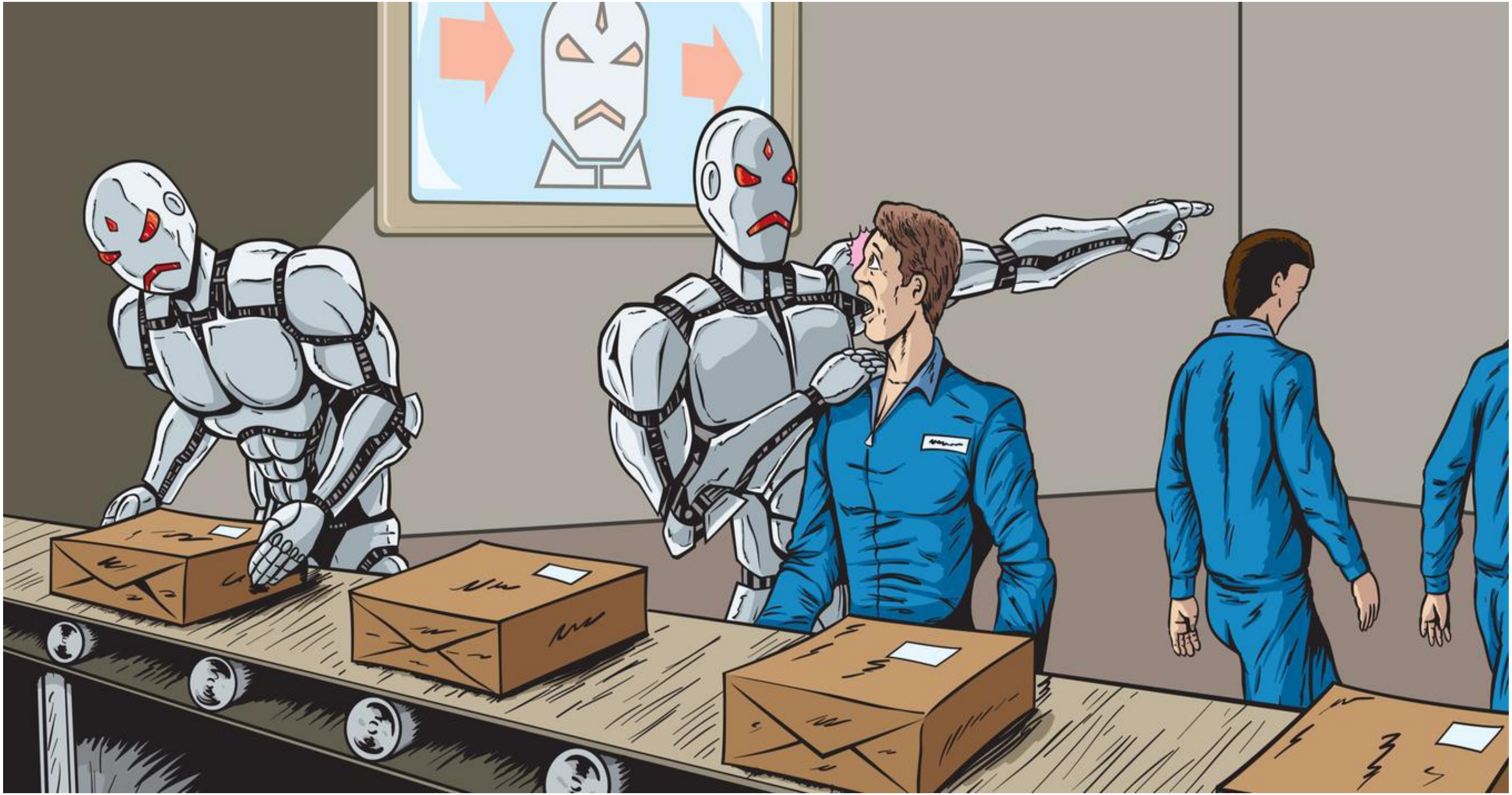


Automation anxiety (question 3)

- A survey from the Pew Research Center (2017) found that over 70% of American adults are "worried" by the prospect of robots performing more varieties of jobs and 67% are also concerned about the use of algorithms in evaluating and hiring job candidates.
- The 2016 OECD report estimates that, on average, 9% of jobs across the OECD member states face a high automation risk. Among them, "low educated" workers are more likely to be replaced by machines than "low qualified" workers in the automation wave. Thus, countries with smaller shares of "highly educated" workers usually have greater automation potential.
- Dr. Frey and Dr. Osborne of the Oxford Martin School are more pessimistic. In their research report published in 2016, they estimate that about 47% of jobs in the US may be replaced by robots.
- In November 2017, McKinsey published research estimating a potential 800 million jobs lost by 2030 to automation (around 50% of current jobs are technically automatable).

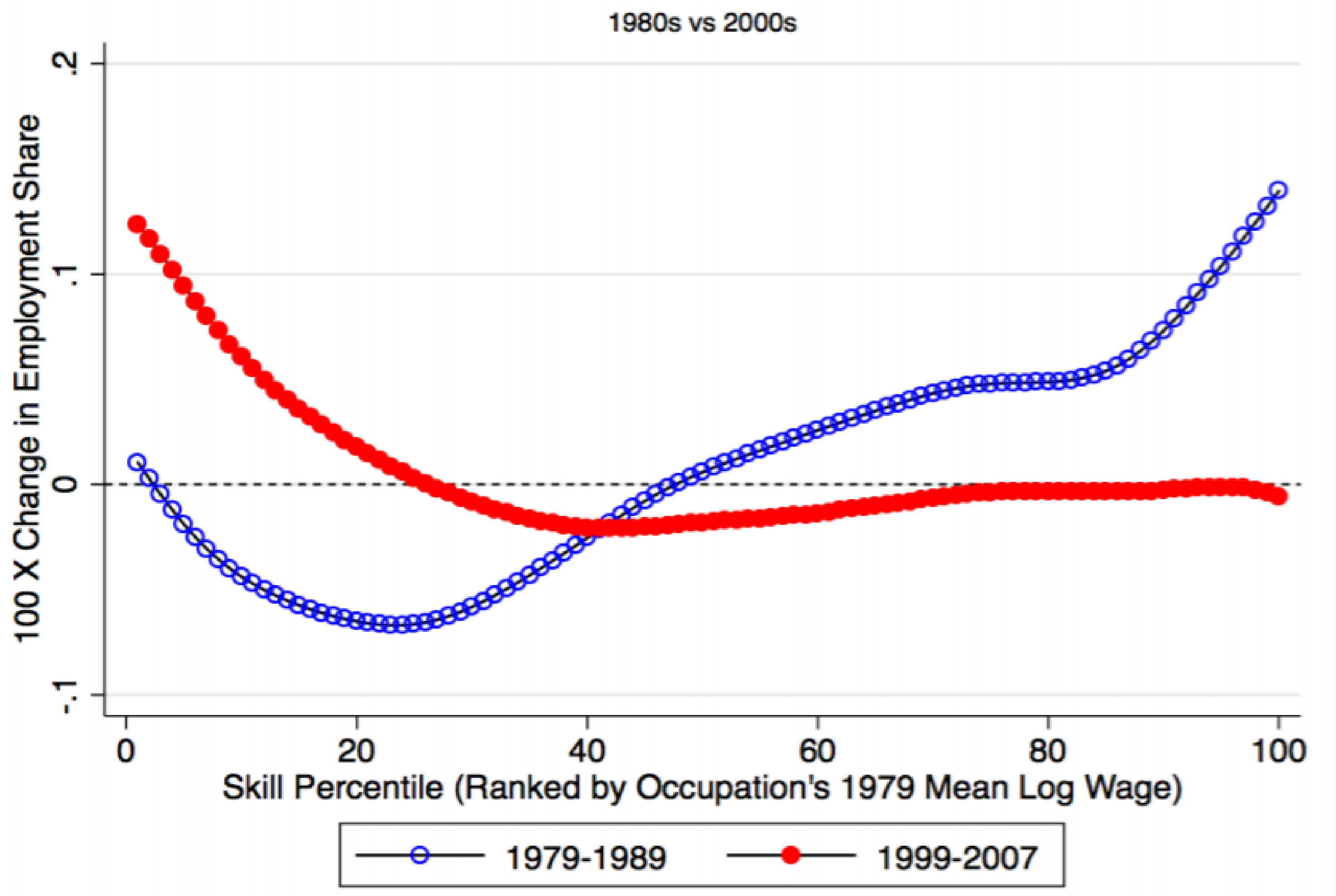
A word on automation

- LSE team identified two phases of employment polarisation since the 1970s.

- Phase 1 saw declines at the bottom and growth at the top (1980s plus some of the 1990s).

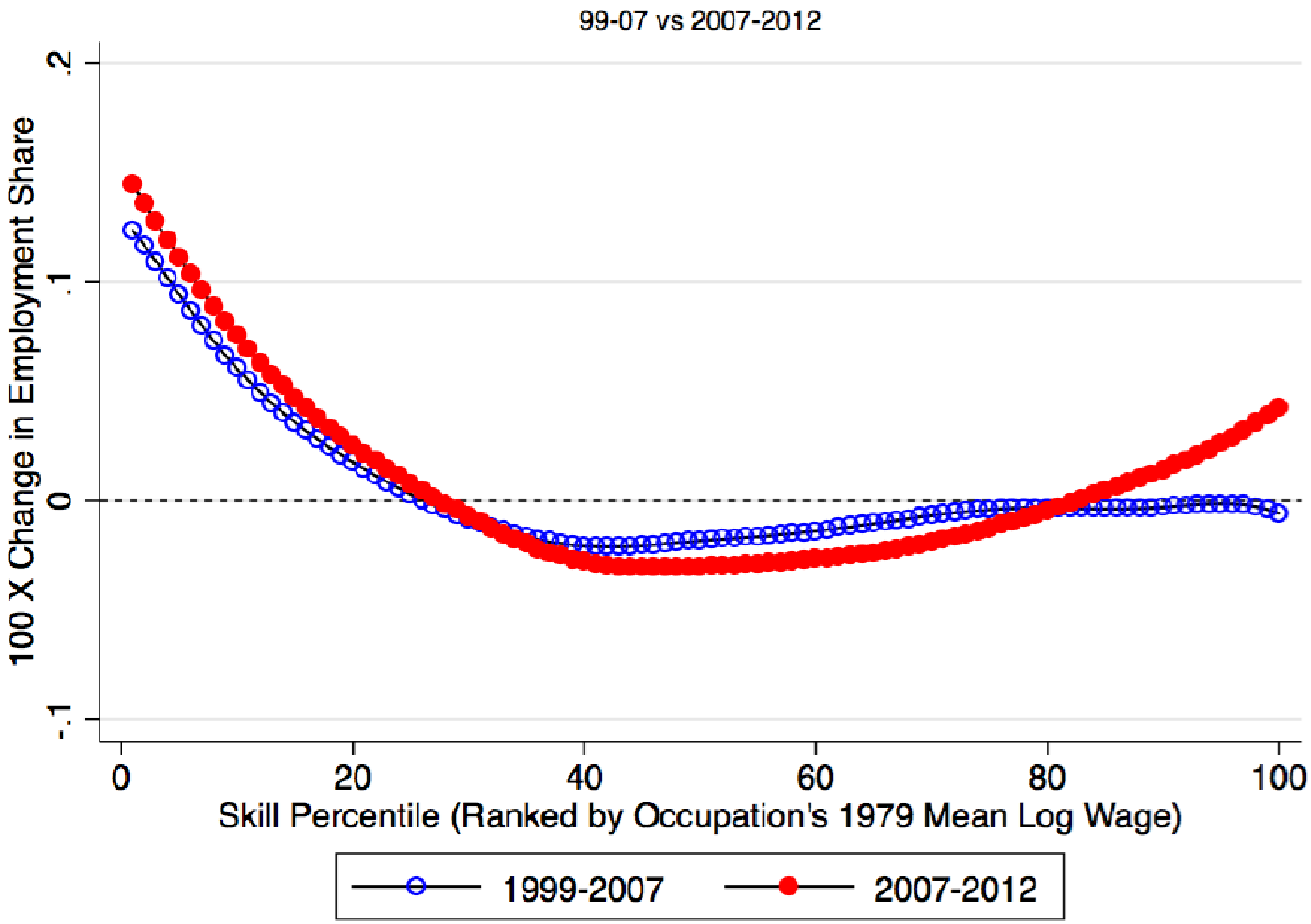
- Phase 2 saw growth in low-skill work and flattening of high-skill job expansion (2000s onwards).

Employment polarisation, 1980-2007



Notes: Data from Acemoglu and Autor(2011), based on US Census IPUMS data and American Community Survey (ACS). The horizontal axis represents the ranking of an occupation in the 1980 wage distribution.

Employment changes by occupational skill percentile, 1999-2012



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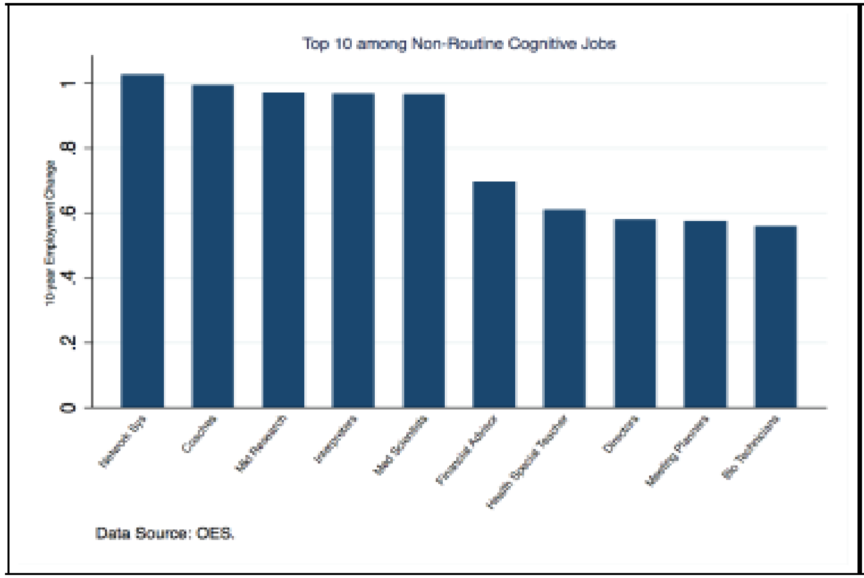
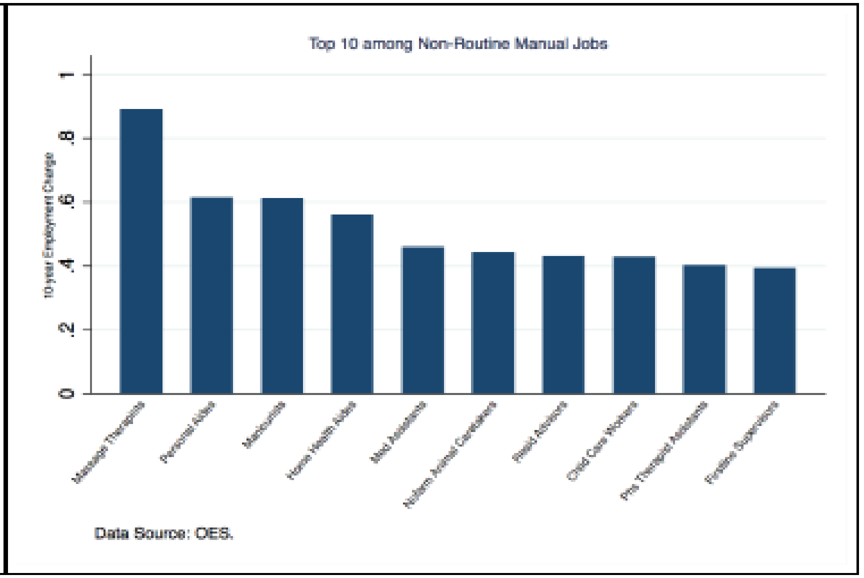
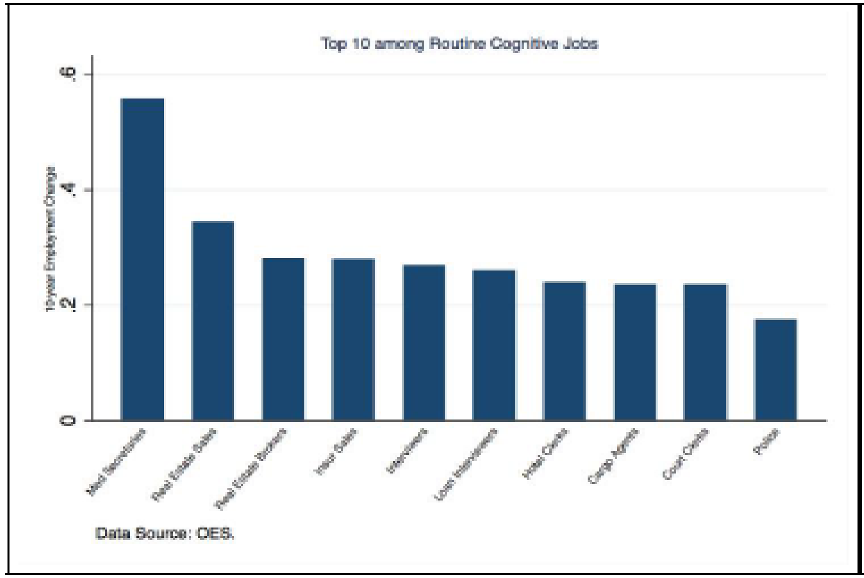
(a) Non-Routine Cognitive



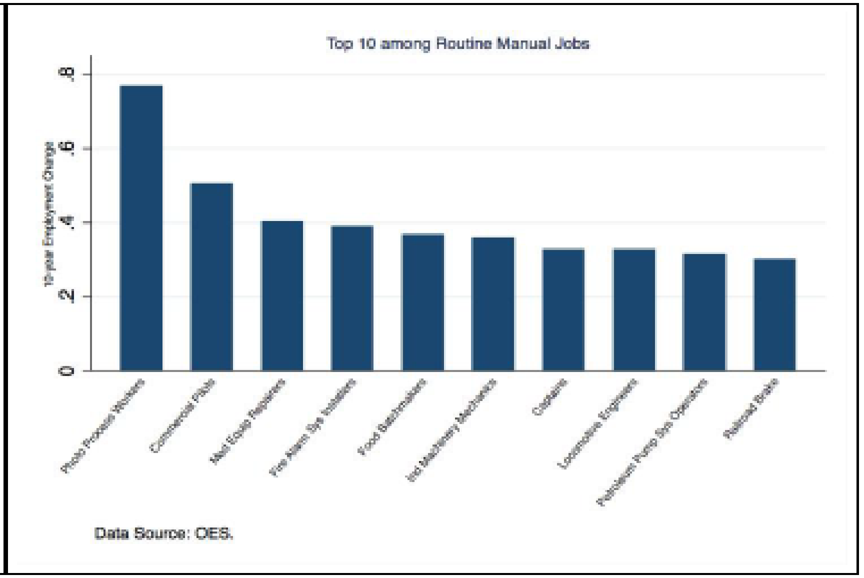
(b) Non-Routine Manual



(c) Routine Cognitive



(d) Routine Manual



A new wave?

- There is no sign (yet) of clear retreat in high-skill non-routine jobs.

- Structural change has tended to occur in recessions, so that's when a shift would next start.

- Even then, 'partial automation' of tasks within jobs protects employment, along with countervailing effects.

Technology and work

- That said, the post 1980s industrial robotics wave is associated with non-trivial employment reductions (and productivity growth).

- Automation-related challenges represent one of the biggest areas for policy development....

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Projecting the impact of ‘super-innovations’

- **Autonomous vehicles**. Estimates by the US Bureau of Labor Statistics (BLS) put the size of the commercial driver workforce (classified under ‘motor vehicle operators’) at 3.5 million.
- Consider a hypothetical 60% reduction of the commercial driver workforce to around 1.5 million.
- A static calculation gives us an aggregate productivity boost of 1.7% which, spread out over a 10 year transition period, would deliver a 0.17% increase in annual productivity growth. A ‘dynamic calculation’ would also need to encompass the complementary effects of autonomous vehicles. So the overall boost would be higher.
- What about the workers? This would imply that 200,000 drivers per year would be laid off this would increase total layoffs by only 1% per year.
- As a benchmark, the peak of the late 2000s recession saw annual layoffs increase by about 10% per year between 2007 2009 (from 22 million to 26.6 million).

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Projecting the impact of ‘super-innovations’

- **AI-staffed call centers**. Consider a scenario where IBM Watson-style AI technology was deployed in telephone call centers.
- Official BLS estimates (BLS Occupational Employment Statistics) put the size of the office and administrative section of the Telephone Call Center industry at 327,000 in mid-2016 (but could be 2.2 million + home workers).
- If we adopt a ‘maximalist’ scenario and assume 60% of the 2.2 million workers could be replaced this would imply a 1% increase in productivity in total over 10 years, annualized to 0.1% per year.
- On the labour market side there would be an extra 130,000 layoffs per year which would represent a 0.7% annual increase in lay-offs.

Policy for an evolving ICT economy (1)

Our report explores the evidence base on ICT and pinpoints some policy messages.

- Long-run investment in R&D capacity pays off. The knowledge base and ‘spillovers’ created by ICT are immense.
- Bio-tech and clean energy are great but ICT is still ‘where it’s at’ for government investment strategy.

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Policy for an evolving ICT economy (2)

- Broadband (fixed + mobile) policy is innovation policy. It provides the platform for subsidiary innovations & its expansion has been so fast that the effects are hard to grasp.

- No clear evidence that the next ‘automation wave’ threatening higher skills jobs is under way (yet).

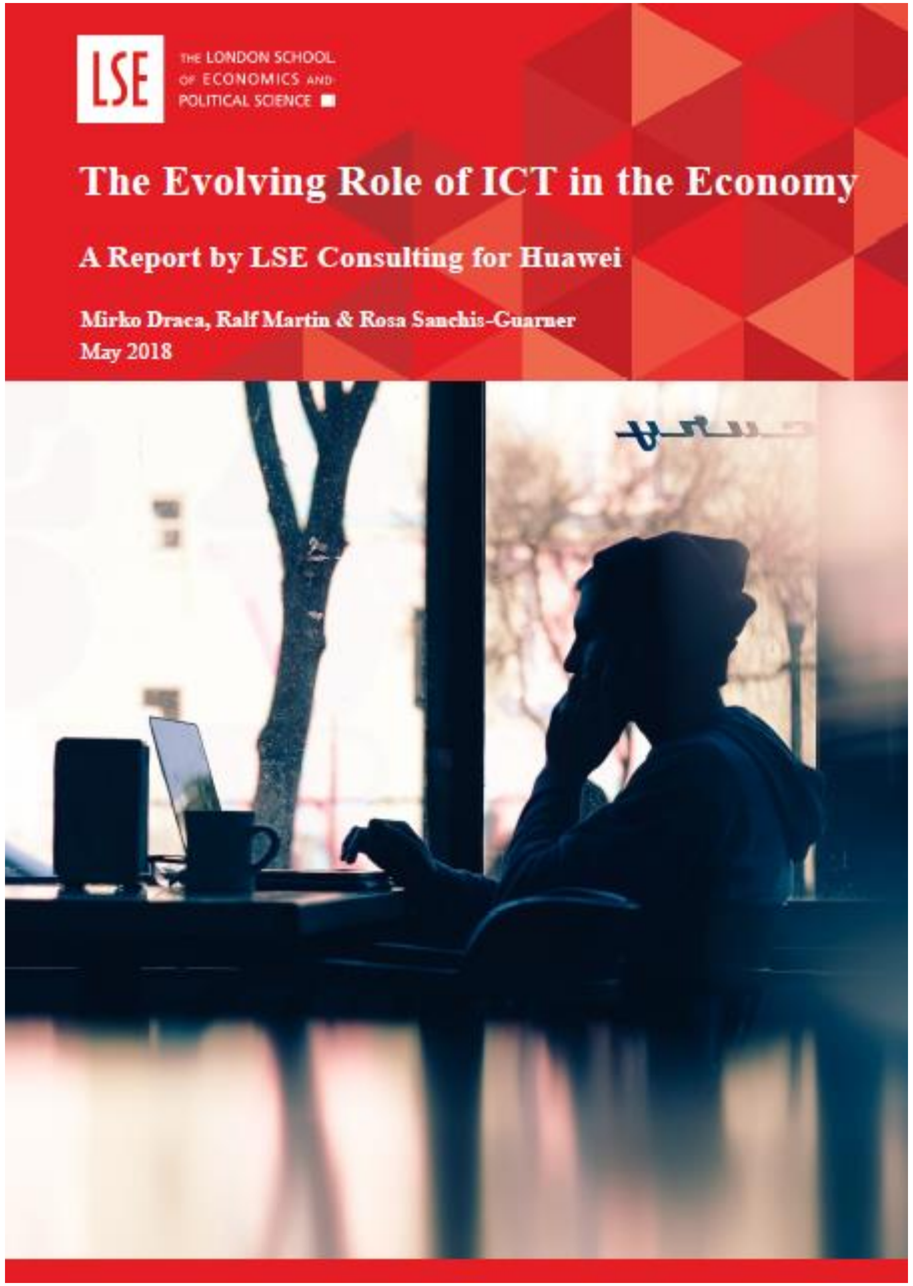
- This would emerge in the next recession and jobs are subject to ‘partial automation’ in any case.

Policy priorities

- Basic science + R&D tax credits + ‘independent’ industry policy.
- Skills tax credit + tax policy towards employment (gig economy).
- Consolidation of broadband policy.

Report

http://www.lse.ac.uk/business-and-consultancy/consulting/news/the-evolving-role-of-ict-in-the-economy



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