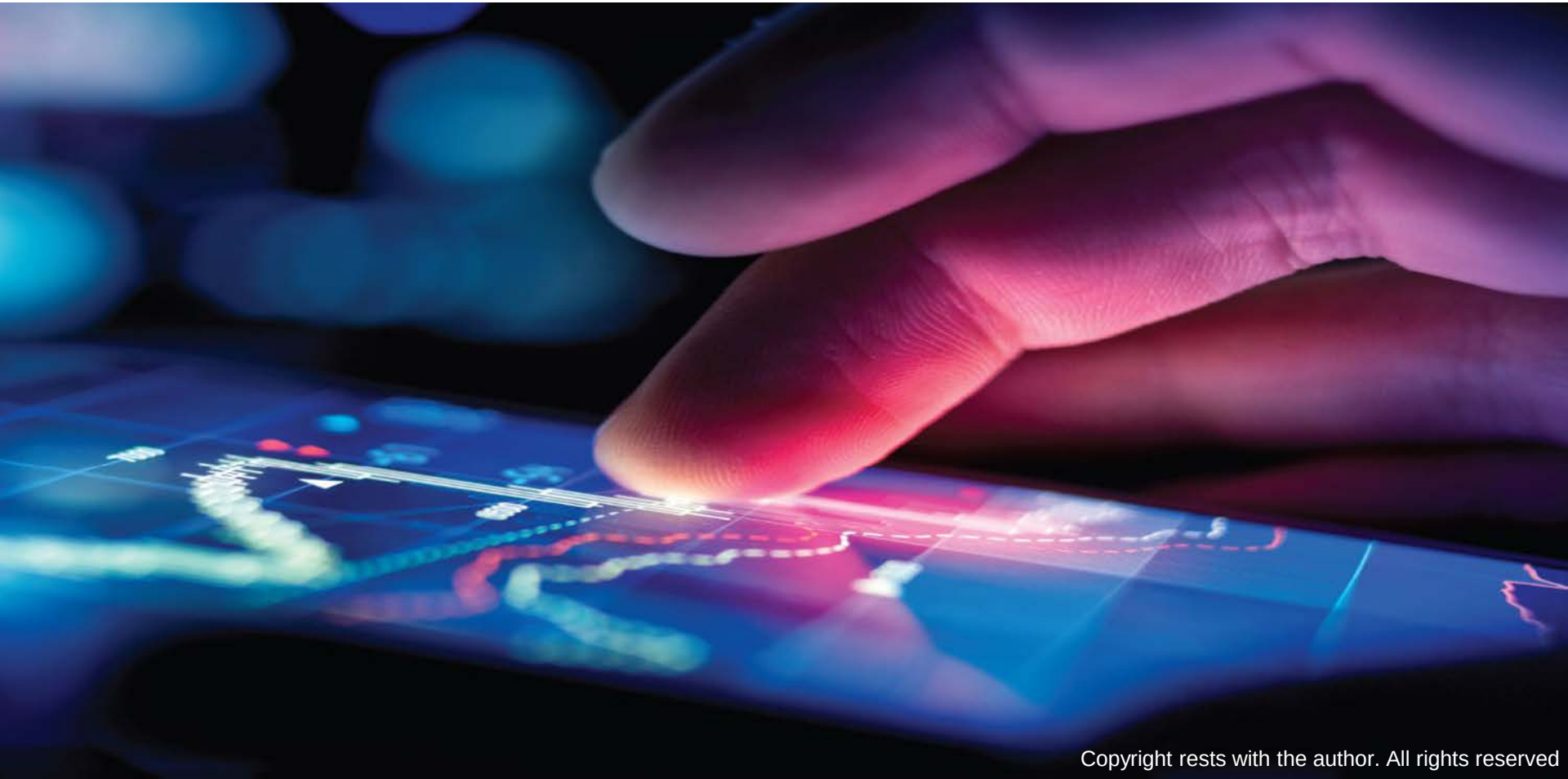
Productivity and Growth in the Midst of the Digital Transformation Age

Bart van Ark, The Conference Board and University of Groningen



Global productivity slowdown and exacerbation of Europe's long-term productivity stagnation

Source: The Conference Board Total Economy Database (adjusted version), November 2018

What has caused the productivity slowdown in past 10-15 years?

- The global financial crisis (slow demand, weak investment)
- Smaller contribution of globalization, incl. emerging markets running out of catching-up potential;
- Regulatory environment more challenging for productivity gains (e.g. environmental, financial)
- Slow absorption of digital technology:
  - ✓ The New Digital Economy diffuses rapidly but is not absorbed that quickly in business models
  - ✓ Slow adaptation of employee skills and management skills to NDE

The New and Old Digital Economy represent distinctly different technologies and innovation patterns

The Old Digital Economy (1980s-2000s)

Digitization driven by the rise of the personal computer and the internet as key drivers of greater business efficiency, creating access for individuals to digitization and the beginning of e-commerce.

The New Digital Economy (as of 2000s)

Digitization driven by a combination of mobile technology; ubiquitous access to the internet; and the shift toward storage, analysis, and development of new applications in the cloud.

1st: The Industrial Revolution → 2nd: Steam and Railways → 3rd: Steel and Heavy Engineering → 4th: Energy and Combustion Engine → 5th: Digital Age

Based on Carlota Perez

Digital transformation is more than just the development of a new set of tools in the workplace

- **DIGITIZATION** is the adoption or increase in use of digital technology, which creates value through new products, new processes, business models and organizational structures
- **DIGITAL TRANSFORMATION** leverages digital technologies and the data they produce to connect organizations, people, physical assets and processes, etc. which drives long-term value and productivity

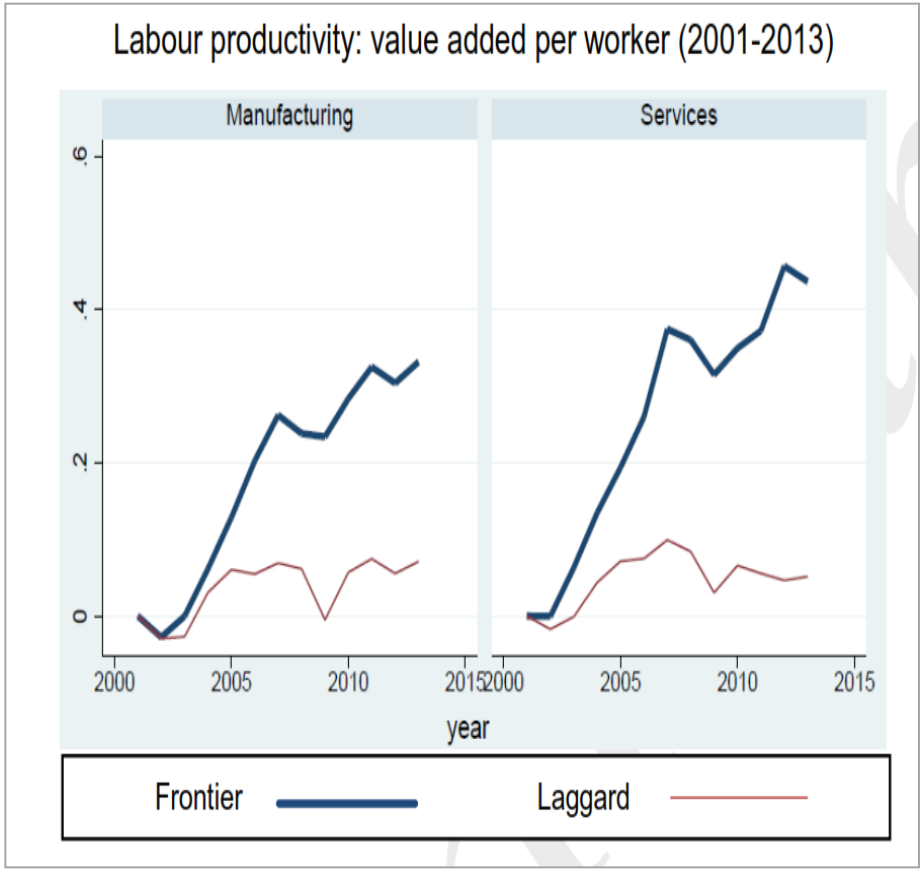
Digital Technologies

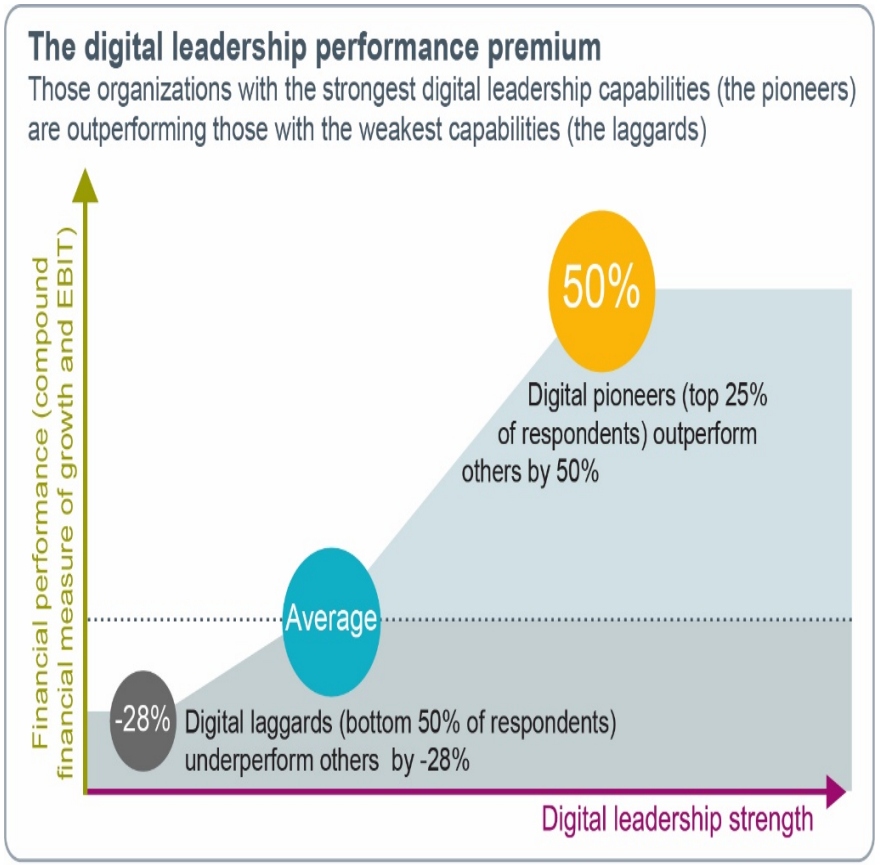
- Internet
- Mobile
- Embedded sensors
- Cloud
- Social media
- Enterprise or business collaboration platforms
- Public or open platforms
- Advanced analytics
- Artificial intelligence/ cognitive computing
- Automated trend scouting
- Bots
- 3-D printing
- Block chain

Digital Transformation

- The use of digital technologies and the data they produce to
  - Connect organizations, people, physical assets, processes, etc. in new ways
  - Rapidly develop new products, services, markets, business models
  - Meet emerging customer needs
  - Aligned with digital business strategy
- Digital End-to-End processes:
  - Integration of stakeholders, systems and processes across multiple functions and geographies

Productivity performance and digital competencies suggest large gaps between frontier and other firms

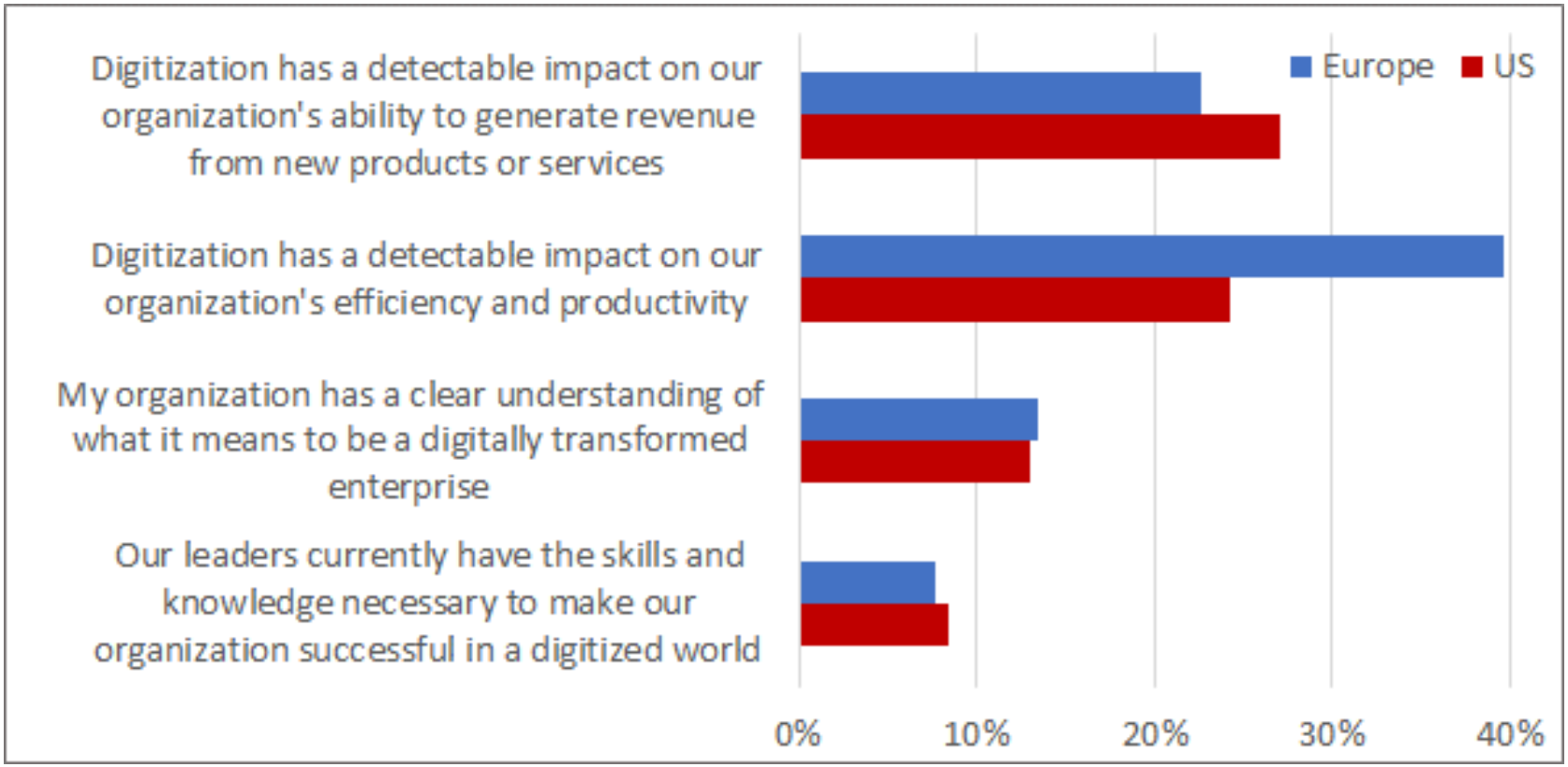




Note: The global frontier is measured by the average of labor productivity for the top 5% of companies with the highest productivity levels within each 2-digit industry. Services refer to non-financial business services. See details in Section 3.3.
Source: OECD-Orbis productivity database; DDI, The Conference Board, EYGM Limited

CEO-awareness of slow digital transformation

CEO Perception of Impacts of Digital Transformation, % that “strongly agree”, 2017



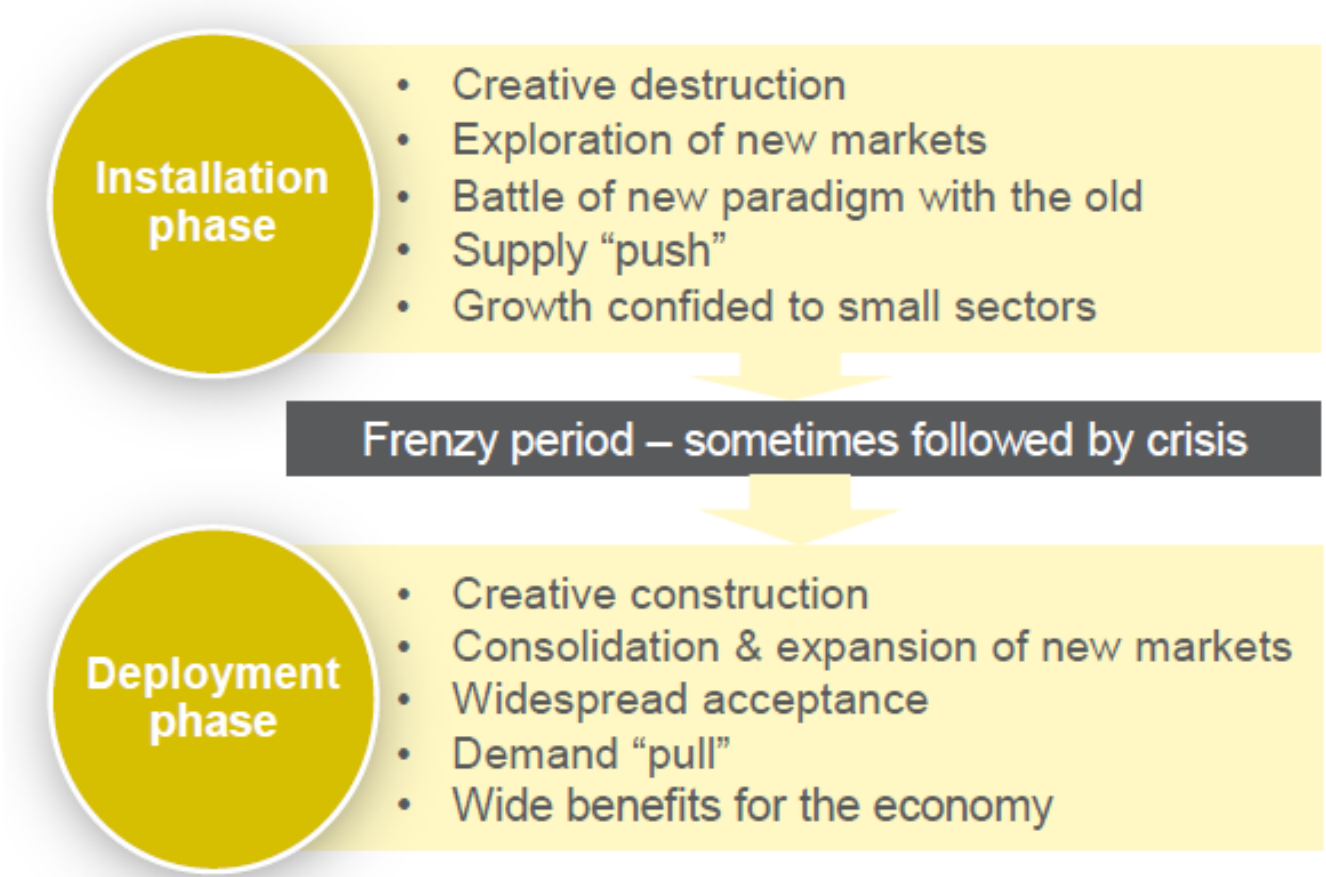
Source: The Conference Board, C-Suite Challenge Survey, 2018

Hypothesis 1: During the digital transformation process the productivity gains at industry level have become randomly distributed

- Mushroom-like growth indicates a pattern in which only a limited number of industries contribute positively to the aggregate growth
  - ✓ Mushrooms are scattered and pop up almost overnight, in a fashion that is not easy to predict
  - ✓ Some industries see rapid productivity gains but depending on different “random” circumstances (technology opportunity, market opportunity, breakthrough innovation, etc.)
- Growth is yeast-like when it is broad-based and takes place in many industries
  - ✓ Yeast makes bread to expand slowly and evenly
  - ✓ Industries contribute widely to accelerating productivity growth

Source: Harberger AC: A Vision of the Growth Process, *American Economic Review*, 88(1), pp 1-32, 1998.

Hypothesis 2: We may be transitioning from the installation to the deployment phase of the digital transformation process



Source: based on Carlota Perez, *Technological Revolution and Financial Capital. The Dynamics of Bubbles and Golden Ages*, (Cheltenham, United Kingdom, Edward Elgar Publishing Limited), 2002

We looked at two taxonomies to characterize whether or not industries are “prepared” for the New Digital Economy

1. ICT Assets + Services Intensity
   - ✓ ICT investment plus purchases of ICT services as a % of “synthetic output” (value added + intermediate use of ICT services)
   - ✓ Based on minimum 4 out of DE, FI, FR, NL, IT, SE and UK for 2014
2. Innovation Potential of Occupations
   - ✓ Occupation score based on 12 innovation competencies
   - ✓ Cross tabulated occupation x employment by industry to develop ranking
   - ✓ Based on O-Net (USA) applied to average of occupations x industry, UK, 2015-2017

Two taxonomies do not always score the same

BELOW MEDIAN ACCORDING TO ICT + SERVICE INTENSITY & INNOVATION COMPETENCIES
AGRICULTURE, FORESTRY AND FISHING
MINING AND QUARRYING
Textiles, wearing apparel, leather and related prodcuts
Basic metals and fabricated metal products, except machinery and equipment
Other manufacturing; repair and installation of machinery and equipment
CONSTRUCTION
ACCOMMODATION AND FOOD SERVICE ACTIVITIES

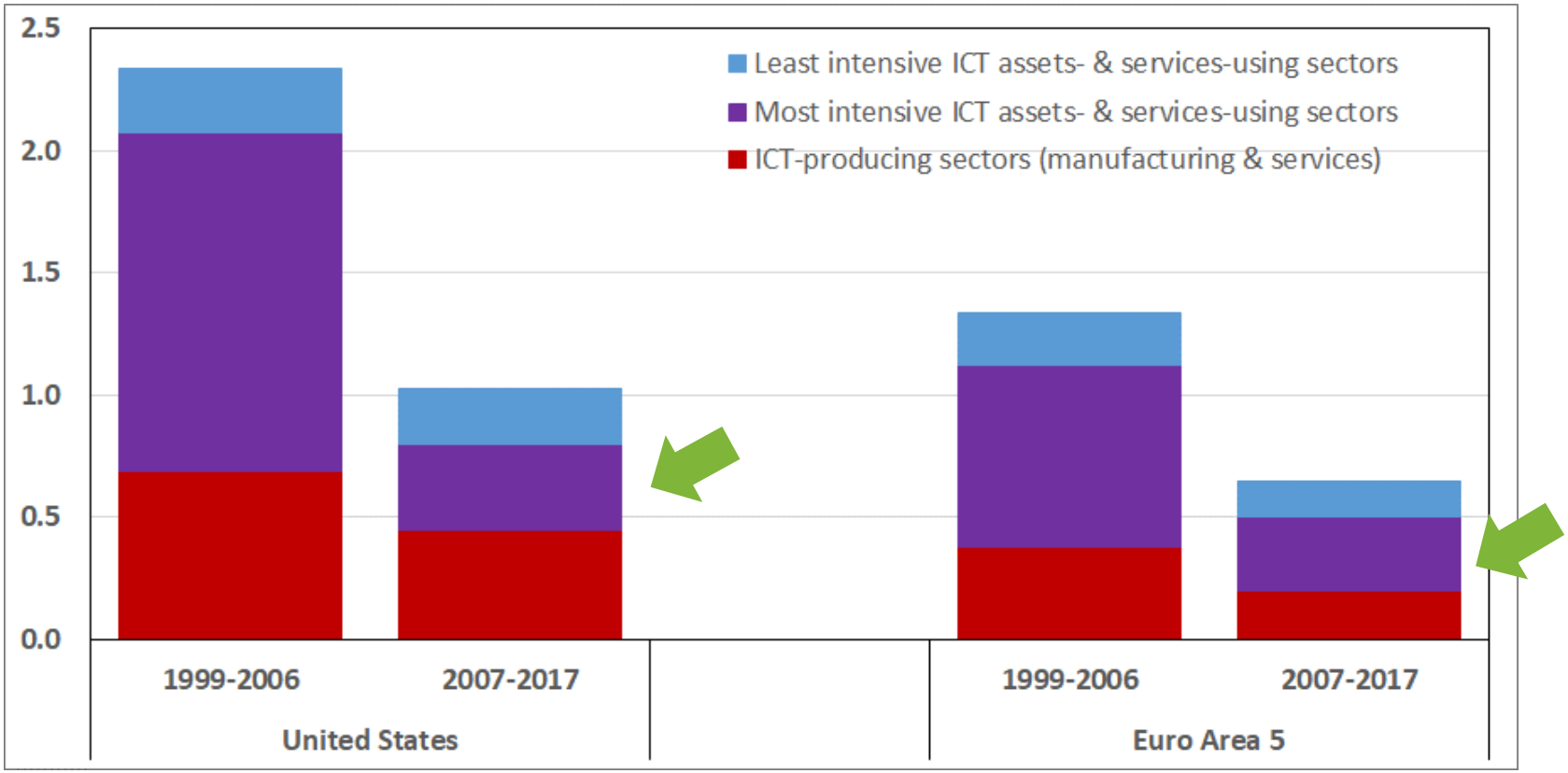
ABOVE MEDIAN ACCORDING TO ICT + SERVICE INTENSITY & INNOVATION COMPETENCIES
Chemicals and chemical products
Electrical and optical equipment
Publishing, audiovisual and broadcasting activities
Telecommunications
IT and other information services
FINANCIAL AND INSURANCE ACTIVITIES
PROFESSIONAL, SCIENTIFIC, TECHNICAL, ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES
Public administration and defence; compulsory social security
Arts, entertainment and recreation

UNDECIDED, INCLUDING
Food products, beverages and tobacco
Machinery and equipment n.e.c.
Transport equipment
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES
TRANSPORTATION AND STORAGE

ICT Assets + Services

The productivity paradox of the New Digital Economy

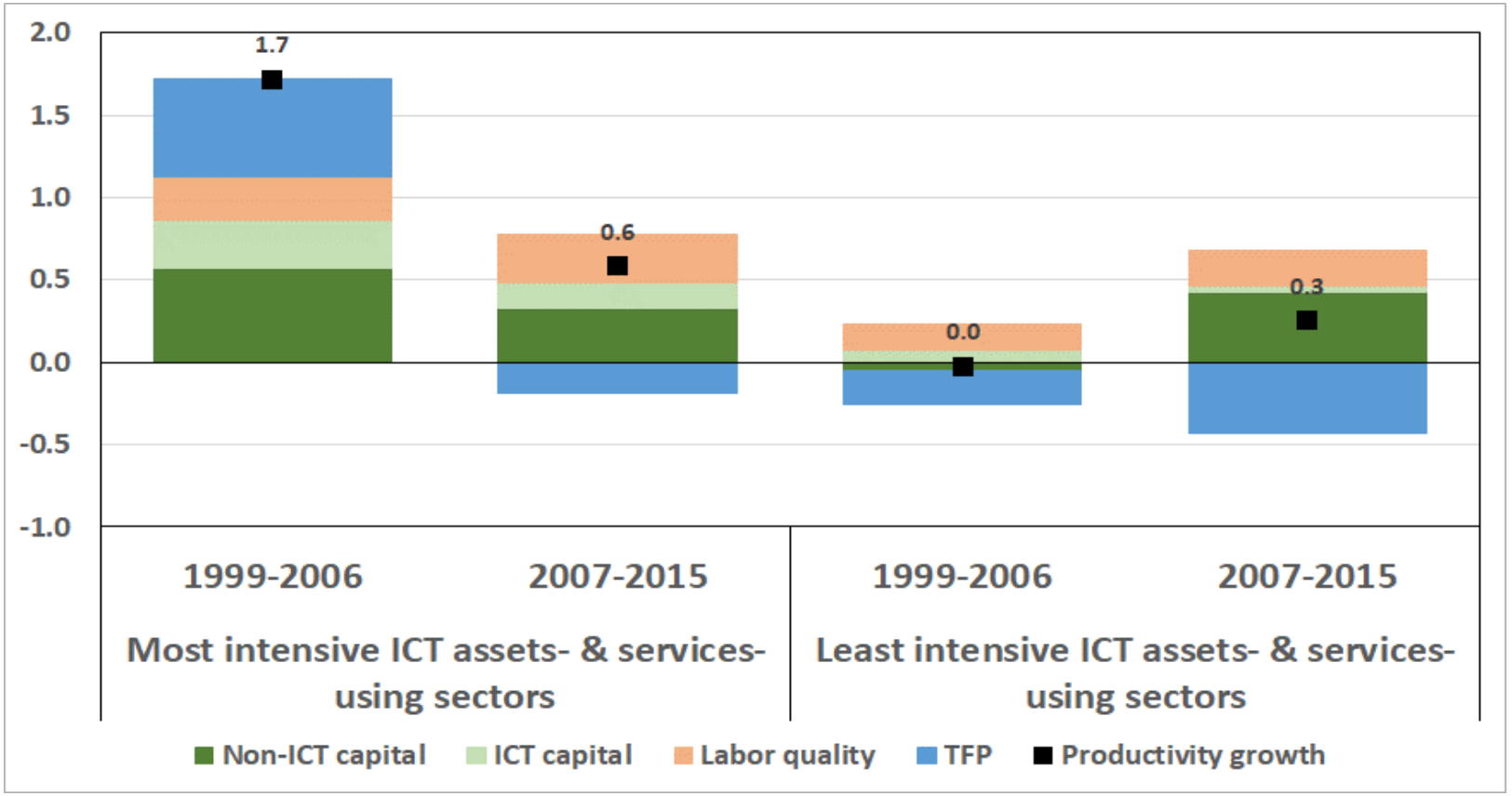
Labor productivity growth and contributions from digital-producing and more and less-intensive – using sectors, in %



Note: Euro Area 5 based on Germany, France, Italy, Netherlands and Finland
Source: Bureau of Economic Analysis; Bureau of Labor Statistics; Eurostat; The Conference Board

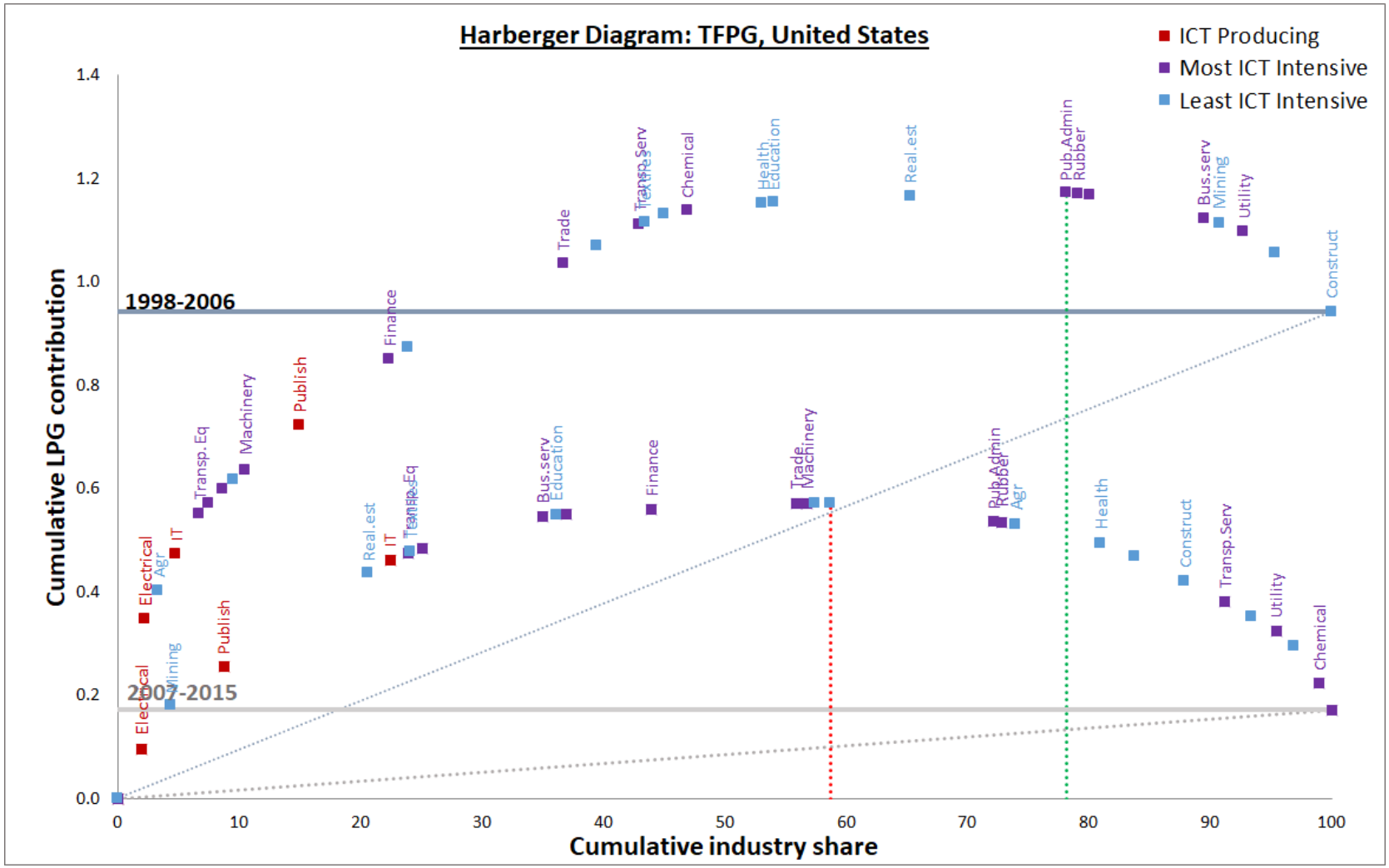
The productivity paradox of the New Digital Economy

Labor productivity growth decomposition into contributions from ICT- and non-ICT capital for EU-12, labor quality and total factor productivity in %



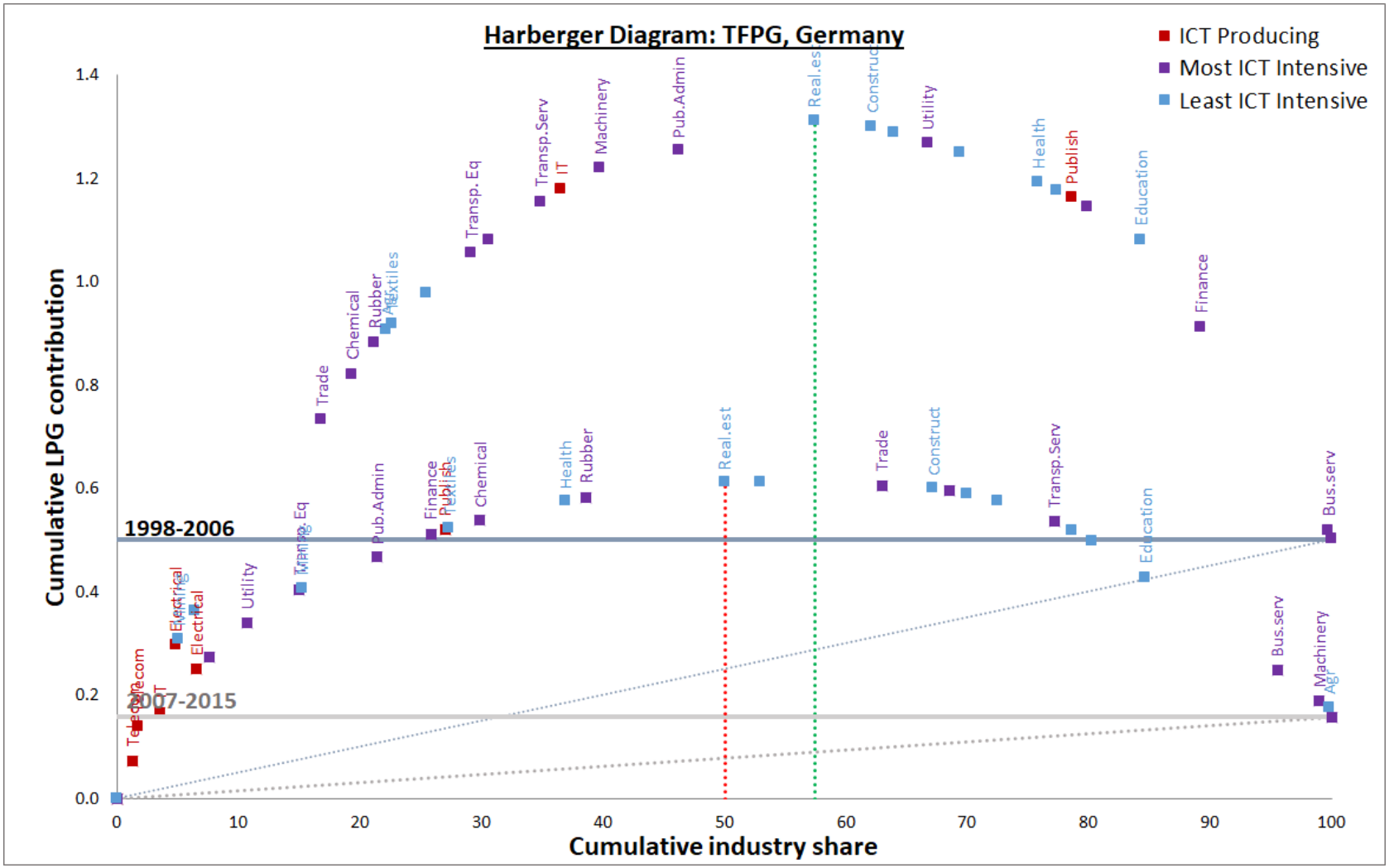
Note: VA weighted average of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, and United Kingdom. 2015 excluding Italy, Czech Republic, Sweden.
Source: The Conference Board, EUKLEMS, 2017

U.S. pattern of industry-level total factor productivity growth



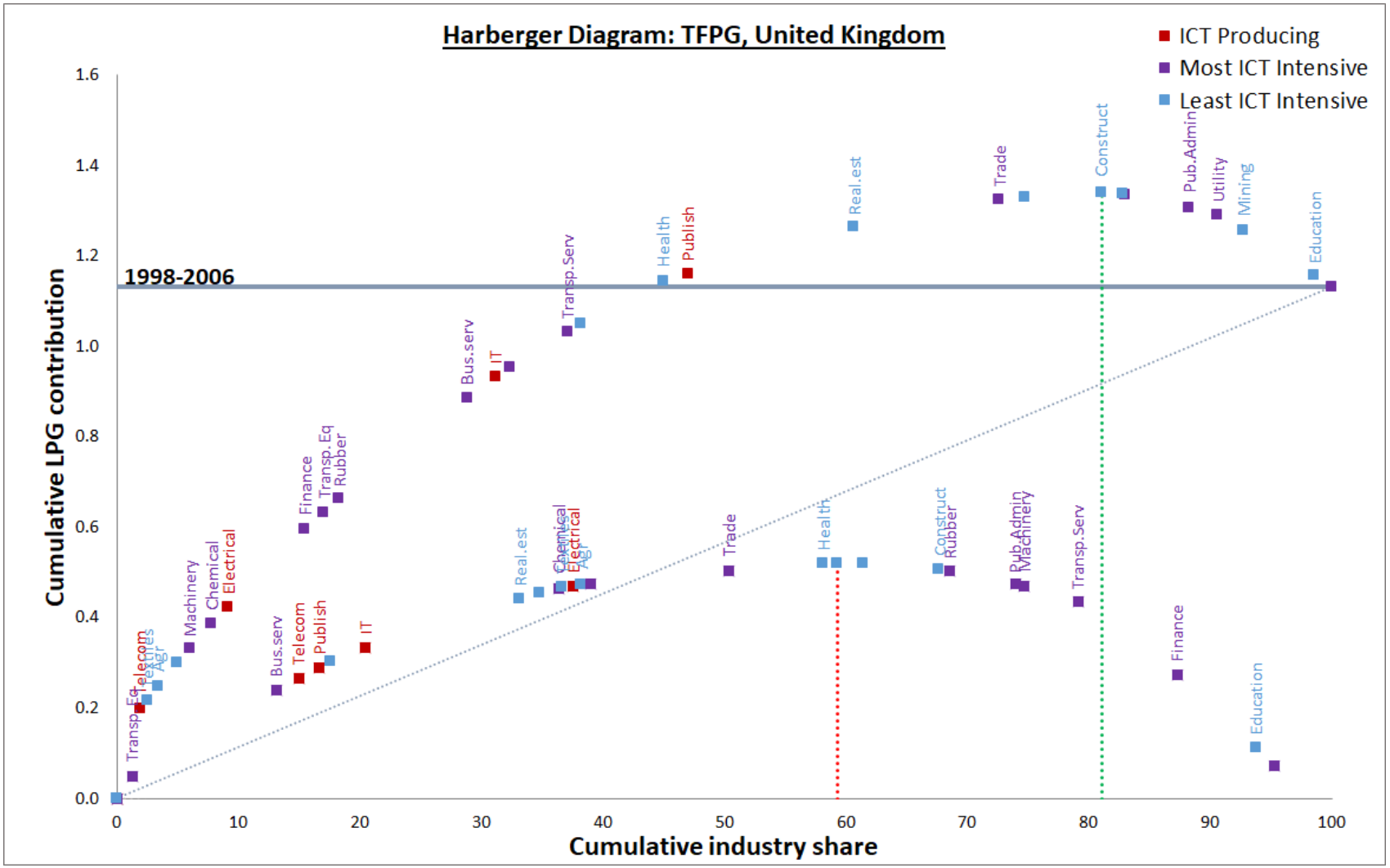
Source: The Conference Board, EUKLEMS, 2017

Germany pattern of industry-level TFP productivity growth



Source: The Conference Board, EUKLEMS, 2017

UK pattern of industry-level total factor productivity growth



Source: The Conference Board, EUKLEMS, 2017

Declines in productivity stronger for LP than TFP growth, pointing at importance of ICT services for spillover effects

Difference between 2011-2015 and 1998-2003

Total Factor Productivity Growth | **Contribution to aggregate TFP growth**

	ICT producing	ICT intensive	Less ICT intensive	ICT producing	ICT intensive	Less ICT intensive
Germany	-0.5	1.2	-0.1	0.0	0.6	0.0
France	-2.1	-0.8	-0.5	-0.2	-0.4	-0.2
United Kingdom	-3.6	-0.8	-0.8	-0.3	-0.4	-0.4
Netherlands	0.5	0.4	0.6	0.0	0.2	0.2
Italy	-3.9	0.9	1.0	-0.2	0.5	0.4
Finland	-7.3	-1.8	-0.9	-0.9	-0.8	-0.4
Sweden	-0.9	0.6	1.3	-0.1	0.3	0.6
United States	-5.5	-0.8	0.1	-0.5	-0.5	0.0

Labor Productivity Growth | **Contribution to aggregate labor productivity growth**

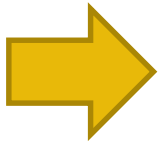
	ICT producing	ICT intensive	Less ICT intensive	ICT producing	ICT intensive	Less ICT intensive
Germany	-1.6	-0.4	-0.4	-0.1	-0.2	-0.2
France	-2.0	-0.9	-0.7	-0.2	-0.5	-0.3
United Kingdom	-6.8	-1.7	-1.2	-0.5	-0.8	-0.5
Netherlands	-5.0	-1.2	0.2	-0.3	-0.7	0.1
Italy	-3.8	0.1	1.5	-0.2	0.0	0.7
Finland	-10.3	-1.5	-0.4	-1.3	-0.7	-0.2
Sweden	-4.1	-0.7	-1.9	-0.4	-0.4	-0.8
United States	-7.6	-2.3	-1.2	-0.6	-1.3	-0.4

Innovation Potential of Occupations

Innovation competencies need to go beyond STEM – measuring a broader list of 12 competencies

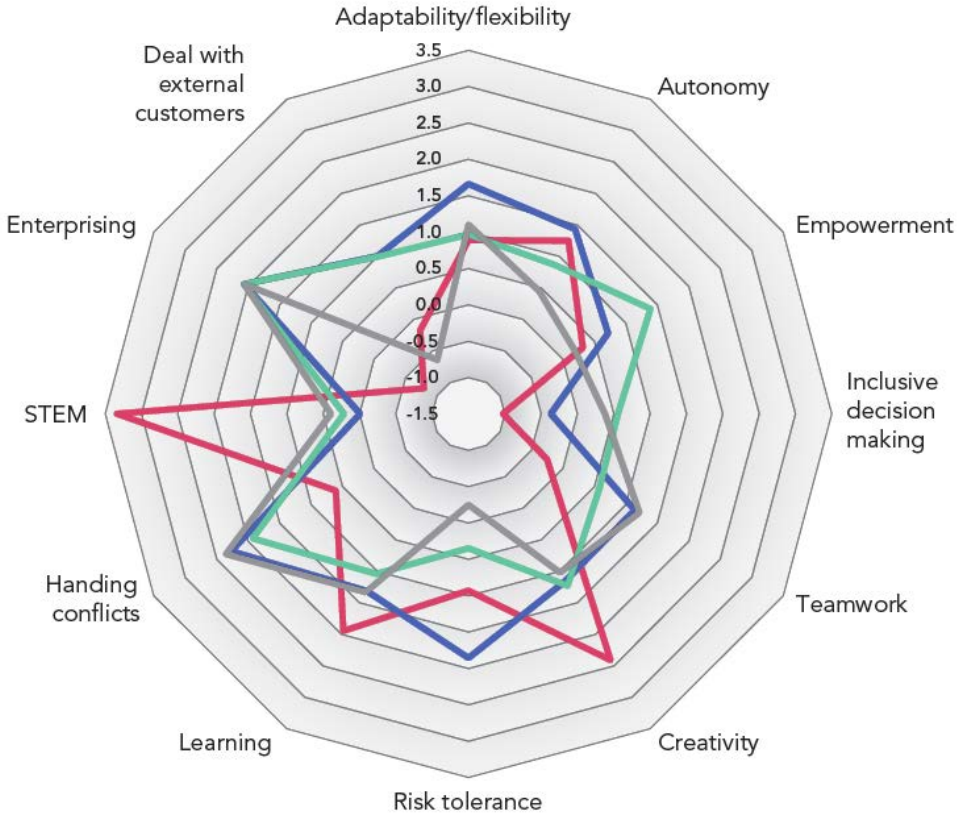
- STEM
- Adaptability/Flexibility
- Autonomy
- Empowerment
- Decision Making
- Cooperative teams and group interaction
- Creativity
- Mistake handling
- Learning culture
- Conflict Handling
- Enterprising
- Deal With External Customers

Data on the innovation competencies of 772 U.S. occupations, across all business functions



Innovation Potential of Occupations Dashboard

Physicists as well as HR managers, sales managers, and marketing managers have high innovation potential, but for different reasons



Source: The Conference Board Innovation Potential of Occupations Dashboard.

Physicists (IPO=0.79)

Human Resources Managers (IPO=0.80)

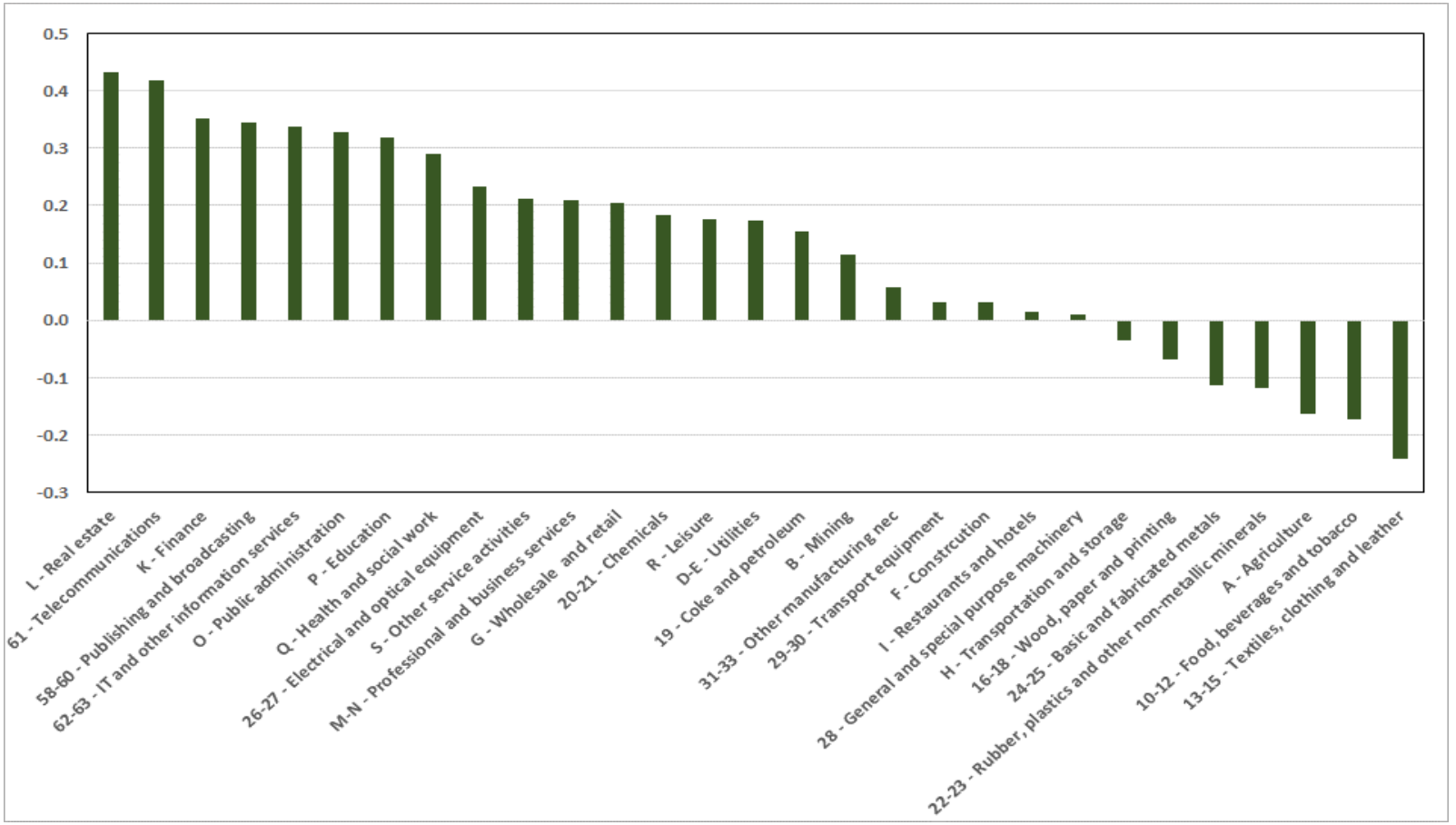
Marketing Managers (IPO=1.01)

Sales Managers (IPO=1.19)

Note: IPO Dashboard scores are in brackets by the title of the occupation. We care more about whether the score of a particular occupation falls into, for example, the top 10 percentile (most innovative) than its exact IPO Dashboard score, for reasons related to weights of the 12 competencies we have explained in the main text and in the Methodology. A spider chart such as Chart 1 looks across the 12 axes and gives us a complete view of the occupation's innovation competencies. Zero on the axis indicates the mean score of that particular competency across 700+ occupations.

Occupations in services sector have highest innovation competencies

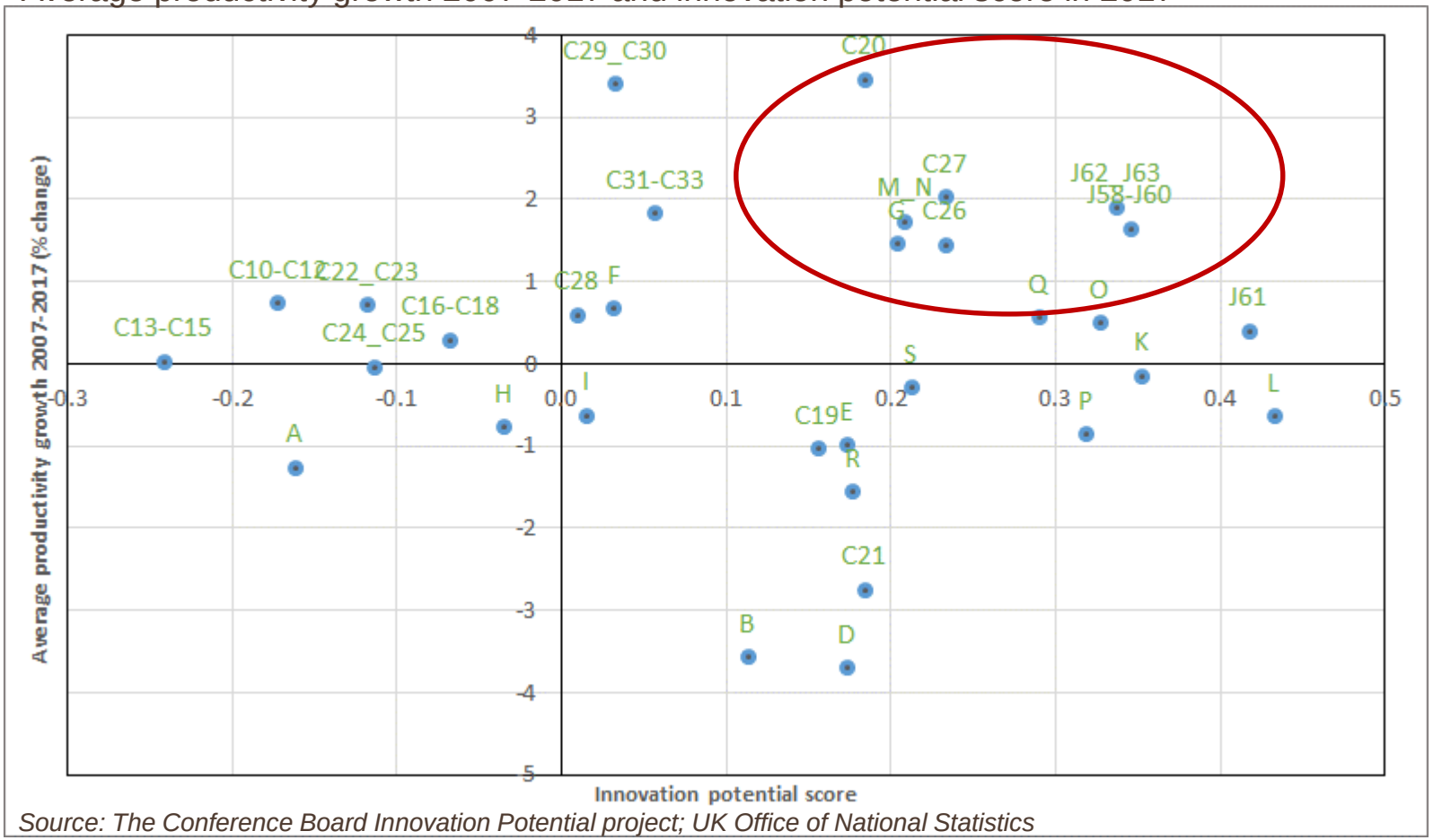
Innovation potential of occupations (IPO) score by industry UK, 2017



Source: The Conference Board Innovation Potential project; UK Office of National Statistics

Occupations in services sector have highest innovation competencies

Average productivity growth 2007-2017 and innovation potential score in 2017



Source: The Conference Board Innovation Potential project; UK Office of National Statistics

Observations so far

- Productivity effects from New Digital Economy are still fairly random – confirming we are still in the installation phase
- Taxonomies of New Digital Economy point at different industries as intensive users
- While productivity growth for more intensive ICT-using has declined, it is less so for TFP pointing at signs from spillover effects from digital services
- Innovation competencies point at stronger productivity effects in services than in manufacturing
- One important insights from evolutionary theory: the transition from installation to deployment phase usually happens through frenzy period followed by crisis

Next steps for research

- Improve taxonomies, e.g. along different dimensions of digital performance, e.g. skills, intangibles
- Further analysis to identify the drivers of relationship between digital dimensions and performance
- Can an uptick in productivity growth be observed beyond cyclical effects?
- What causes a transition from the installation to the deployment phase?

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