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ARTIFICIAL INTELLIGENCE – TRENDS AND POLICY ISSUES

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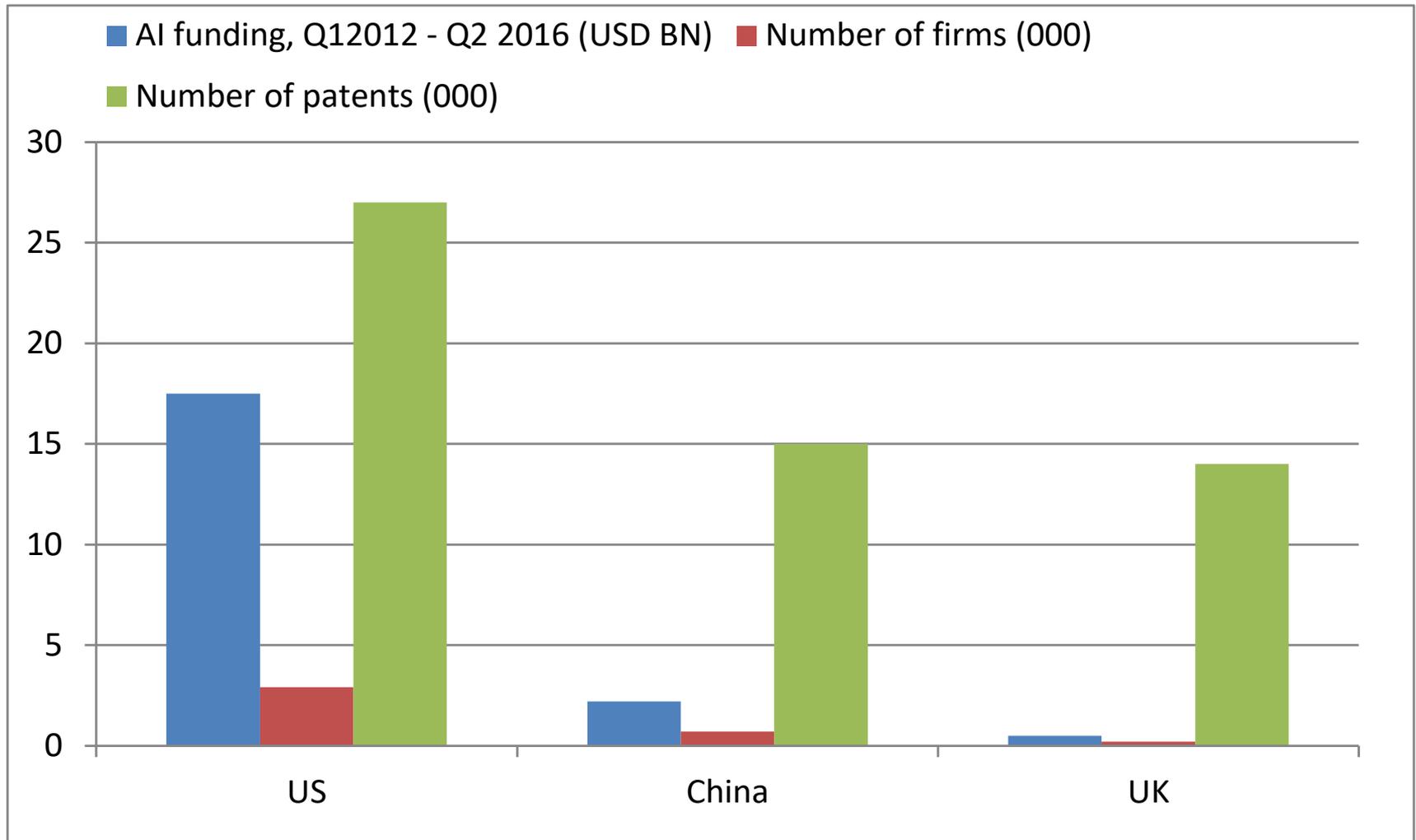OECD
BETTER POLICIES FOR BETTER LIVES

Outline

1. Some trends: Science, innovation and private investment

2. Main Policy Initiatives

3. Key policy issues: AI and the Going Digital policy framework

4. Ongoing OECD work

1. SOME TRENDS
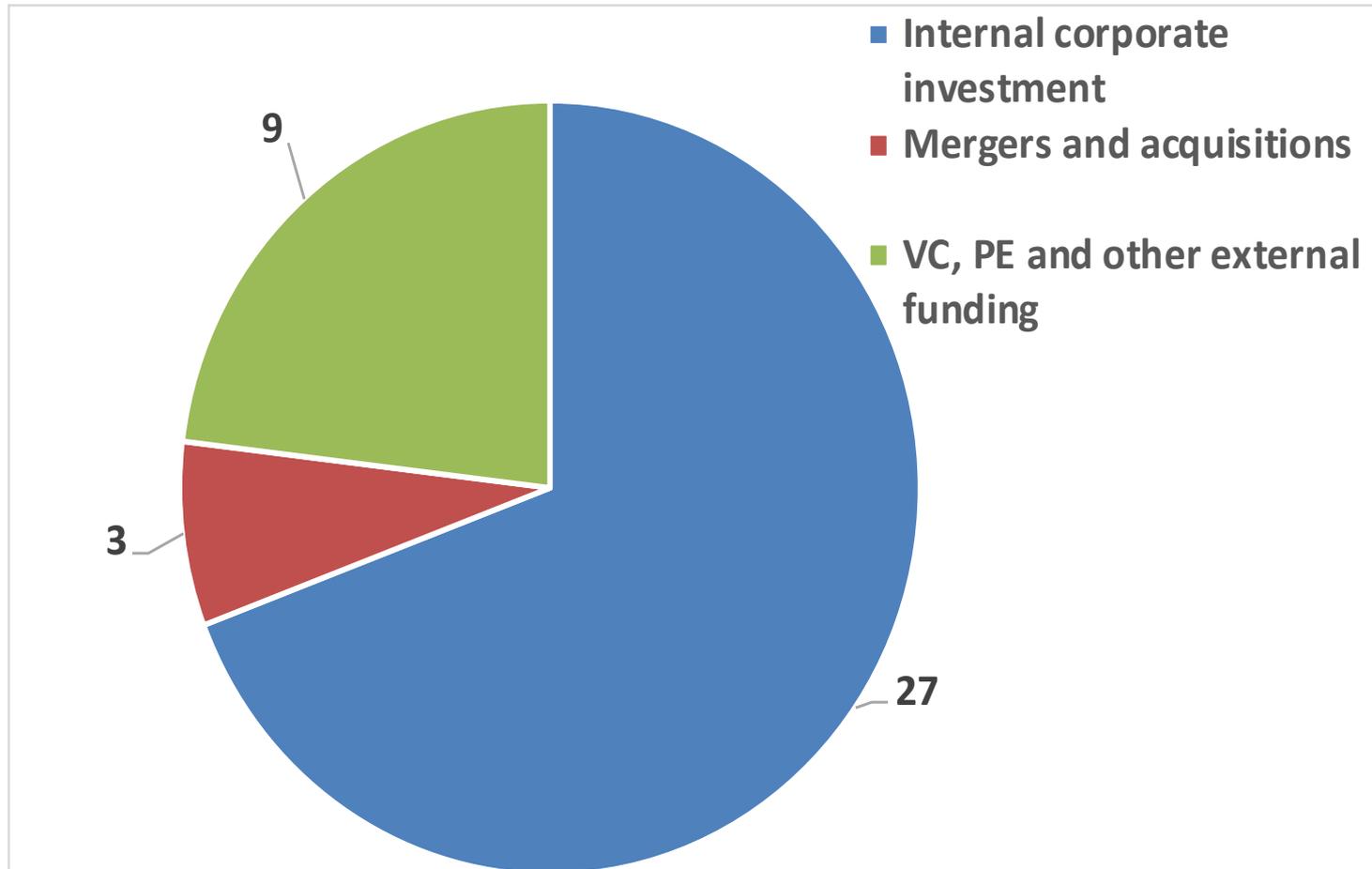
1. Some Trends - The AI race (1)

Key indicators for AI, US, China and the UK

Legend: AI funding, Q12012 - Q2 2016 (USD BN) ■ Number of firms (000) ■ Number of patents (000)

Source: Financial Times, 9 May, based on Goldman Sachs Global Investment Research

Investment in AI, 2016 (USD billion)

Legend:
- ■ Internal corporate investment
- ■ Mergers and acquisitions
- ■ VC, PE and other external funding

Values shown on pie: 9, 3, 27

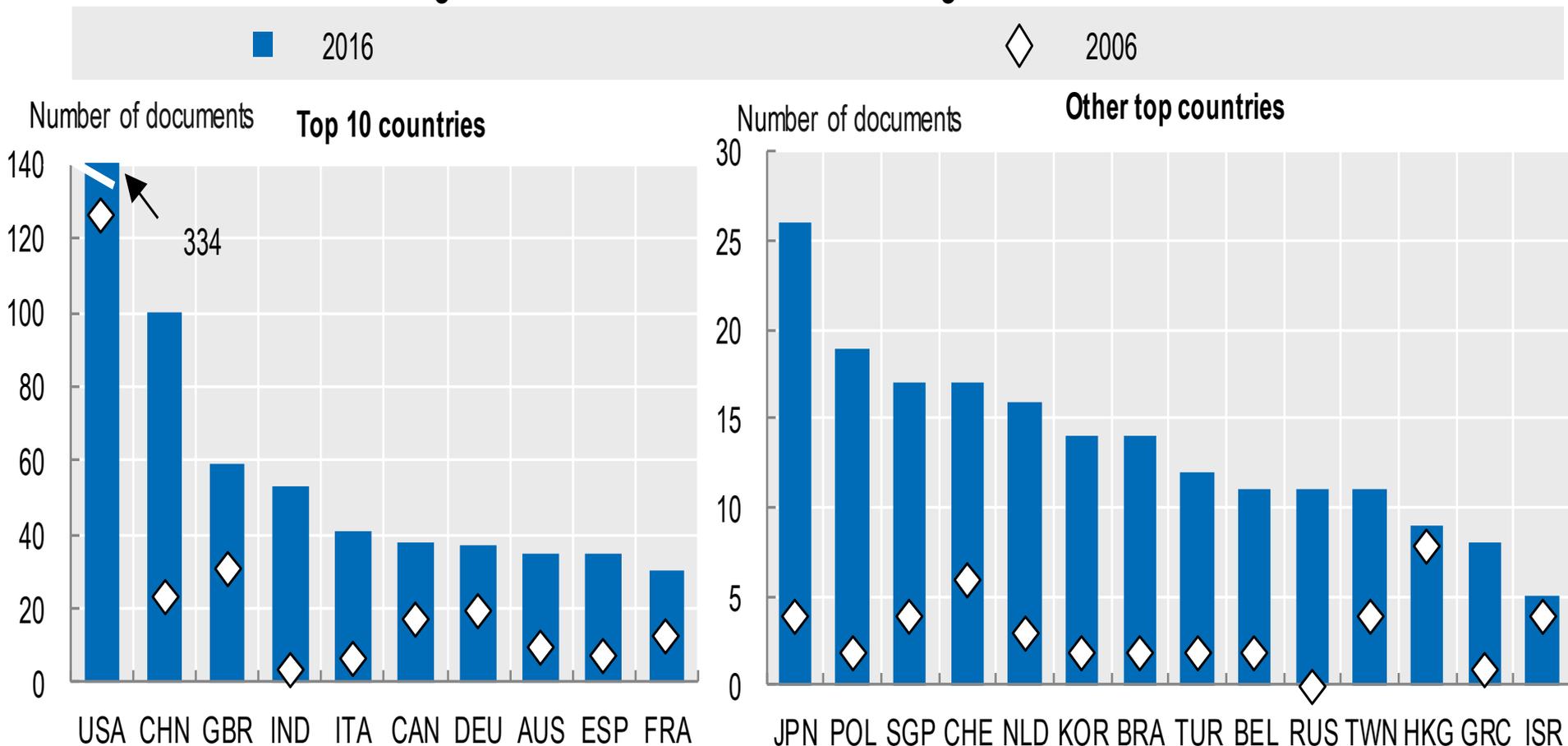*Source*: McKinsey Global Institute, Artificial Intelligence – the Next Digital Frontier?, June 2017

The Science of AI continues to advance (2)

Top-cited scientific publications related to machine learning, 2006 and 2016

Economies with the largest number of ML documents among the 10% most cited, fractional counts

■ 2016　　　　　◇ 2006

Number of documents　**Top 10 countries**

334

USA CHN GBR IND ITA CAN DEU AUS ESP FRA

Number of documents　**Other top countries**

JPN POL SGP CHE NLD KOR BRA TUR BEL RUS TWN HKG GRC ISR

Patenting in AI is growing rapidly …

Patents in artificial intelligence technologies, 2000-15

Number of IP5 patent families, annual growth rates and shares of economies
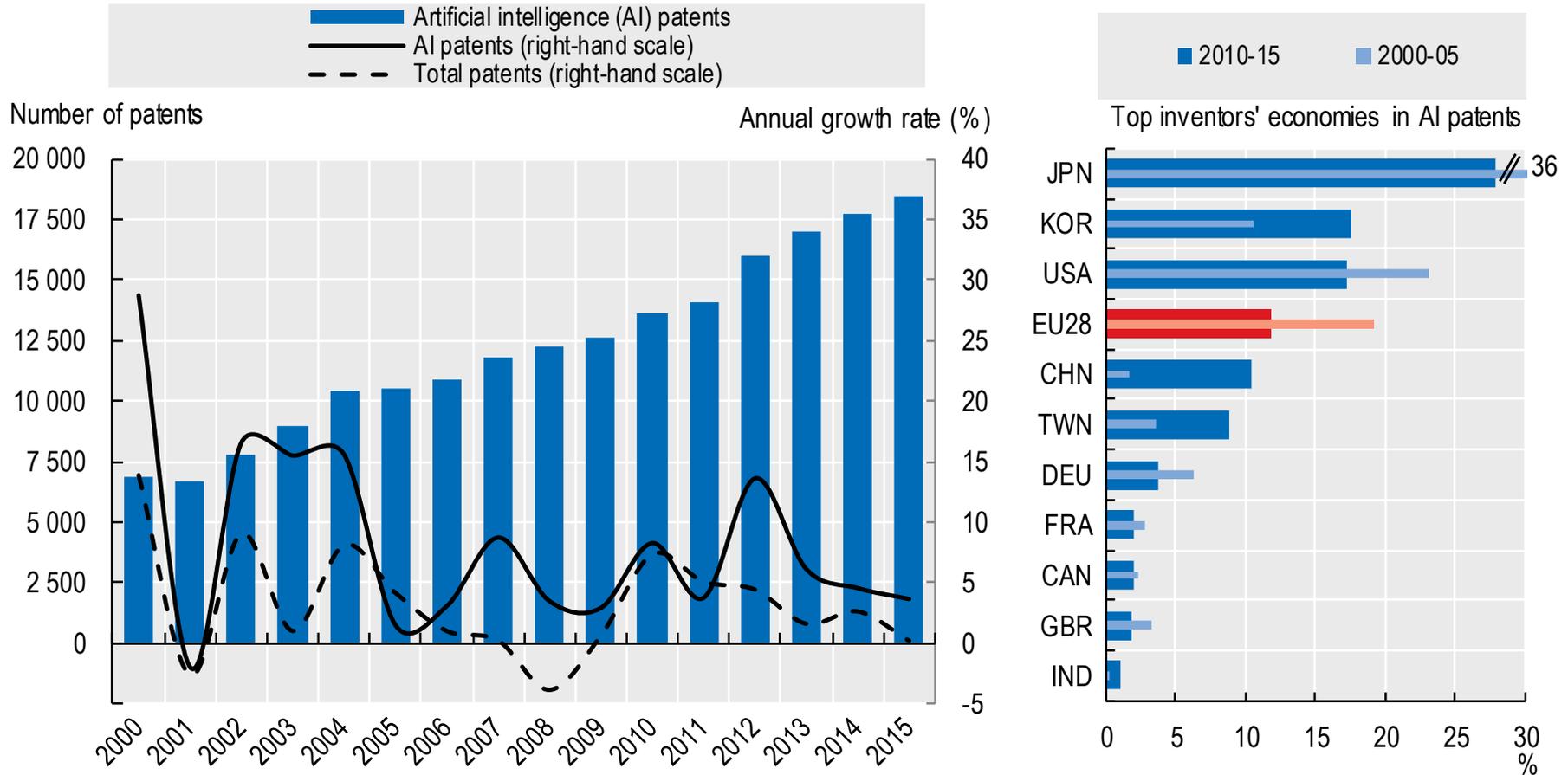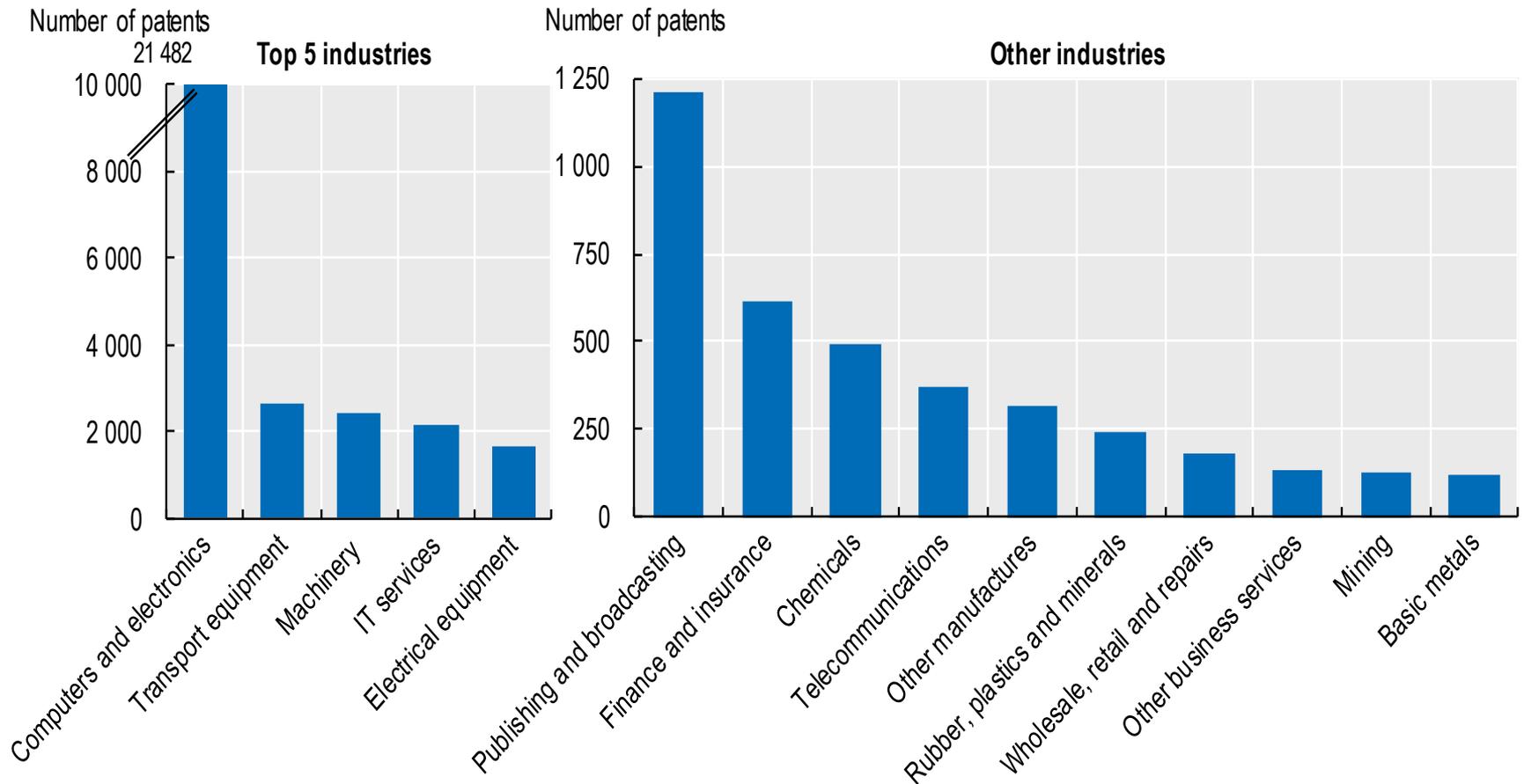

Source: OECD Science, Technology and Industry Scoreboard 2017,
StatLink: http://dx.doi.org/10.1787/888933616978

.. and is affecting many industries

Artificial intelligence patents by top 2000 R&D companies, by sector, 2012-14
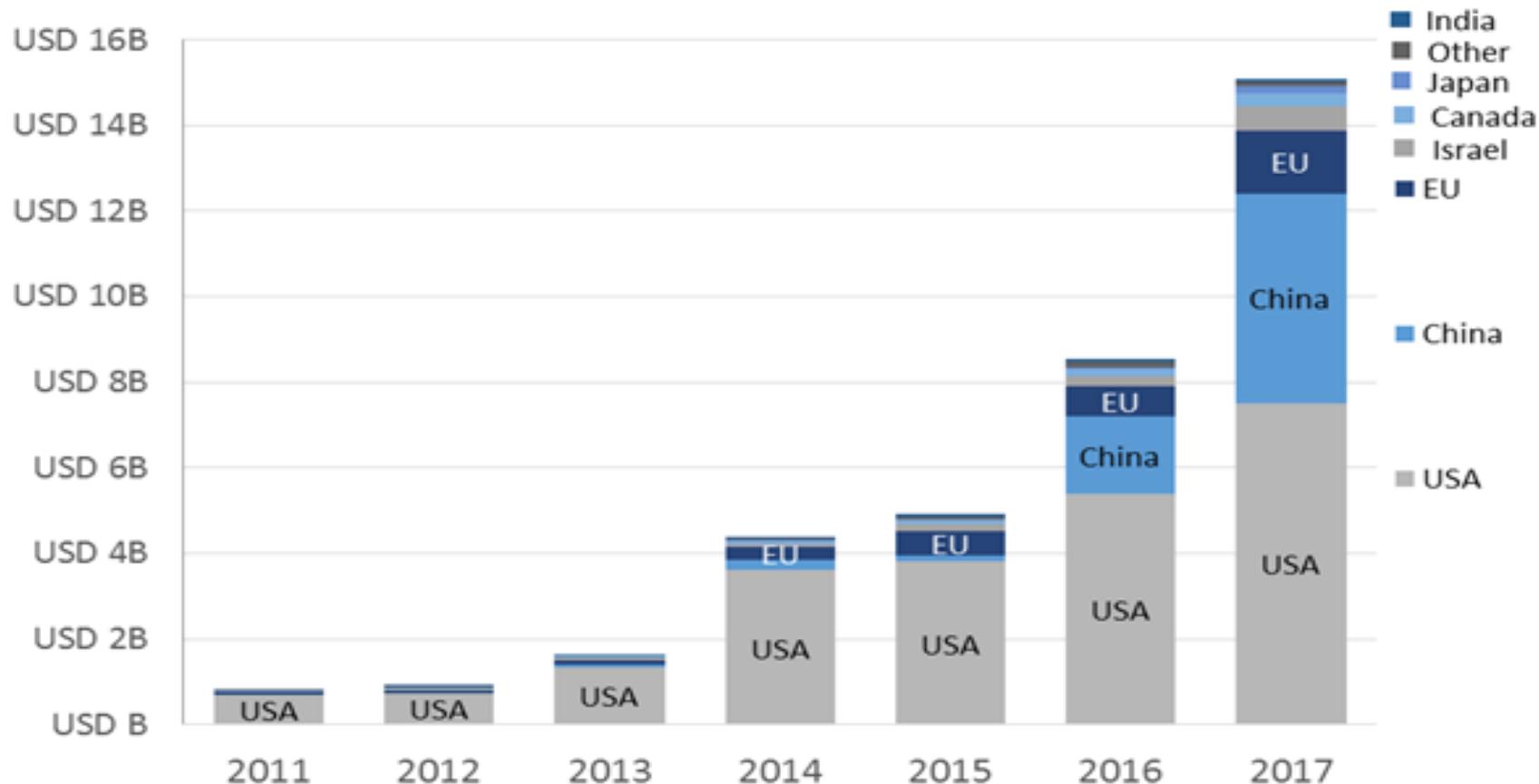
Number of IP5 patent families, top 20 industries

Private investment in start-ups is growing, mainly in the US and China …

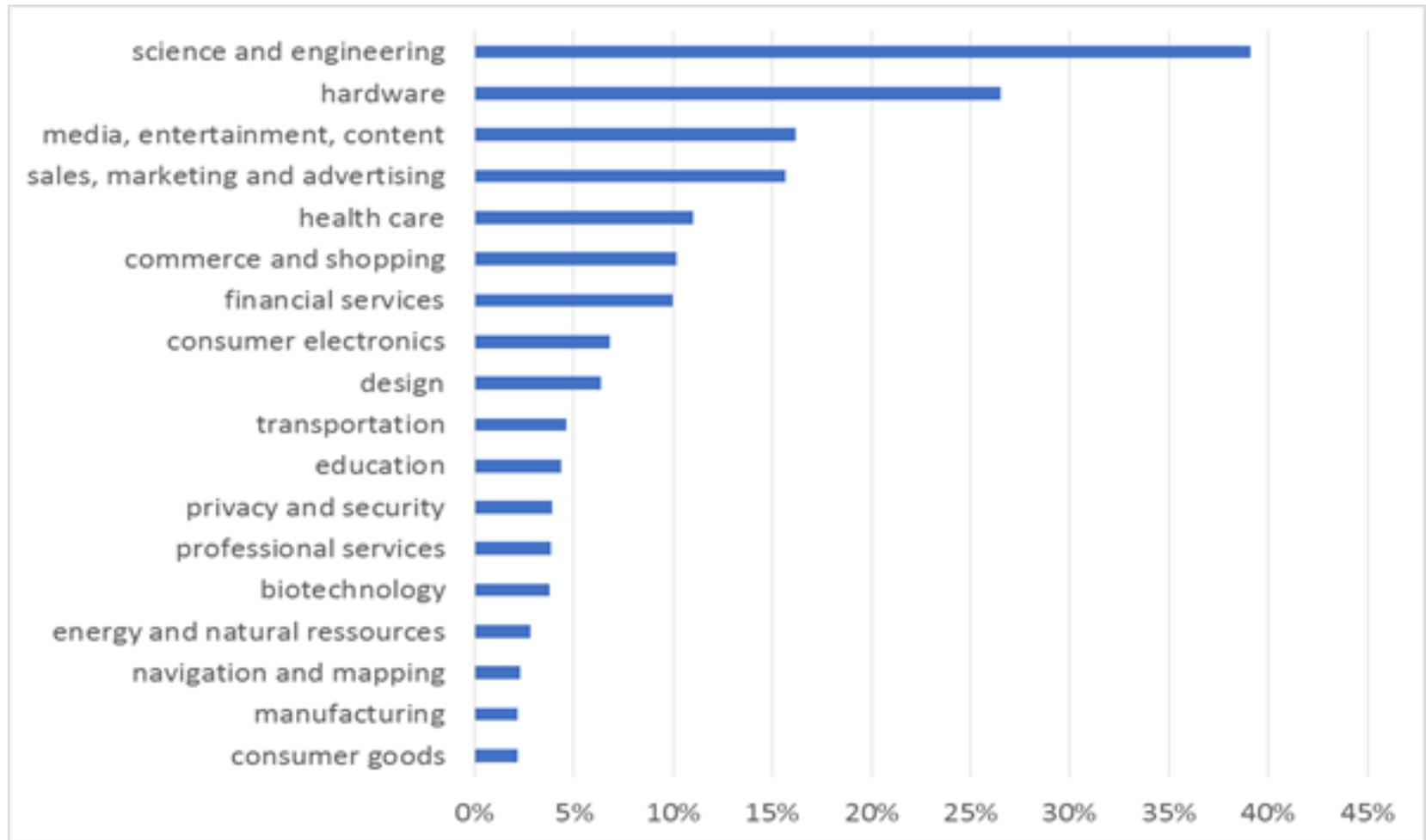**Total estimated investments in AI start-ups (USD billion), 2011-2017**

By start-up location

Source: OECD estimates based on Crunchbase (April 2018), www.crunchbase.com,

AI spans a range of industries

**Top sectors of AI Start-ups from 2011 to 2017 (preliminary)**

Source: OECD estimates based on Crunchbase (April 2018), www.crunchbase.com,

2. MAIN POLICY INITIATIVES

- Governmental AI initiatives – incl. Canada, China, Estonia, Finland, France, Germany, Korea, Japan, UK, US, EC.

- G7 ICT/Innovation/Industry Ministers' Meetings focus on AI: April 2016 Japan; Sep 2017 Turin; March 2018 Canada.
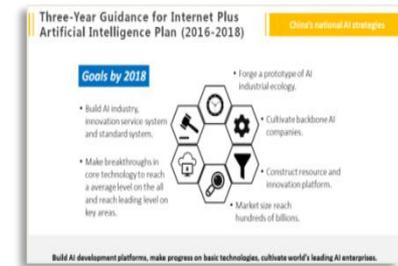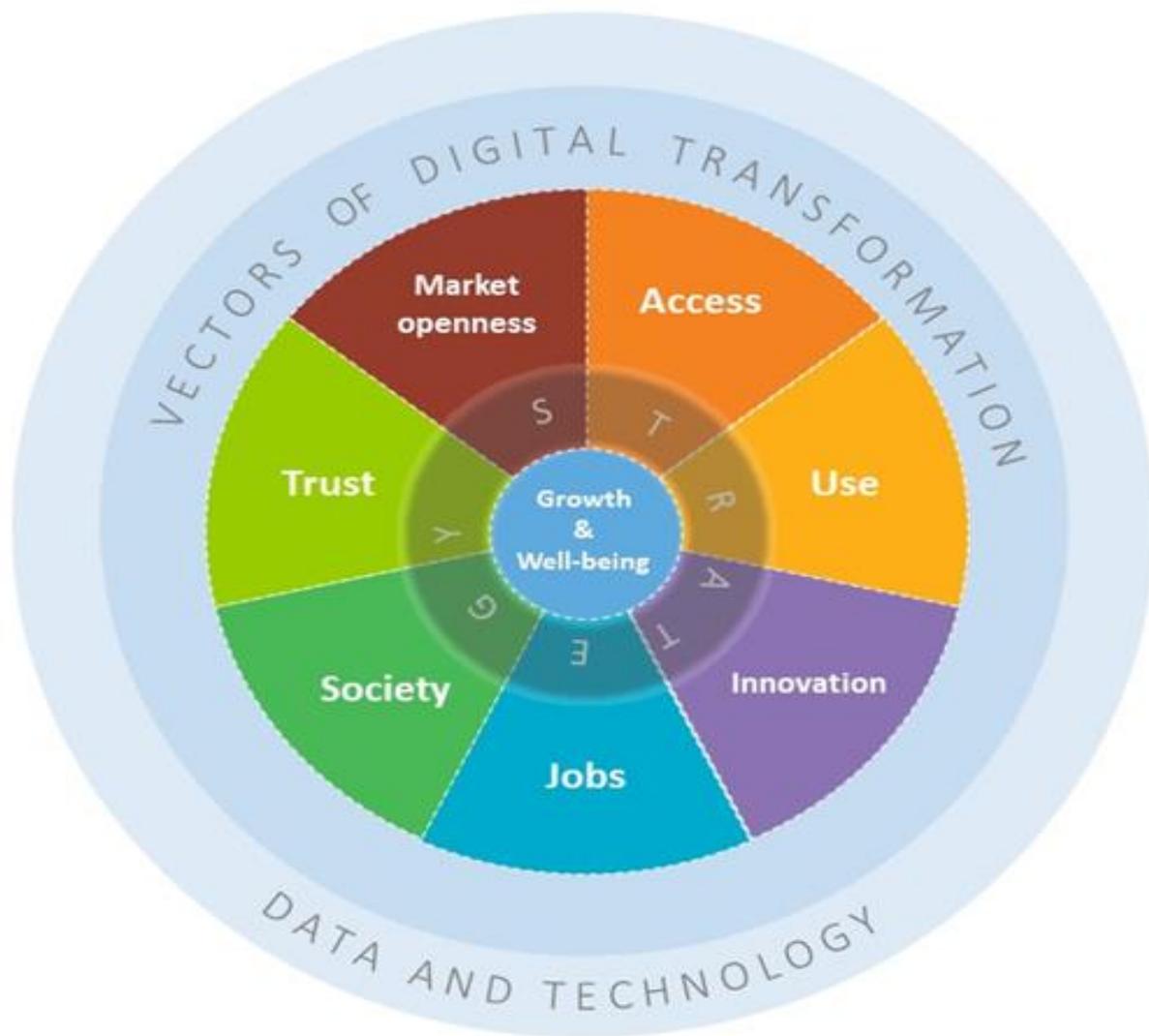

- Non-governmental stakeholder groups are also actively engaged in discussions on AI.

3. KEY POLICY ISSUES

Main Policy Issues:

1. **Access**
2. **Use**
3. **Innovation**
4. **Jobs**
5. **Society**
6. **Trust**
7. **Market Openness**

Contributing to an Integrated Strategy for Growth and Well-Being (or for AI)
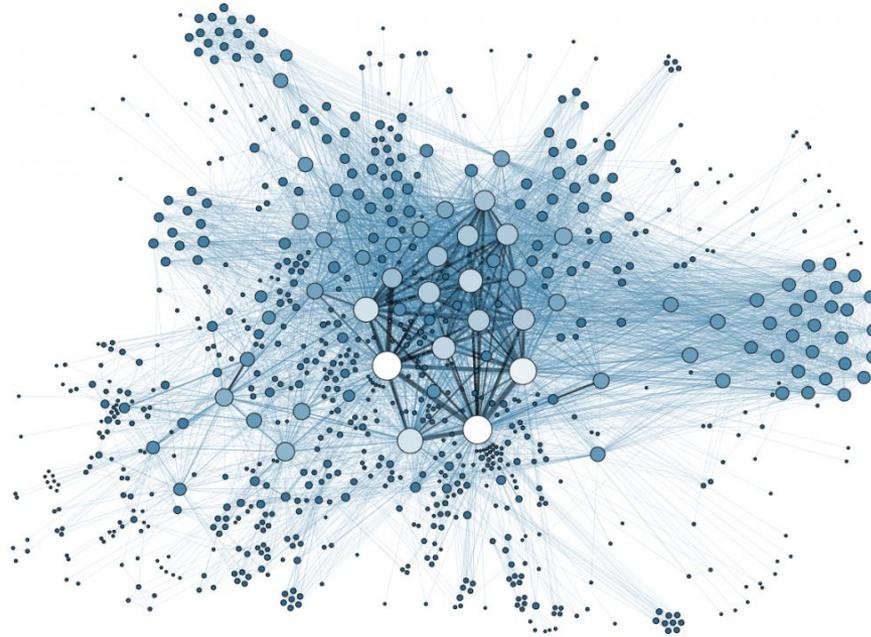
1. **Access** to data …

- AI relies on, and leverages data in fundamentally new ways

- Network and scale effects

How to enhance access to data

- Curated and accurate data

- SME access

- Public interest and global challenges (e.g. a Global Data Commons)?

GOVERNMENT DATA ARE ESSENTIAL FOR AI USE

– **DATA QUALITY**, **INTEROPERABILITY** AND **CONSENT** MODELS ARE A REQUISITE

– AI ENABLES ADVANCES FOR A **DATA-DRIVEN PUBLIC SECTOR**

– **USER-DRIVEN** AND **PROACTIVE SERVICE DELIVERY** THROUGH BETTER UNDERSTANDING OF CITIZENS NEEDS

– **DIGITAL BY DESIGN** APPROACHES INCLUDING AI ARE NOW REQUIRED

… and computing power

AlexNet to AlphaGo Zero: A 300,000x Increase in Compute

https://blog.openai.com/ai-and-compute/
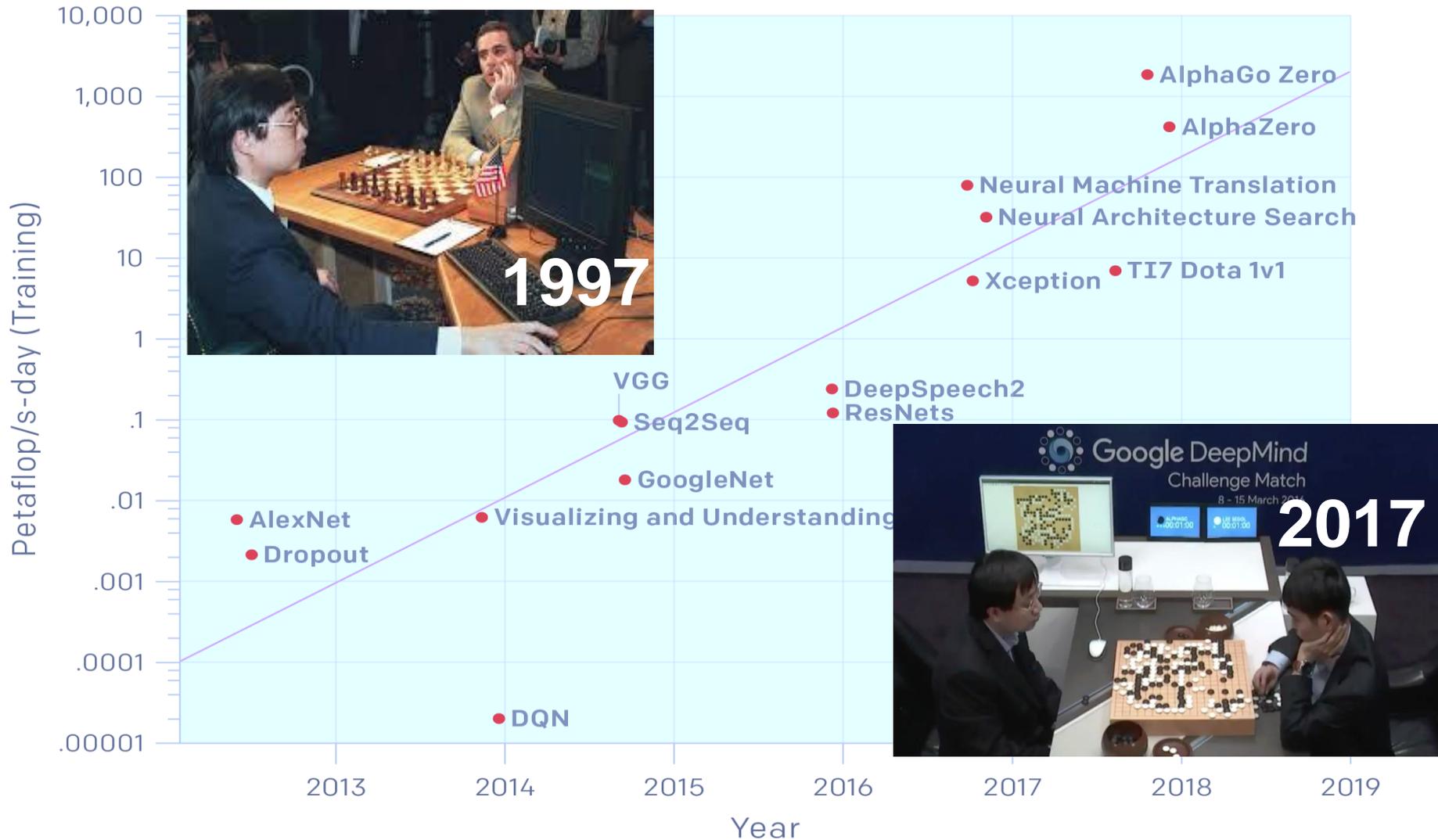
AI helps discover new metals for jets:

"What would have taken years, it narrowed down to days"

The Periodic Table
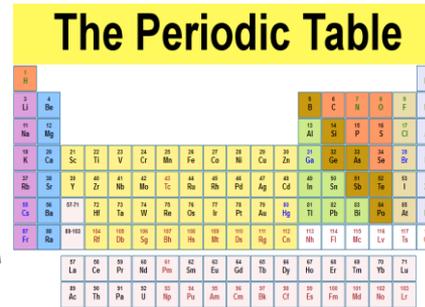
Citrine Informatics AI

Assesses millions of materials combinations

The AI suggests a new metal alloy for use in 3D printing.

Even scans pre-digital era research

BOEING®
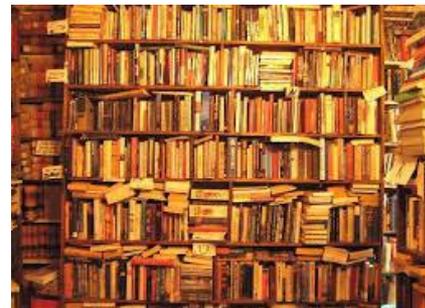
… with opportunities for entrepreneurship, …

AI as a share of financial investments in start-ups, 2011-2017
As a percentage of all investment deals
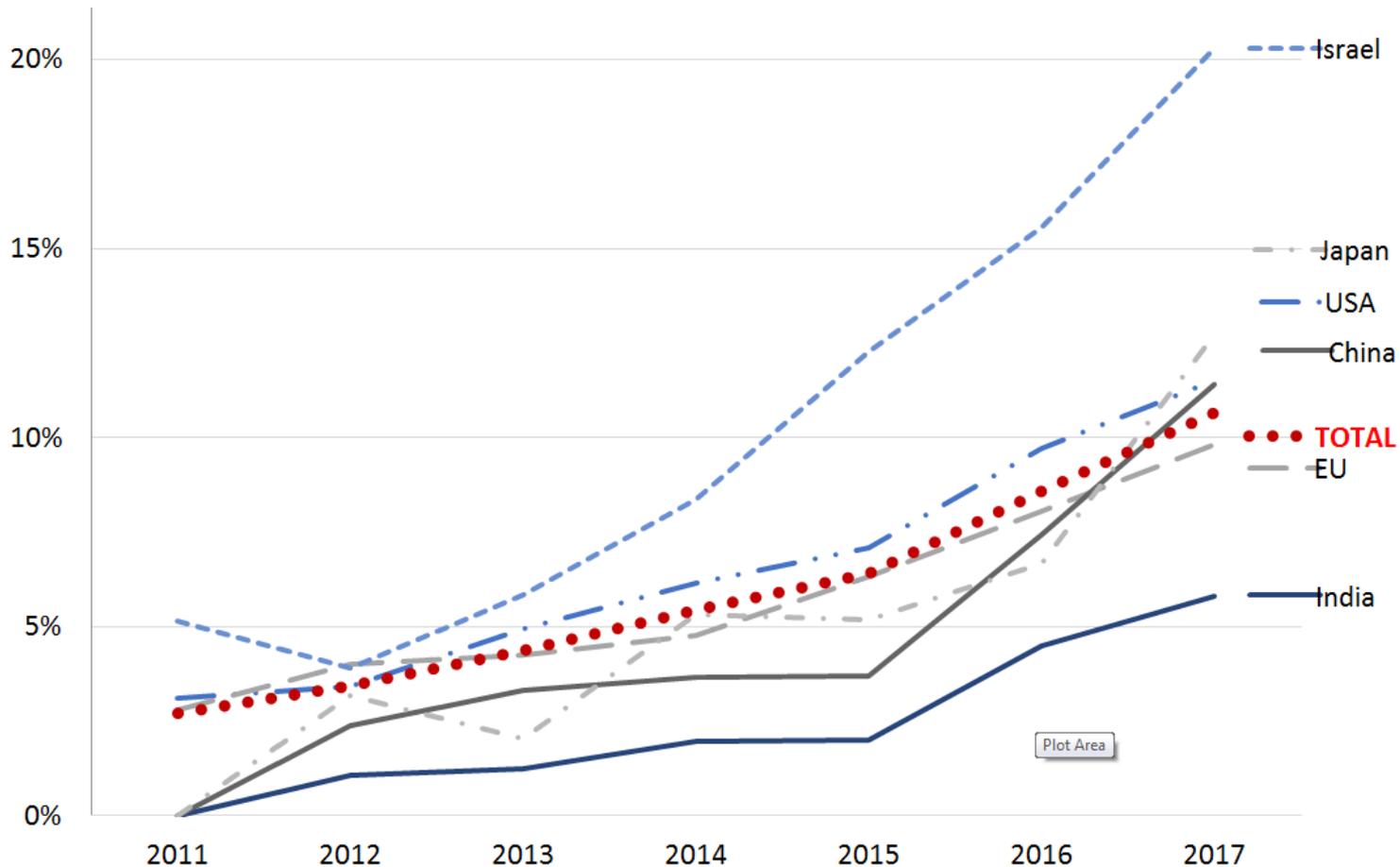
Source: OECD estimates based on Crunchbase (April 2018), www.crunchbase.com,

… and questions about leaders and laggards

The divergence in multi-factor productivity growth

ICT services
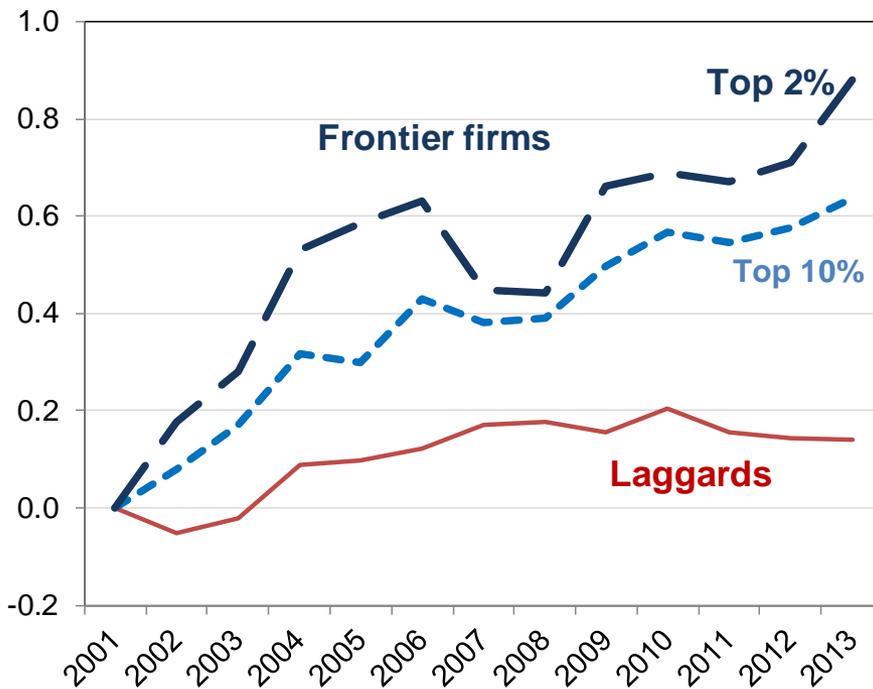
Non-ICT services

Note: Excluding the financial sector

Source: Andrews, D., Criscuolo C., and Gal P. N., "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy", OECD Productivity Working Papers, 2016-05, OECD Publishing, Paris.

4. AI and Jobs: high demand for data scientists and ICT degrees …

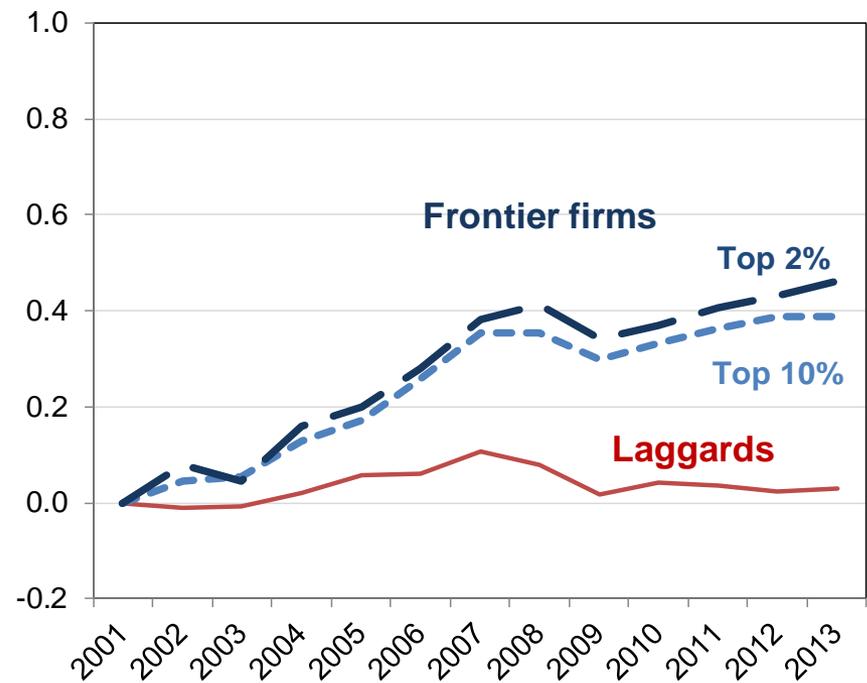## Tertiary graduates in information and communication technologies, by gender, 2015

As a percentage of all tertiary graduates
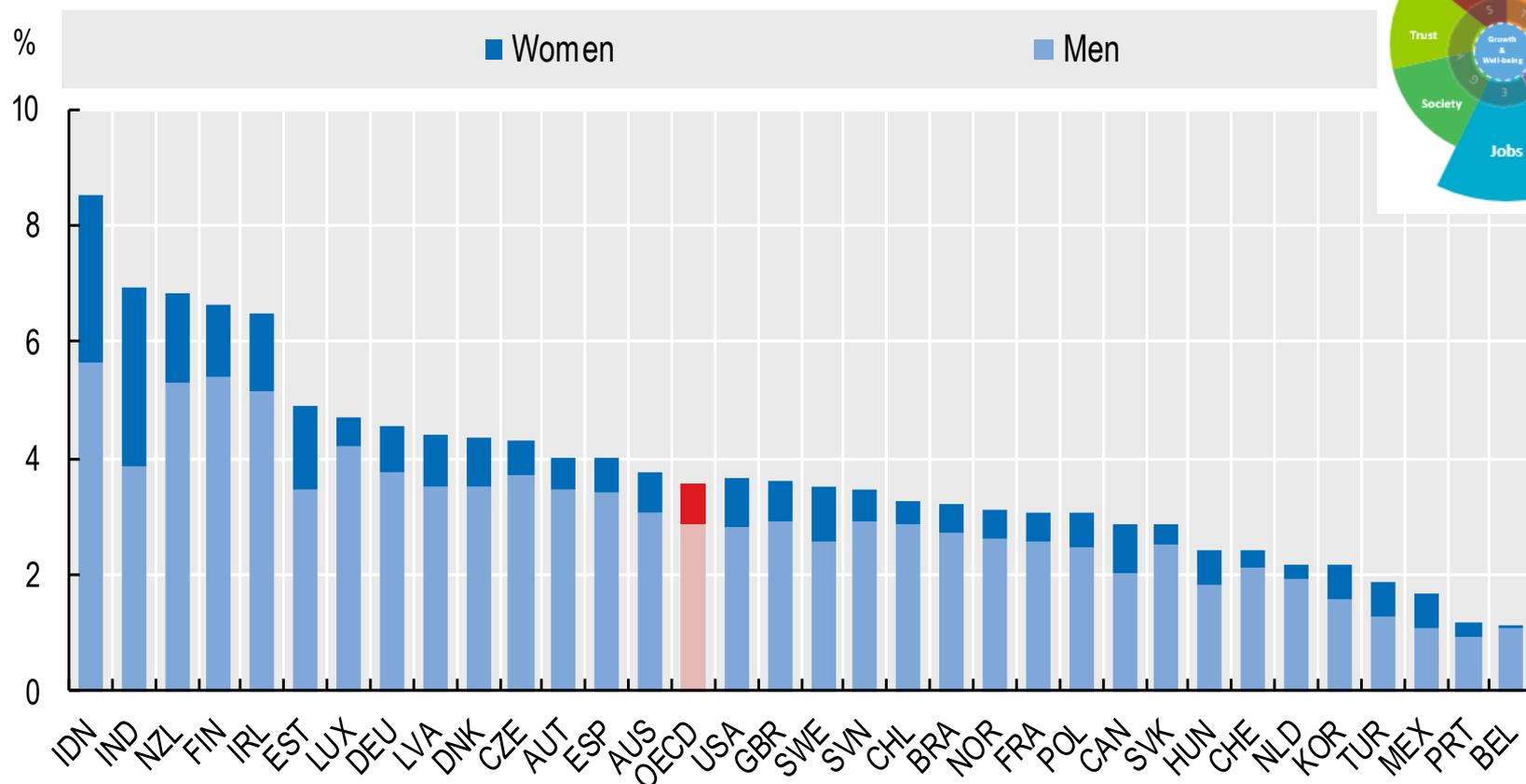
Source: OECD, Science, Technology and Innovation Scoreboard 2017, based on OECD, Education Database, September 2017.

Highest risk in **routine jobs** with low skill and education requirement BUT low risk applies to a broad range from **professionals to social workers**

The risk of automation also falls with **educational attainment**

No evidence of **polarisation or rising risk at the high end**: automation risk declines with skills, education and hourly wages

Educational Research and Innovation
Computers and the Future of Skill Demand

Stuart W. Elliott

OECD
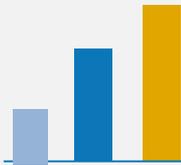
Young people are the most at risk of automation, followed by older workers, with disappearing student jobs and entry positions.

Profiling, monitoring, automated decision-making, algorithmic bias
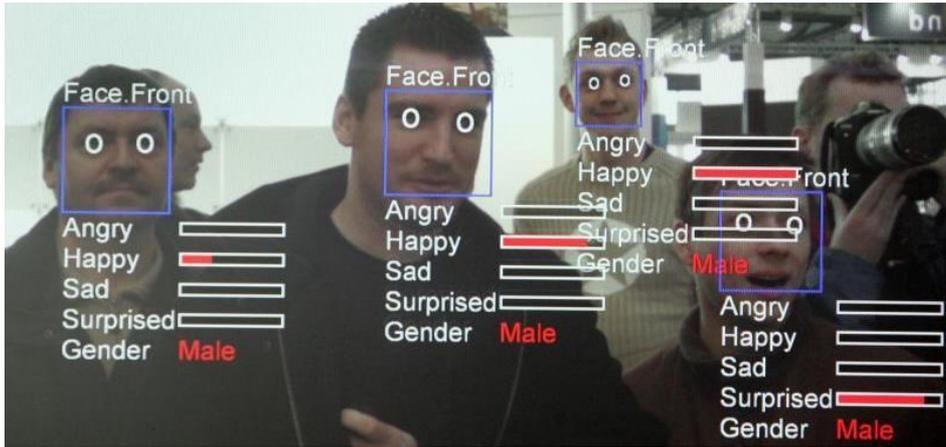
AI challenges collection and use limitation, purpose specification

- Individual control
- Impact assessments
- Privacy by design
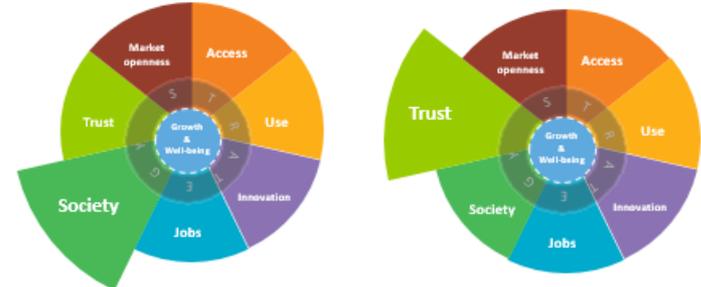
- What do concepts such as "product", "safety", "defect", "damage" mean for s*elf-learning* and *autonomous* systems?

- What about cybersecurity risks that could impact safety (e.g. if hackers take control of car)?

- Adapting liability regimes?

- Treatment of risk via insurance?

- Risk assessments?

- AI system certification?

- Understanding / explaining how systems operate, which factors influence result, level of certainty
- Detecting bias
- Being able to challenge results

7. **Market openness**, e.g. competition

Value of M&A deals per Year by Target Firm Industry

Value of M&As in Digital Sectors – Normalised (2005 = 100)
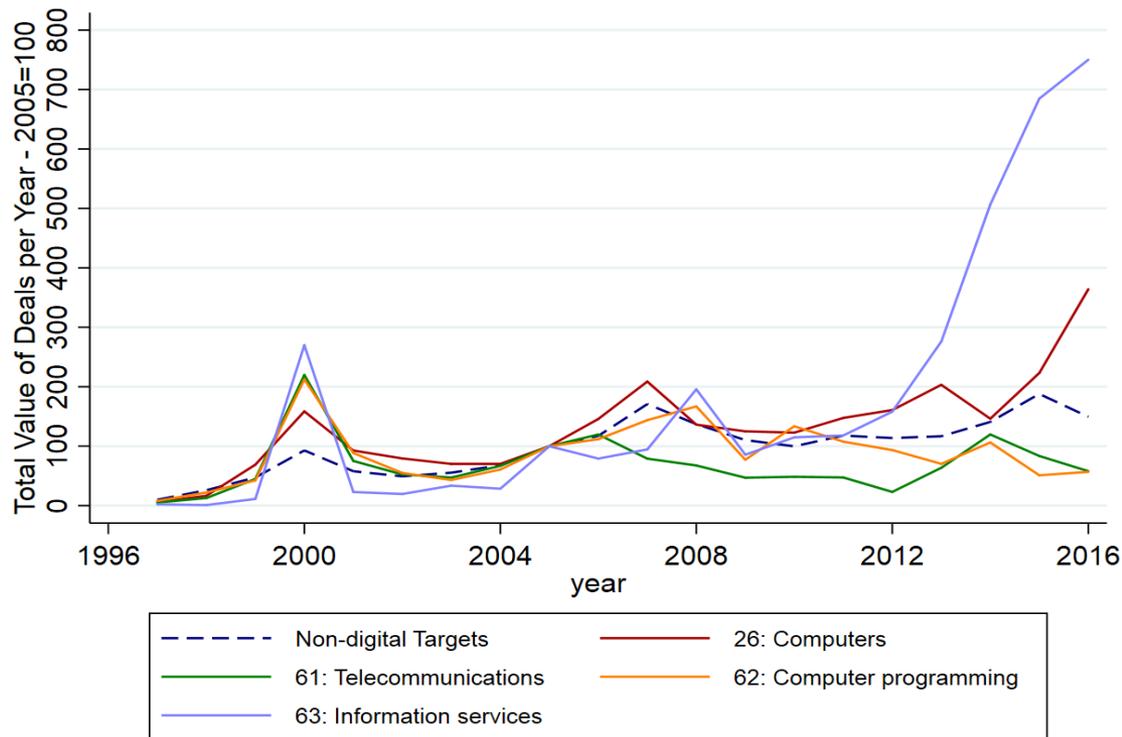
Source: Zephyr M&A database, see DSTI/CIIE(2018)6

4. ONGOING OECD WORK

- The **Going Digital project already touches on many issues related to AI, e.g. access to data, privacy, security, jobs/skills, as well as productivity & competition.**

- **Measurement efforts are also underway**, to improve the evidence base on AI and its impacts

- **Other areas of existing OECD work:**
  - **The implications of AI for science and innovation (CSTP)**
  - **The application of AI within the government (GOV – next slide)**
  - **AI and education (EDU/CERI)**
  - **Automated vehicles (ITF)**
  - **…**

GOV work to support governments in the use of AI

- DIGITAL GOVERNMENT **INDICATORS**
- DIGITAL TRANSFORMATION REPORT (2019)
- **THEMATIC GROUP** ON EMERGING TECHNOLOGIES (INCL AI AND BLOCKCHAIN)
  - 15 COUNTRIES INVOLVED
  - **MAPPING** OF PRACTICES
  - DRAFT OF **GUIDELINES** ON THE USE OF EMERGING TECHNOLOGIES IN THE PUBLIC SECTOR
- **E-LEADERS 2018** DEDICATED TO EMERGING TECHNOLOGIES IN THE PUBLIC SECTOR (SEOUL, 30-31 OCTOBER)
- **OECD EXPERT GROUP ON AI** –TO UNDERSTAND HOW INTELLIGENT MACHINES ARE CHANGING LIVES AND REDEFINING WHAT IT MEANS TO BE HUMAN.

Next steps

- Planned development of OECD **guidelines and Council Recommendation** related to ensuring trust in AI, also in response to G7 discussions in Ottawa

- **Further work analytical and mapping work and measurement**, to improve the evidence base on AI and its impacts

- Development of an **AI Policy Observatory**

- **OECD Expert Group on AI in Society**

- …

Towards AI guidelines …

Reference	Existing sets of guidelines for AI developed by stakeholders
ACM	Association for Computing Machinery US Public Policy Council (2017) "Statement on Algorithmic Transparency and Accountability"
Asilomar	Future of Life Institute (FLI) (2017) "Asilomar AI Principles"
COMEST	World Commission on the Ethics of Scientific Knowledge and Technology (2017)
EPSRC	Engineering and Physical Sciences Research Council (2010) "Principles of robotics"
FATML	Fairness, Accountability, and Transparency in Machine Learning (FATML) (2016) "Principles for Accountable Algorithms and a Social Impact Statement for Algorithms"
IEEE	Institute of Electrical and Electronics Engineers (IEEE) (2017) Global Initiative on Ethics of Autonomous and Intelligent Systems, "Ethically Aligned Design Version 2"
ITI	Information Technology Industry Council (ITI) (2017) "AI Policy Principles"
JSAI	The Japanese Society for Artificial Intelligence (JSAI) (2017), JSAI Ethical Guidelines
MIC	Japanese Ministry of Internal Affairs and Communication (MIC)(2017) "Draft AI R&D Guidelines for International Discussions"
Montreal	University of Montreal (2017), "Montreal Declaration for a Responsible Development of Artificial Intelligence"
Nadella	Nadella, S (2017) "The Partnership of the Future"
PAI	Partnership on AI to benefit people and society (2016) "TENETS"
UNI	UNI Global Union (2017) "Top 10 Principles for ethical artificial intelligence"

Thank you

OECD Going Digital website: http://oe.cd/goingdigital

GOV work: http://www.oecd.org/gov/digital-government

Some OECD resources related to AI:

AI: Intelligent Machines, Smart Policies – Conference Summary
[DSTI/CDEP(2018)8]

Artificial Intelligence in Society – Part1
[DSTI/CDEP(2018)9]