



*Investing in Science and Innovation,
CSIC and CEMFI Workshop, Madrid 25 October 2018*

_ The dual impact of excellent research on science and innovation

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OUTLINE

- Motivation

- The dual impact of excellent research:
 1. countries and institutions

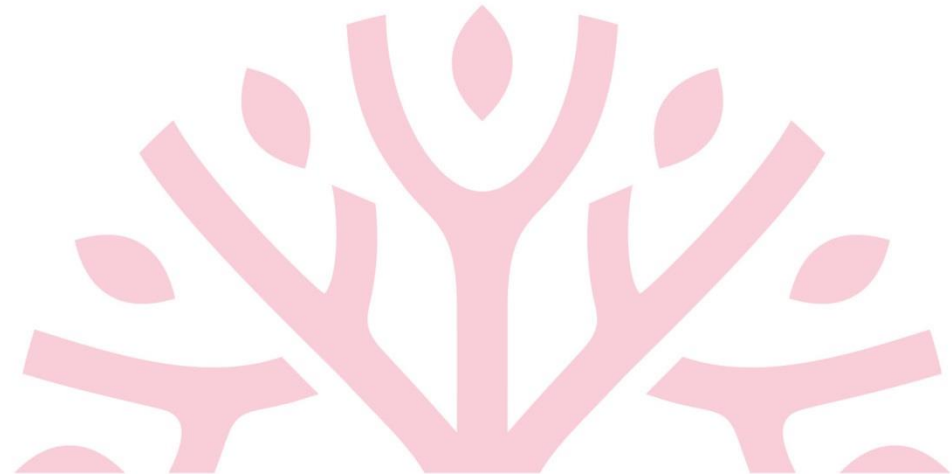
- The dual impact of excellent research:
 2. individual publications

- Conclusions for policy design



MOTIVATION

EVIDENCE BASED R&I POLICY DESIGN



SCIENCE, RESEARCH AND INNOVATION PERFORMANCE OF THE EU 2018

STRENGTHENING THE FOUNDATIONS FOR EUROPE'S FUTURE

European commission

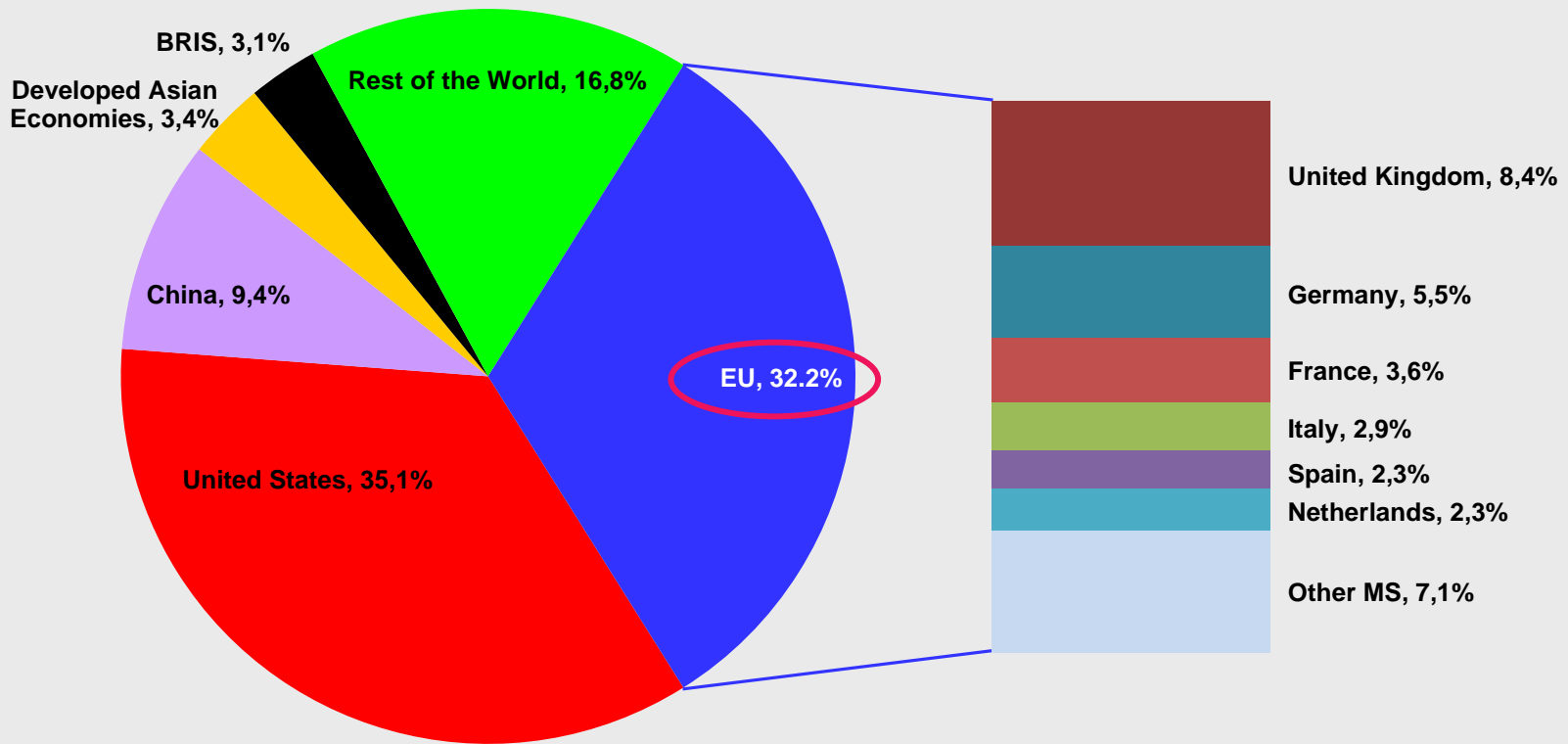
Europe is the world's largest producer of high quality scientific knowledge, and yet its innovation performance remains far below its potential.

Extract from the Foreword by Carlos Moedas,
European Commissioner for Research, Science and Innovation

WORLD SHARE OF TOP 1% MOST CITED PUBLICATIONS*

Size dependent indicator

2014



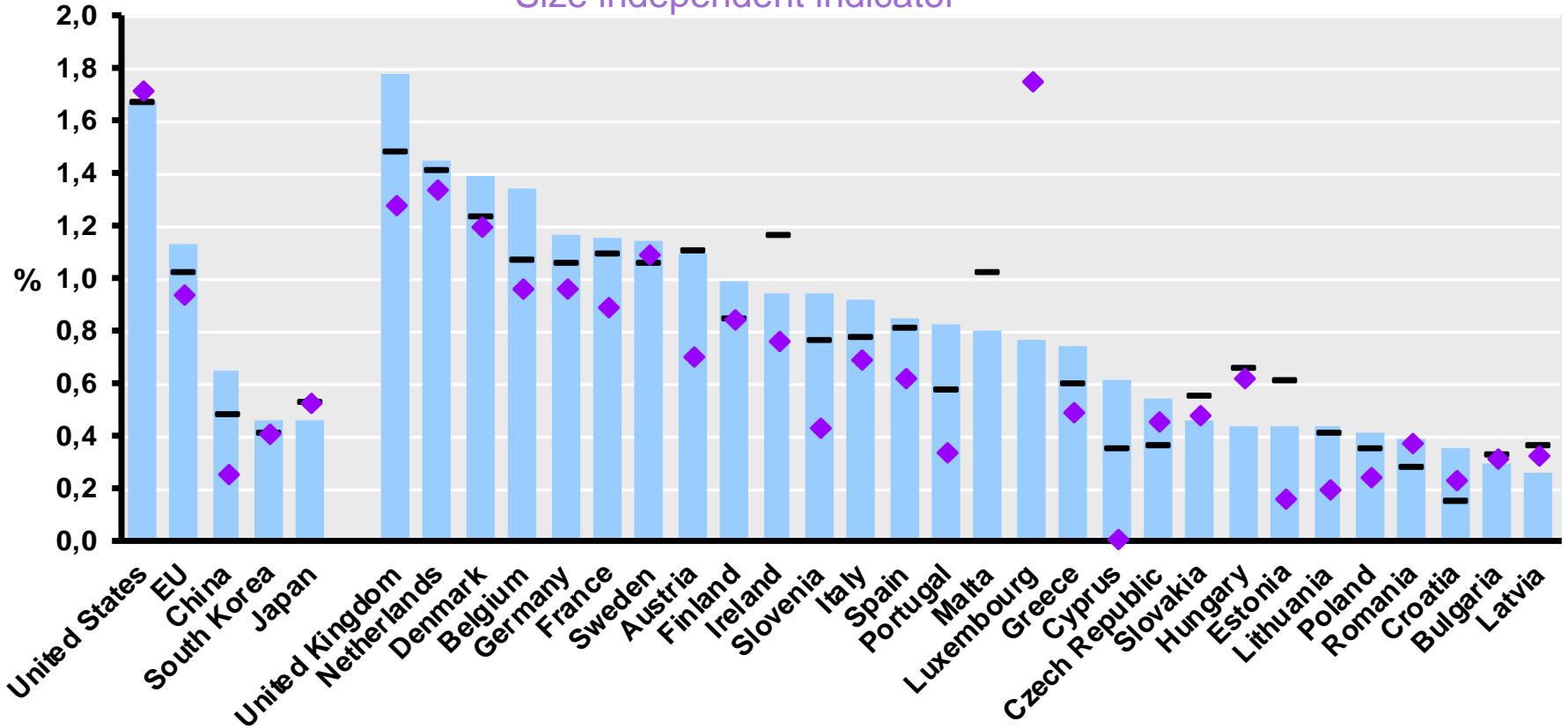
* Fractional counting

Source : SRIP 2018

PROPORTION OF TOP 1% PUBLICATIONS

Top 1% highly cited scientific publications⁽¹⁾, 2000, 2007 and 2014

Size independent indicator



■ 2014 (citation window: 2014-2016) – 2007 (citation window: 2007-2009) ◆ 2000 (citation window: 2000-2002)

Source : SRIP 2018

LAB – FAB – APP Investing in the European future we want

Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes

European Commission 2017

Extract from the INTRODUCTION

When looking ahead to the future of Europe in a globalising world, the contrast is striking between Europe's comparative advantage in producing knowledge and its comparative disadvantage in turning that knowledge into innovation and growth.

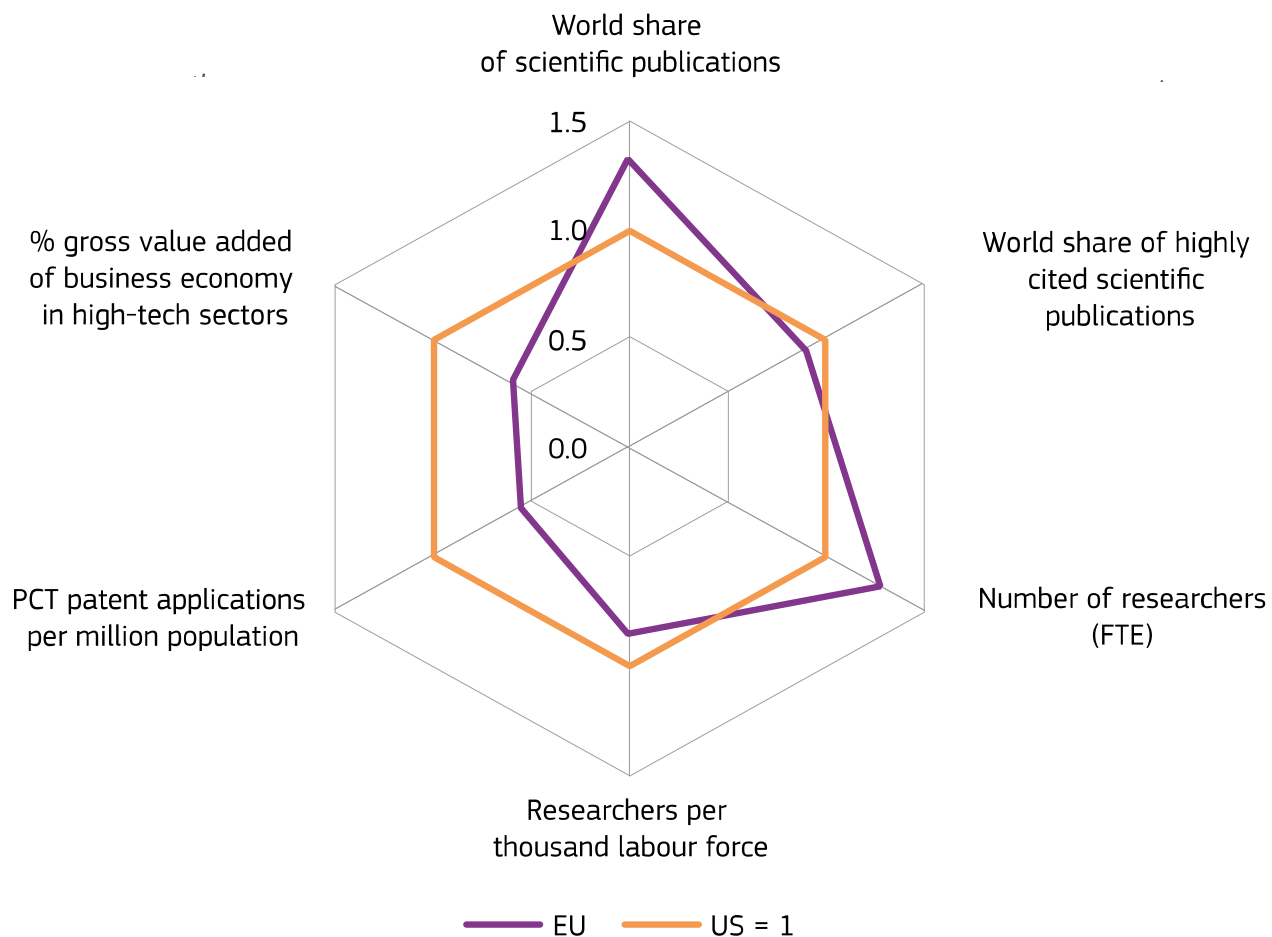
...

At the heart of Europe's slow growth lies its innovation deficit. Europe does not capitalise enough on the knowledge it has and produces.

LAB – FAB – APP

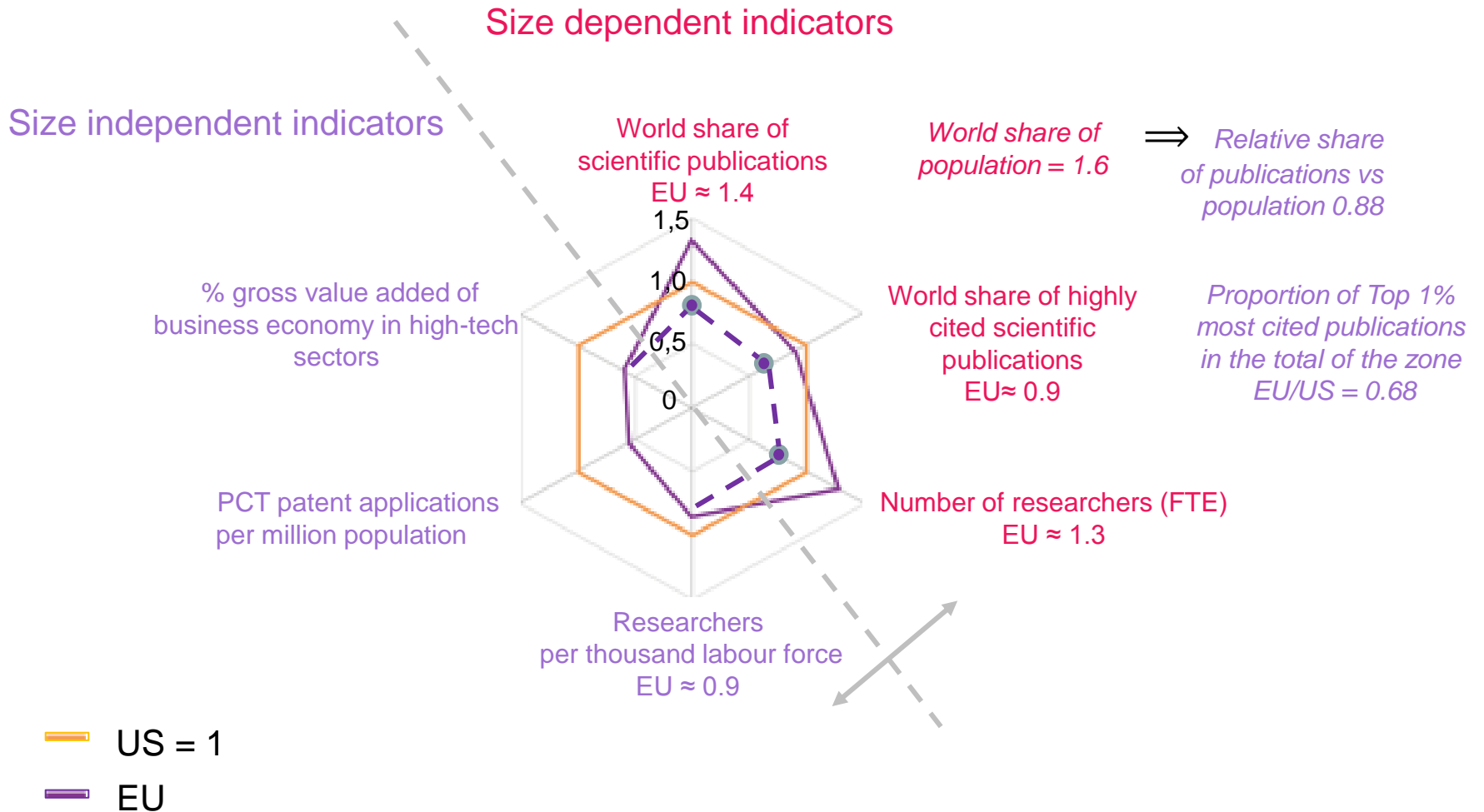
INTRODUCTION

Figure 1



Source: European Commission, DG Research and Innovation. Data: Eurostat, OECD, CWTS based on Web of Science

LAB-FAB-APP Figure 1 : discussion



MOTIVATION

The « European paradox » has been formulated in different ways over the last two decades, but only exists if the scientific indicators are expressed in volume/size dependent while innovation indicators are expressed in intensity .

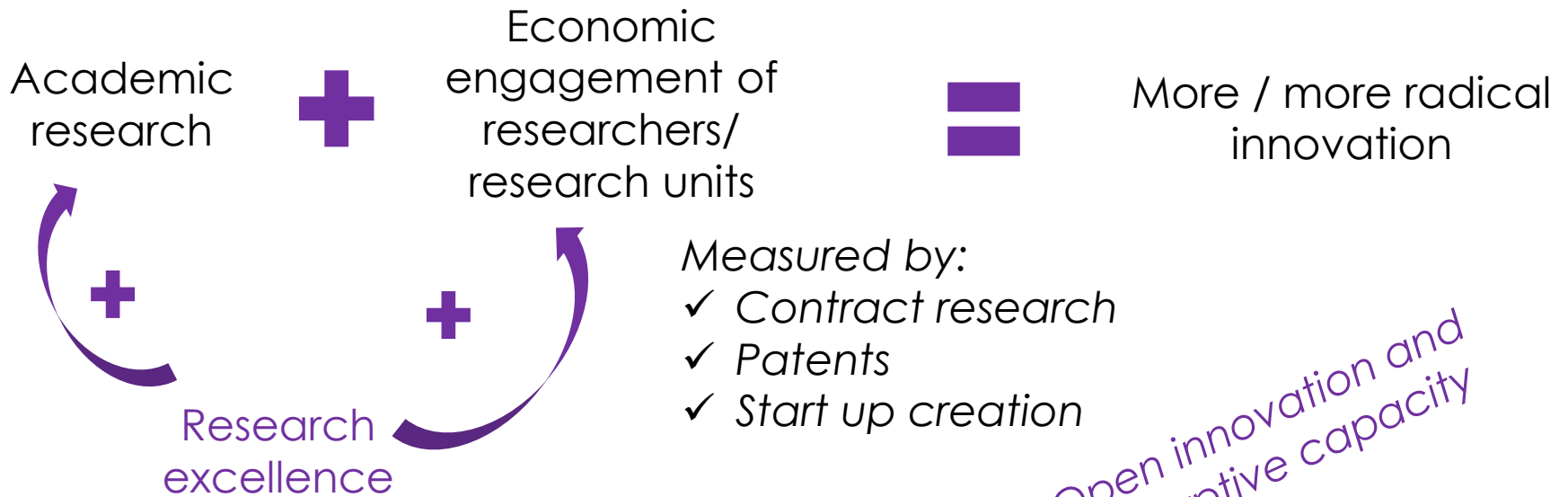
Then an important question for policy design can be formulated as follows: does innovation depend on the volume of scientific production or on its quality/novelty/excellence ?

The dual impact of excellent research

1. countries, institutions and individuals



IMPACT OF EXCELLENCE ON TECH TRANSFER



Measured by:

- ✓ Project research funds
- ✓ Bibliometric indicators
- ✓ National evaluation process

The dual impact of 'excellent' research on science and innovation: the case of Europe,
K. Jonkers, F. Sachwald, *Science and Public Policy*, 2018

The dual impact of excellent research

2. *individual scientific publications*



The dual frontier: Patented inventions and priori scientific advance 1.

A. Ahmadpoor, B. F. Jones, *Science* 357, August 2017

- Integrated citation network: traces 4.8M USPTO patents issued from 1976 to 2015 to 32M journal articles published from 1945 to 2013 (WOS, science and engineering).
- Paper-patent boundary (PPB): patents that directly cite articles.
- The network further determines the minimum distance for other papers and patents to this boundary. This distance/D is applied to characterise papers and patents from different scientific fields/technologies, institutional origins.
- First result : 60% of patents made references that could be traced to scientific papers; 80% papers with at least one citation could ultimately be connected to a patent. At the boundary: 21% of connected patents and 10% of connected papers. Mostly indirect connectivity.

The dual frontier: Patented inventions and priori scientific advance 2.

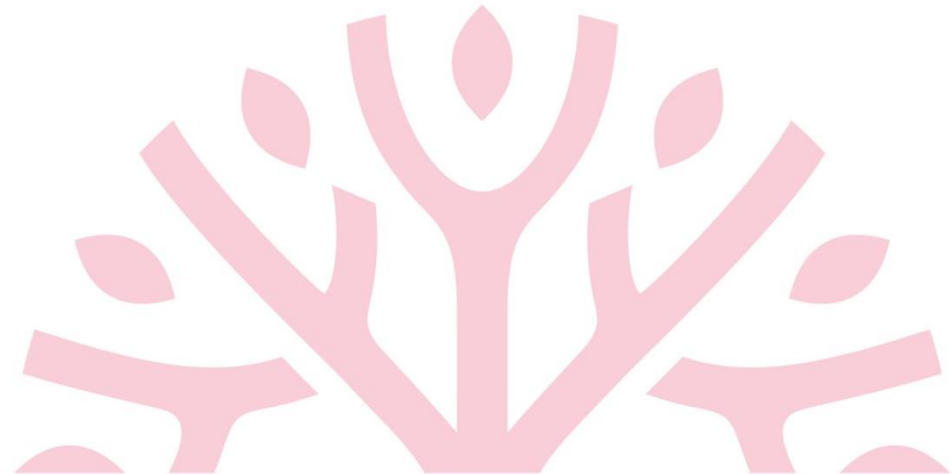
- Mean distance connexion varies across disciplines and technologies. Closest technologies to the PPB: molecular biology, artificial intelligence...
Closest sc. fields: nanoscience and techno, materials sc. and biomaterials... and most distant, mathematics
- Related concept: delays for the citations to occur.
- Patents at the PPB are more cited. Similarly, articles directly cited by patents are more likely to be highly cited by other papers. **—————>** « dual impact ».
- Universities more engaged in high D research, while articles by firms are closer to $D=1$. This is 1/3 due to field composition
- 55% of university patents cited a paper written by an individual with the same name: Pasteur quadrant and star scientists (citations).

COMPLEMENTARY RESEARCH AT THE PAPER LEVEL

Research underway on novelty indicators and scientific impact, citations in patents.

Complementarity between understanding and use/impact

Conclusion for policy design



LAB – FAB – APP Investing in the European future we want

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European Commission 2017

Recommendation 4

Design the EU R&I programme for greater impact.

Action: make the future programme's pillars driven by purpose and impact, fine-tune the proposal evaluation system and increase flexibility.

1. excellent science	➡	science and skills	/ ERC
2. industrial leadership and society	➡	innovation and competitiveness	/ EIC
3. societal challenges	➡	global challenges	/ large missions

This recommendation and other reports/speeches on R&I policy design neglects the strong connexions/interactions between socio-economic impact and scientific impact that have been demonstrated by a number of empirical studies.

Thank you for your attention



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