



# SCIENCE, TECHNOLOGY AND INNOVATION MEASUREMENT AT THE OECD AND NESTI

OECD-NBS International Training Workshop on Innovation  
Statistics  
16-18 July 2019 Xi'an, China

Fernando Galindo-Rueda  
OECD Directorate for Science, Technology and Innovation





# CONTEXT TO WORK ON STI STATISTICS AT OECD



# Introduction – the OECD context

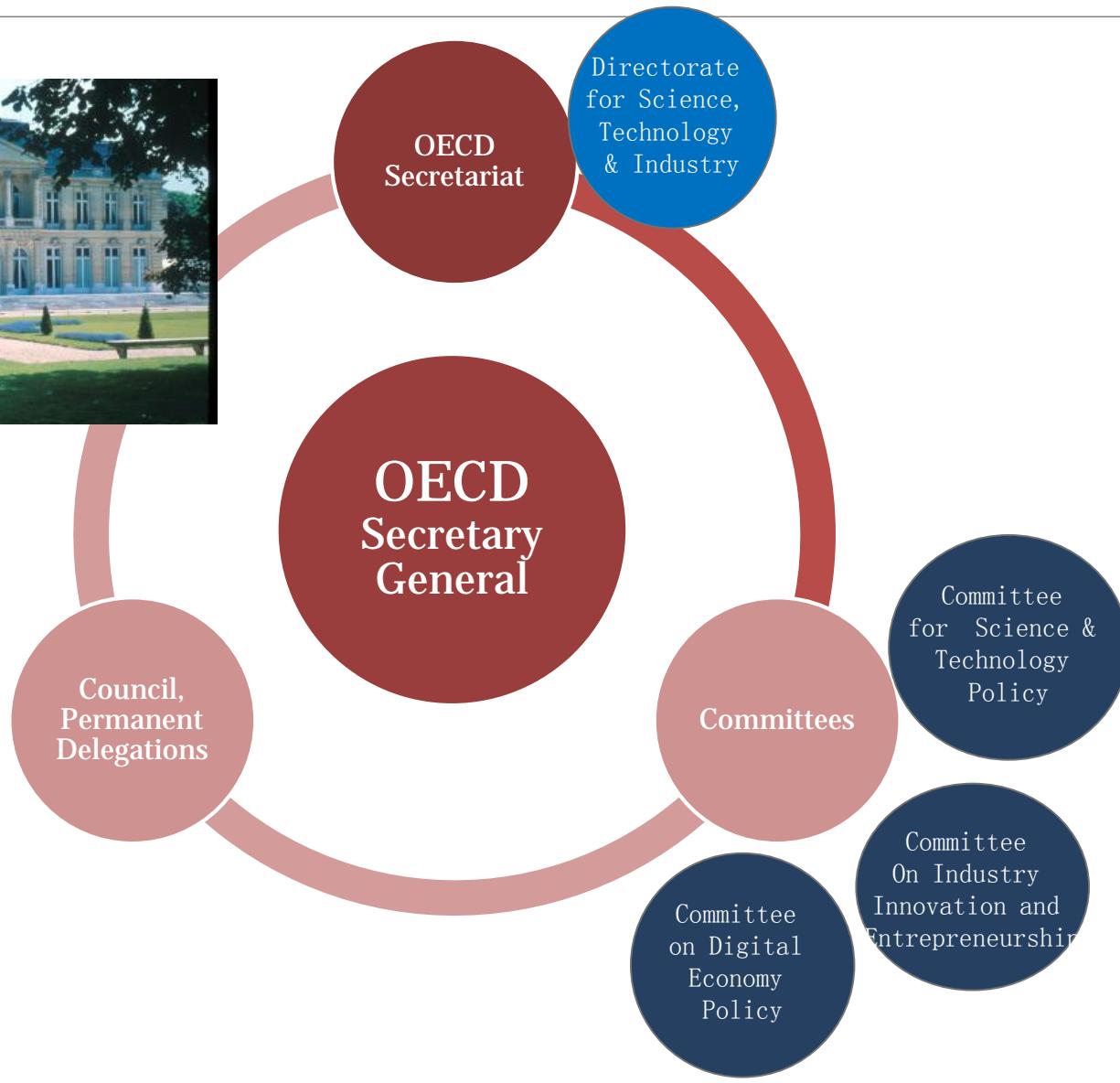
- Paris-based international organisation, created in 1962.
  - Predecessor in agency tasked with implementing the Marshall Plan in Europe



- Mission: “**to promote policies that will improve the economic and social well-being of people around the world**”.
- As of today, 36 member countries and Colombia about to become 37<sup>th</sup> country.

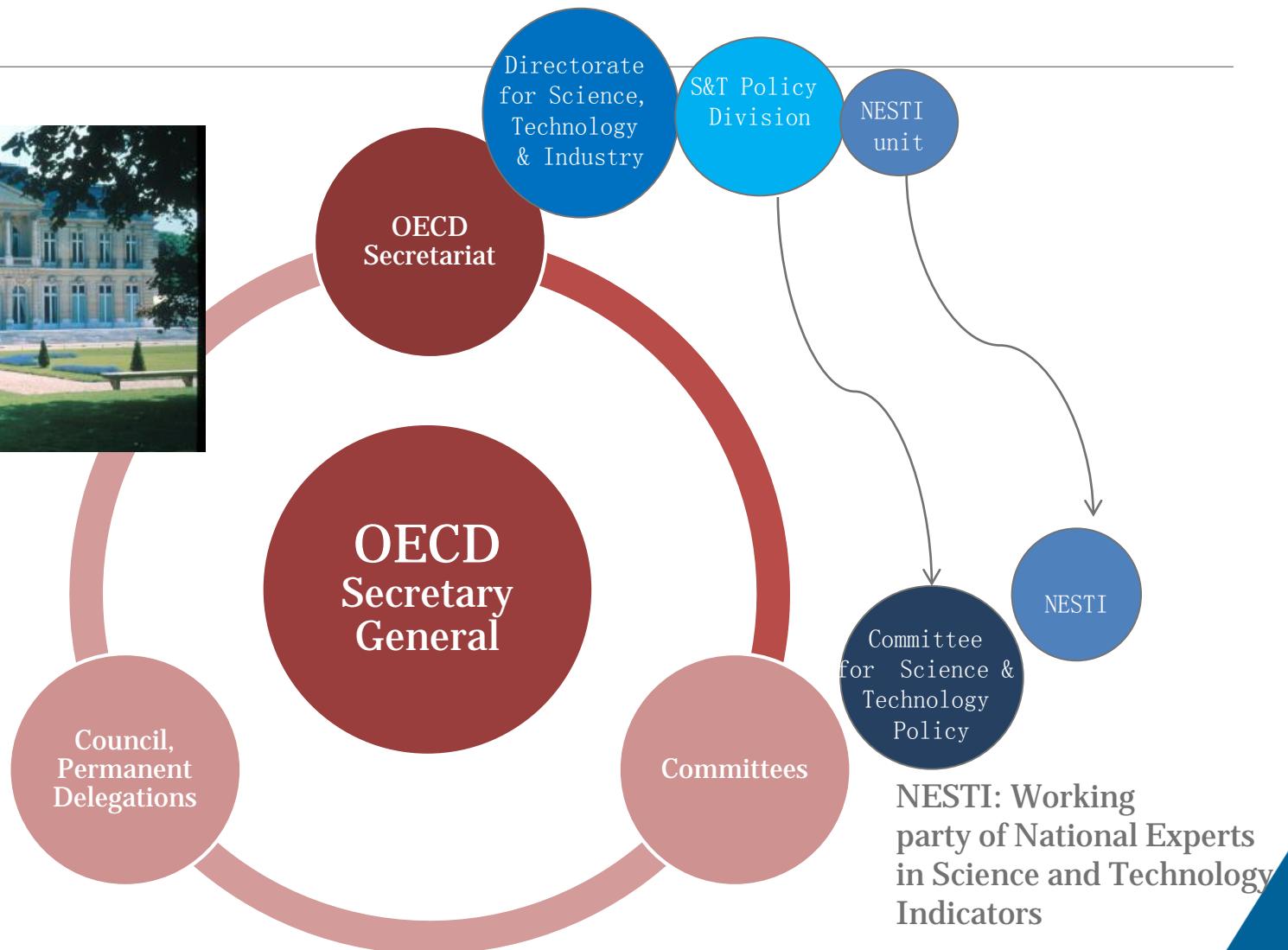


# Work on Science, Technology and Innovation (STI) and STI statistics at OECD





# Work on STI and STI statistics at the OECD





# NESTI: A community of practice for STI stats

- NESTI. Since 1962 engaging users and producers of STI indicators
  - Common language
  - Common concerns and challenges
  - A network of networks

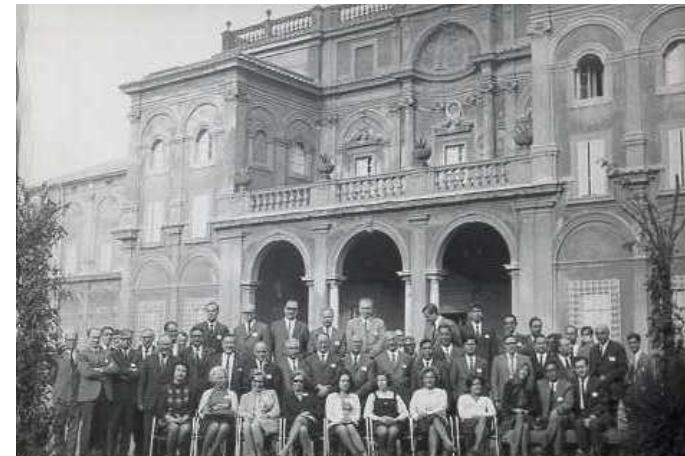


- Heads of statistical and analytical services in science, innovation and industry ministries and agencies
- Experts acting on behalf of the former.
- Heads of STI focused units in national statistical offices.



# Modes of participation at NESTI

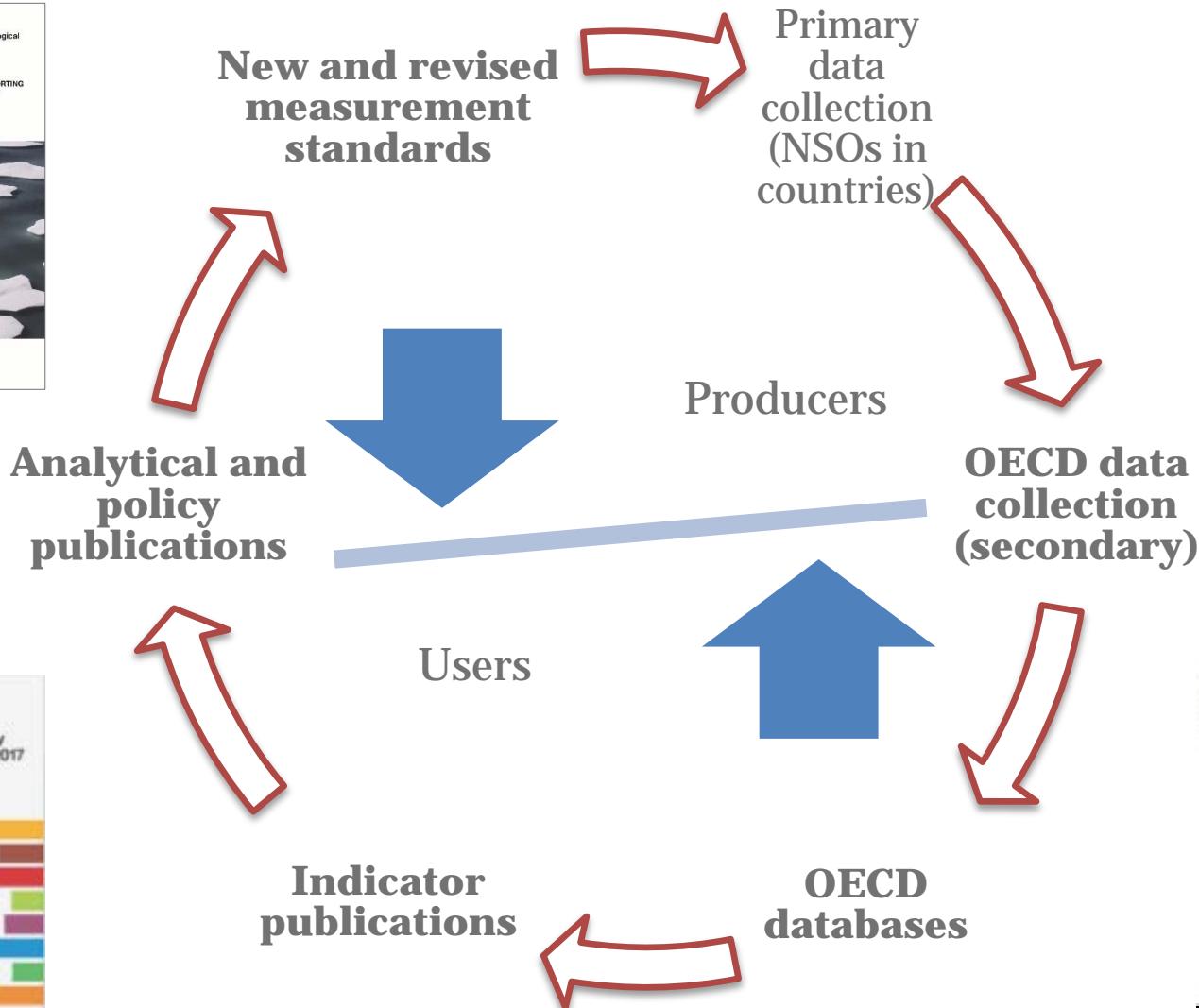
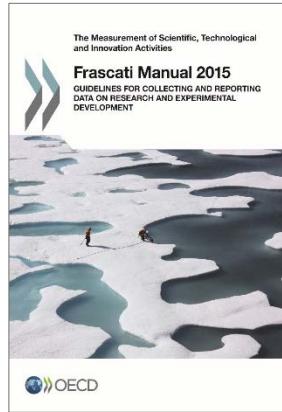
- Member countries (36) and EU
  - Participation open to
    - Countries through OECD accession process
    - Key partners of the OECD
    - Argentina, Russian Federation...
  - Invitees
    - Attendance on ad hoc basis, communication.
    - Recently Viet Nam, Egypt...
  - International organisations
    - UNESCO, African Union, LAC expert network of the IAE, ad hoc participation of World Bank, IADB, EBRD, etc...
- Regional initiatives: *Missing an Asian group.*





# The full cycle of indicators at OECD

## *The designed approach with NSOs*





# Long term view on STI data and indicators

- Major drivers of change
  - Evolving user needs
  - Possibilities and challenges (digital)
- Major topics
  - Digital/AI
  - Globalisation
  - Innovation impacts and SDGs – human centred



OECD (2018), "Blue Sky perspectives towards the next generation of data and indicators on science and innovation", in *OECD STI Outlook 2018* Paris, [https://doi.org/10.1787/sti\\_in\\_outlook-2018-19-en](https://doi.org/10.1787/sti_in_outlook-2018-19-en).



INFORMING SCIENCE AND INNOVATION POLICIES  
**TOWARDS THE NEXT GENERATION  
OF DATA AND INDICATORS**

19-21 September 2016, Ghent, Belgium



# Areas of current OECD measurement work

---

- Innovation statistics (discussed extensively in previous sessions)
- In addition to this:
  - R&D statistics and the Frascati Manual
  - STI statistics about science, scientists and researchers
  - Measurement of STI policies



# R&D STATISTICS AND THE FRASCATI MANUAL

The Measurement of Scientific, Technological  
and Innovation Activities

## Frascati Manual 2015

### GUIDELINES FOR COLLECTING AND REPORTING DATA ON RESEARCH AND EXPERIMENTAL DEVELOPMENT

#### Contents

Chapter 1. Introduction to R&D statistics and the *Frascati Manual*

#### Part I. Defining and measuring R&D: General guidance

Chapter 2. Concepts and definitions for identifying R&D

Chapter 3. Institutional sectors and classifications for R&D statistics

Chapter 4. Measurement of R&D expenditures: Performance and sources of funds

Chapter 5. Measurement of R&D personnel: Persons employed and external contributors

Chapter 6. Measuring R&D: Methodologies and procedures

#### Part II. Measuring R&D: Sector-specific guidance

Chapter 7. Business enterprise R&D

Chapter 8. Government R&D

Chapter 9. Higher education R&D

Chapter 10. Private non-profit R&D

Chapter 11. Measurement of R&D globalisation

#### Part III. Measuring government support for R&D

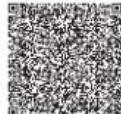
Chapter 12. Government budget allocations for R&D

Chapter 13. Measurement of government tax relief for R&D

Consult this publication on line at <http://dx.doi.org/10.1787/9789264239012-en>.

This work is published on the OECD iLibrary, which gathers all OECD books, periodicals and statistical databases.

Visit [www.oecd-ilibrary.org](http://www.oecd-ilibrary.org) for more information.



The Measurement of Scientific, Technological  
and Innovation Activities

## Frascati Manual 2015

### GUIDELINES FOR COLLECTING AND REPORTING DATA ON RESEARCH AND EXPERIMENTAL DEVELOPMENT



Frascati Manual 2015 GUIDELINES FOR COLLECTING AND REPORTING DATA ON R&D





## Chapter 2. Concepts and definitions for identifying R&D – Broad definition

---

- ***Research and experimental development (R&D)*** comprise creative and systematic work undertaken in order to
  - increase the stock of knowledge – including knowledge of humankind, culture and society –
  - and to devise new applications of available knowledge.





## Three main types of R&D (B-A-D)

---

- **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.
- **Applied research** is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.
- **Experimental development** is systematic work, drawing on knowledge gained from research and practical experience **and generating additional knowledge**, which is directed to producing new products or processes or to improving existing products or processes.

*(Not necessarily experimental as in lab experiments)*



## Chapter 2: Concepts and Definitions for Identifying R&D

---

- Identifies a set of explanatory **criteria** to help in implementation.

All five criteria are to be met, at least in principle, every time an R&D activity is undertaken whether on a continuous or occasional basis, by a performer in any sector.

- **Novel (aimed at new findings)**
- **Creative (based on original concepts; not obvious)**
- **Uncertain (outcome, cost, time allocation not known a priori)**
- **Systematic (planned and budgeted)**
- **Transferable and/or reproducible (there should be the potential to transfer results)**



# R&D resources

## Expenditures and human resources

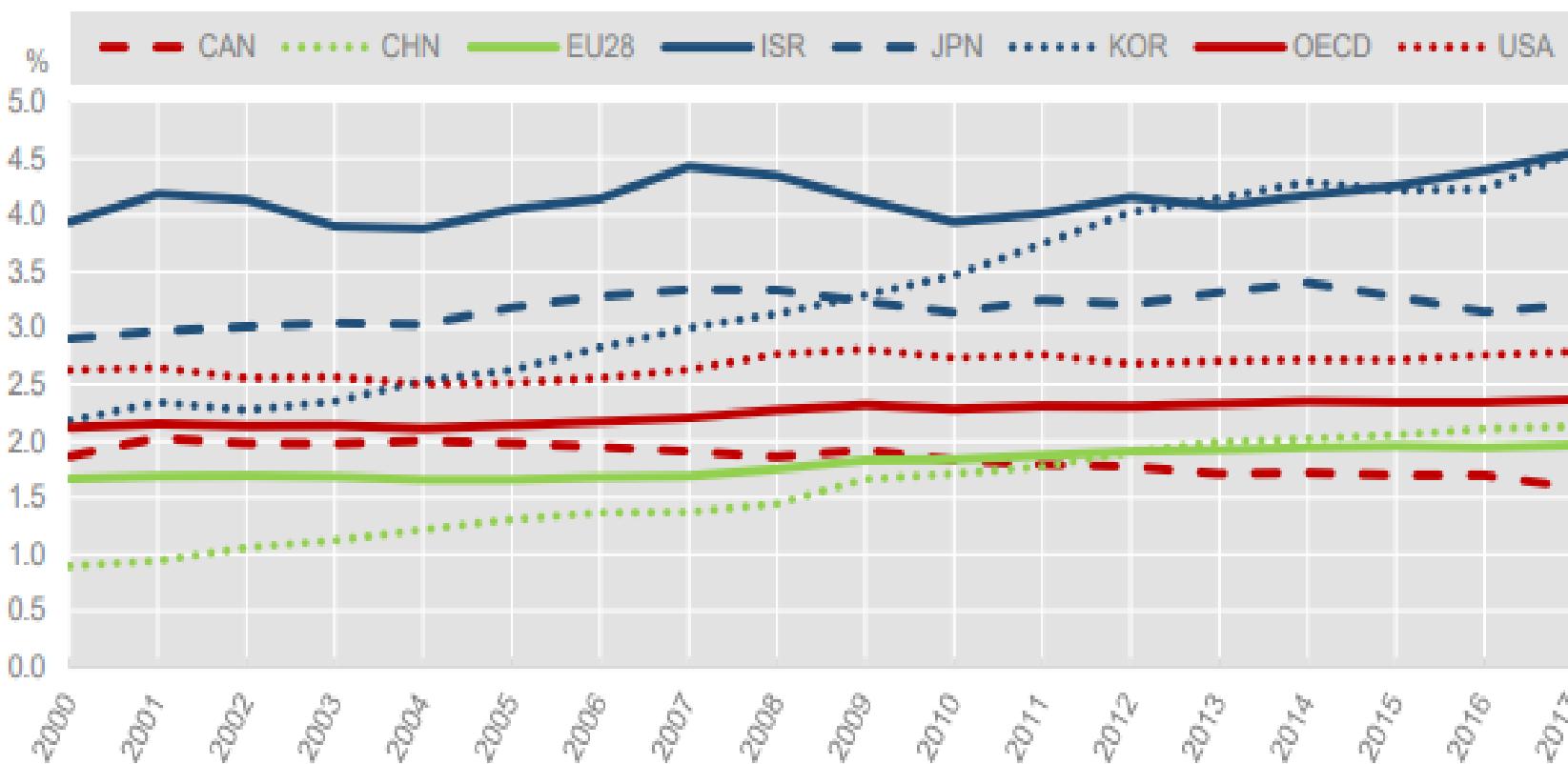
---

- Data collected principally from perspective of performer to
  - avoid double counting
  - ensure maximum awareness of nature of work
- Key aspects of interest for data collection on expenditures
  - sectorisation of unit
  - what is the structure of the R&D activity (types of costs)
  - what is the nature of the R&D activity? Basic/ applied research or experimental development
  - who is funding the R&D activity of a unit?
  - → sectoral specificities : e.g. industry orientation for business R&D
  - → scientific and technological domains



# R&D intensity indicator

## R&D intensity: Gross Domestic Expenditure on R&D as a percentage of GDP, 2000-2017



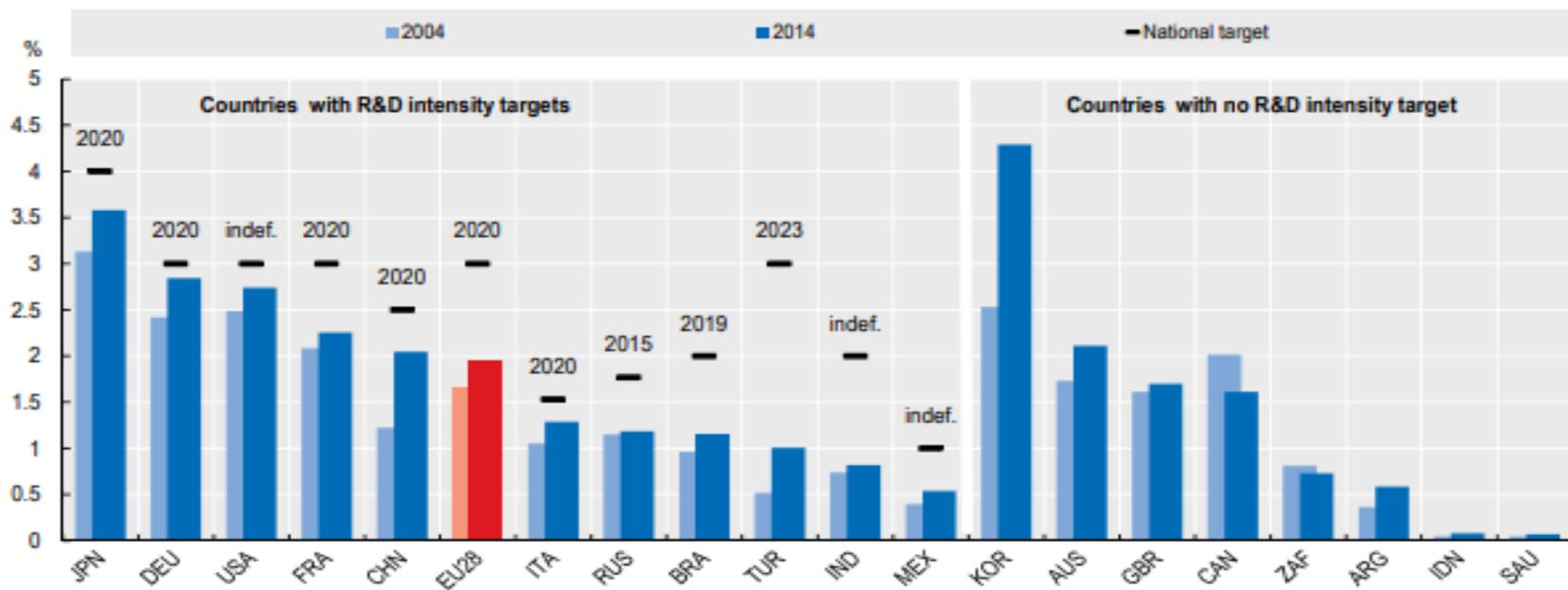
Source: OECD Main Science and Technology Indicators Database, February 2019. <http://oe.cd/msti>



# R&D intensity as a policy target

**Figure 2.** National R&D expenditure targets and gap with current levels of GERD intensity, G20 economies, 2014

As a percentage of GDP

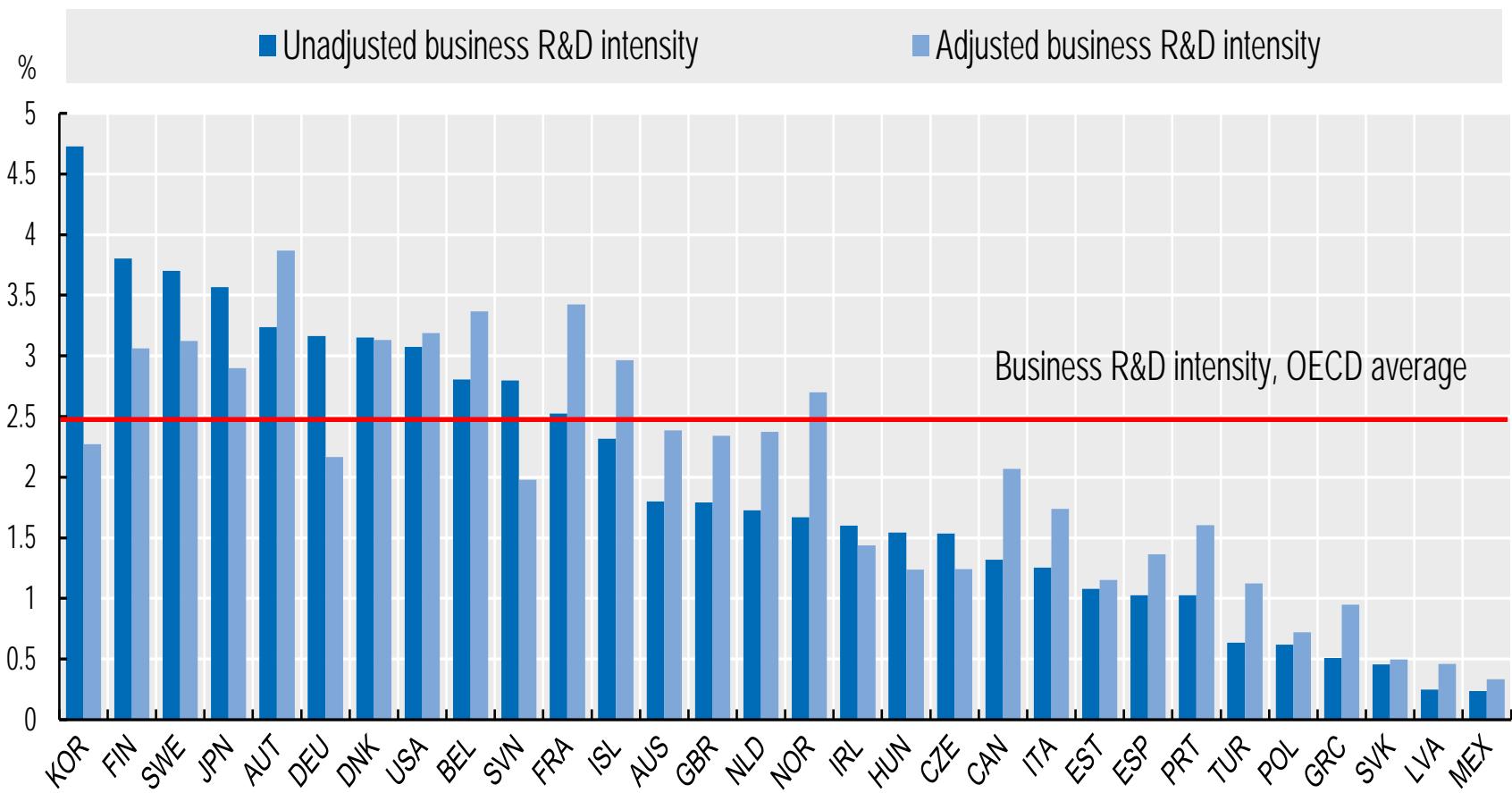


Note: "indef." is an abbreviation for indefinite or no fixed end date for reaching the target.

Sources: OECD, *Main Science and Technology Indicators* database, [www.oecd.org/sti/msti.htm](http://www.oecd.org/sti/msti.htm), January 2016; data for Brazil, India, Indonesia and Saudi Arabia from UNESCO Institute for Statistics, November 2015; data on national R&D targets from country responses to OECD STI Outlook policy questionnaire 2014 and national sources (Brazil).



# ECONOMIC STRUCTURE IS ONE FACTOR EXPLAINING BUSINESS R&D INVESTMENT EFFORTS



Source: [OECD Science, Technology and Industry Scoreboard 2017](#)

Statlink: <http://dx.doi.org/10.1787/888933619524>



# R&D budgets

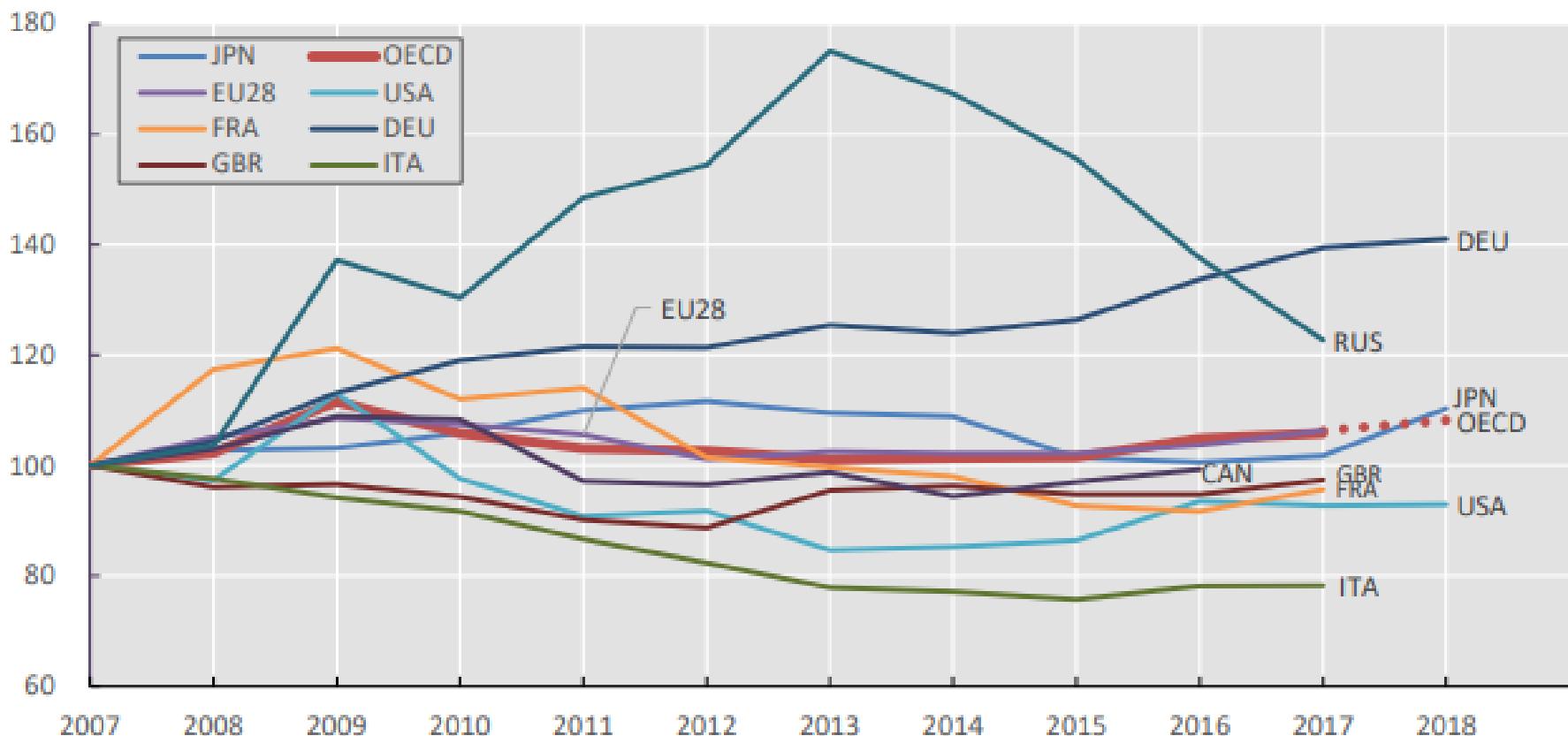
---

- Data from budgetary/related admin sources to inform
  - Latest changes in government support for R&D
  - Direction of government budget support?
    - General advancement of knowledge
    - Specific priorities (health, defence, etc...)



# R&D budgets

R&D budget trends, selected economies, 2007-2018



Source: OECD Main Science and Technology Indicators (MSTI) Database, February 2019 <http://oe.cd/msti>



# R&D statistics

---

- Following adoption of the Frascati Manual 2015 edition, work has focused on implementation with NSOs
- Key areas driving current and future work:
  - R&D globalisation, esp role of MNEs
  - Digitalisation and R&D – R&D efforts on AI
  - Role of government research institutes
  - Relevance of R&D efforts for addressing societal challenges



## Webpage – <http://oe.cd/frascati>

---

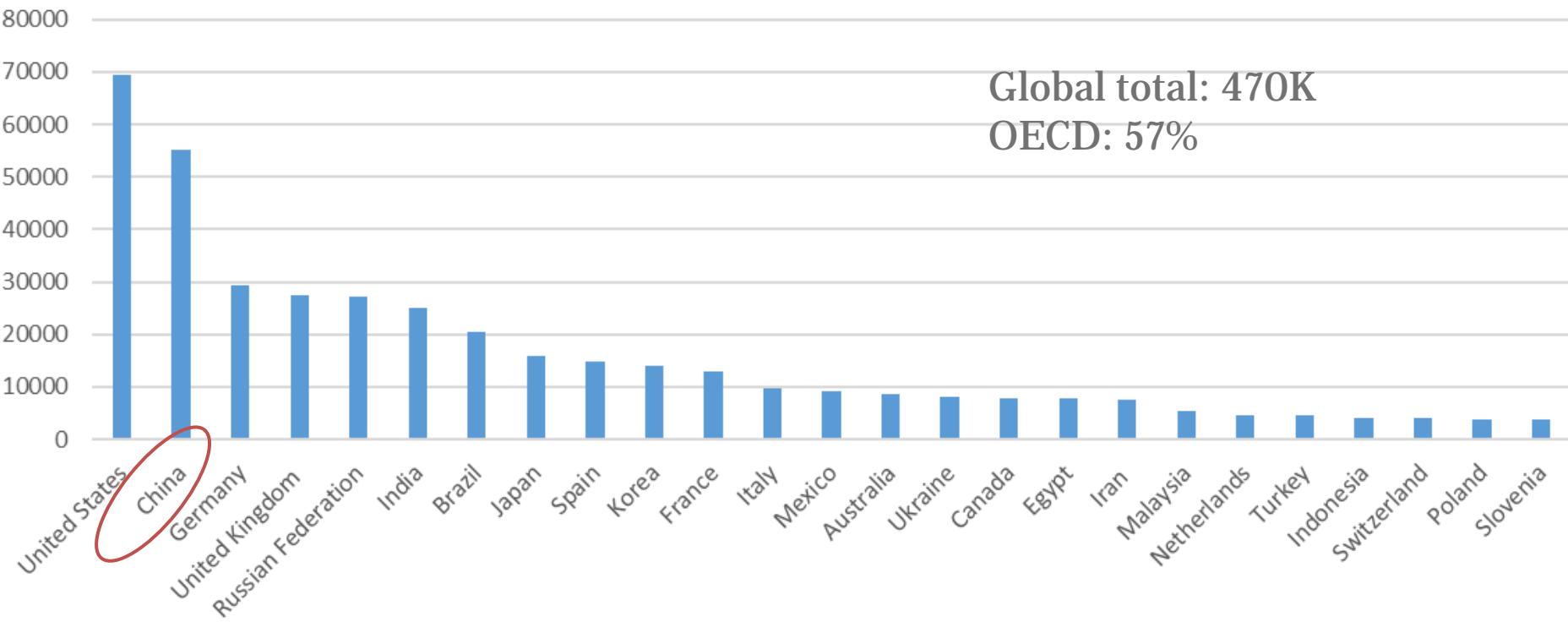
- Frascati webpage fully revamped
- Links to all relevant Frascati resources
- ...including Frascati Community space for R&D survey practitioners
  - <http://oe.cd/frascati-community>
  - Revision collaborative space transformed into implementation support space
  - Key features
    - Q&As on FM methodology interpretation in substitution for bilateral email
    - Relevant documents, e.g. questionnaires, country news.
    - Basis for future annex development



# STATISTICS ABOUT SCIENCE AND SCIENTISTS



# Number of doctorate graduates, 2016



Source: EU/OECD/UNESCO.

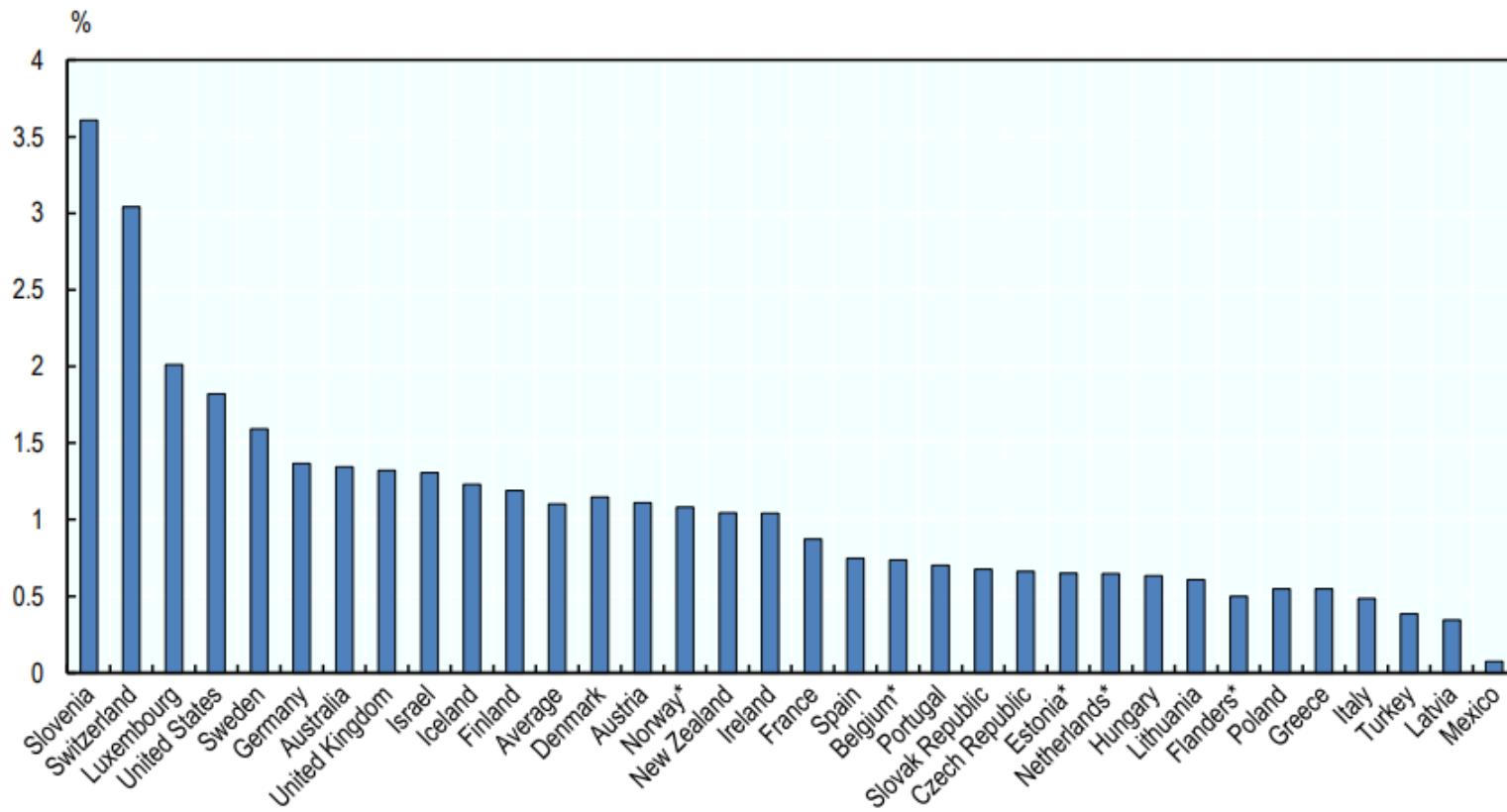
[http://data.uis.unesco.org/OECDStat\\_Metadata/ShowMetadata.ashx?Dataset=EDULIT\\_DS&ShowOnWeb=true&Lang=en](http://data.uis.unesco.org/OECDStat_Metadata/ShowMetadata.ashx?Dataset=EDULIT_DS&ShowOnWeb=true&Lang=en)



# Doctorate holders in the population

## Percentage of individuals with ISCED8, 2016

25-64 year-olds



Note: \*Participating in the Benchmarking Higher Education System Performance exercise 2017/2018.

Source: Adapted from OECD (2018<sup>[32]</sup>), *OECD Education Statistics*, <http://dx.doi.org/10.1787/edu-data-en>.



# *OECD work on Careers of Doctorate Holders (CDH)*

---

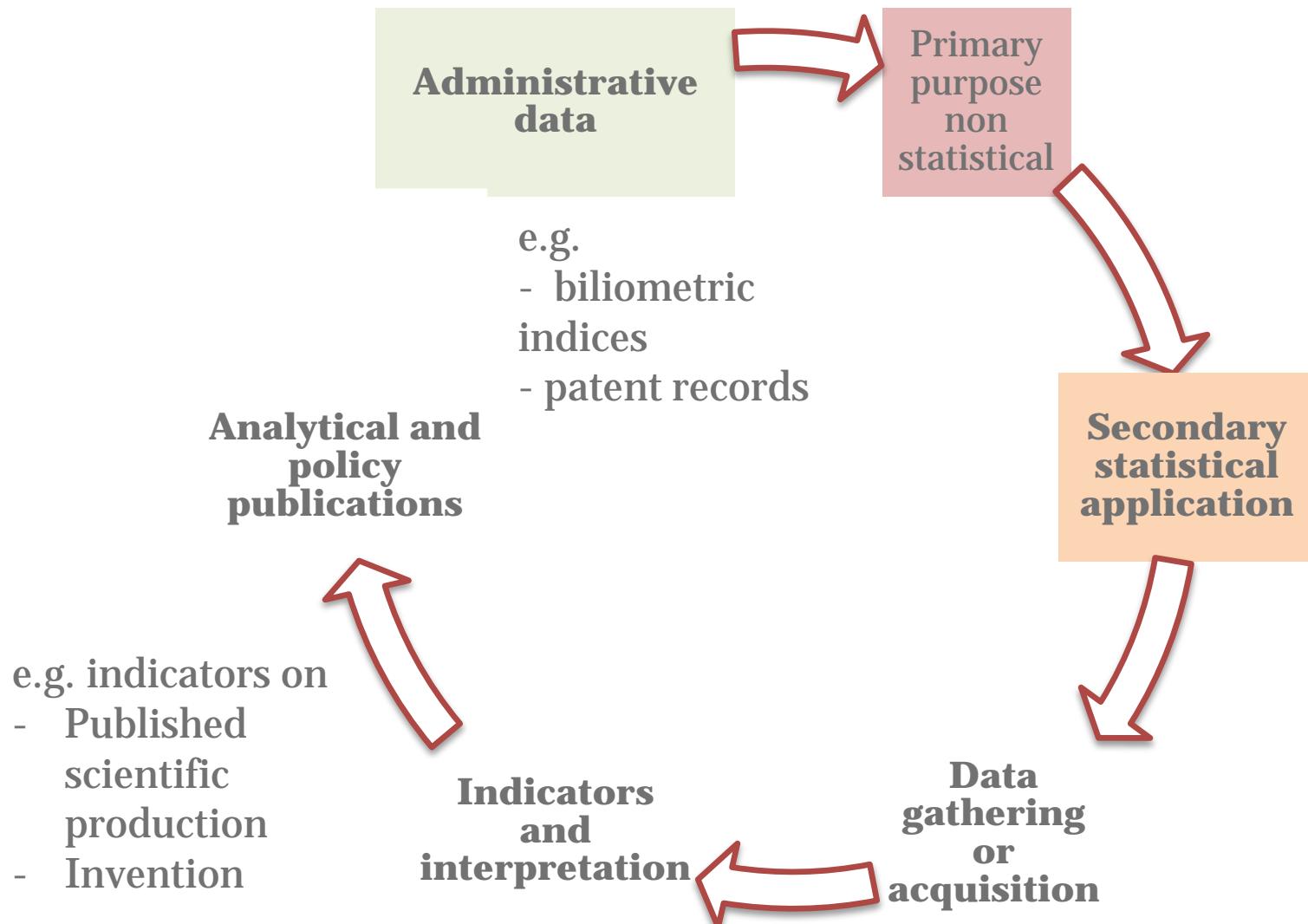
## Main features:

- Focused on recommendation on surveys for...
  - ...doctorates in all institutional sectors
  - ... the full set of doctorates, not only those recently graduated
- The activity
  - Common model survey
  - Model for output indicators
  - Voluntary participation
  - Initial objective to collect data every 3 years
- Results: <http://oe.cd/cdh>



# Different model of data production

## *Opportunity-based statistics*





# Types of bibliometric indicators produced by OECD

---

- Counts of total and highly cited publications (normalised by field)
- Measures of specialisation and citation impact
- Indicators of institutional co-authorship (within or across countries)
- Attributes of documents (e.g. open access, funding acknowledgement, gender of authors)
- Indicators of author mobility (trace of publications over time)
- Analysis of content of research (topics in abstracts)



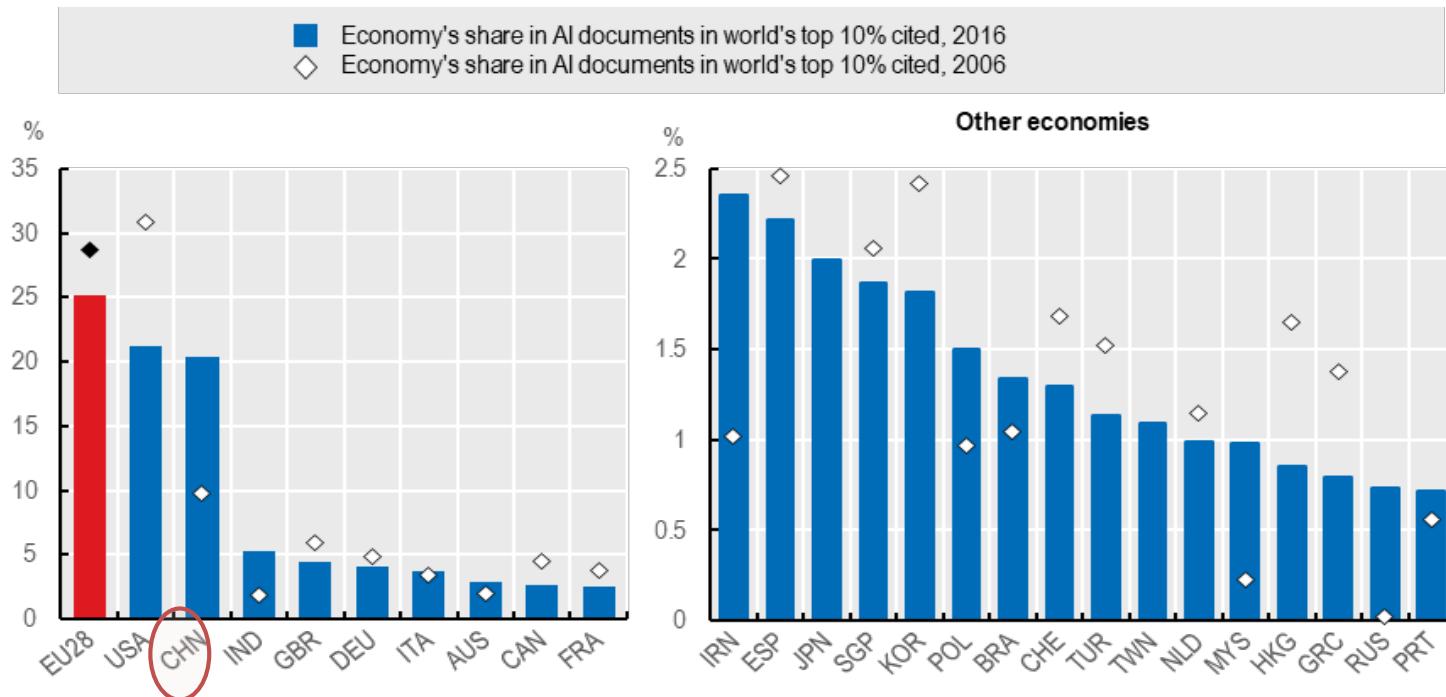
See more at:

<https://www.oecd.org/sti/inno/scientometrics.htm>



# Production of top-cited scientific publications related to AI, 2016 and 2006

Economies with the largest number of AI-related documents among the 10% most cited publications



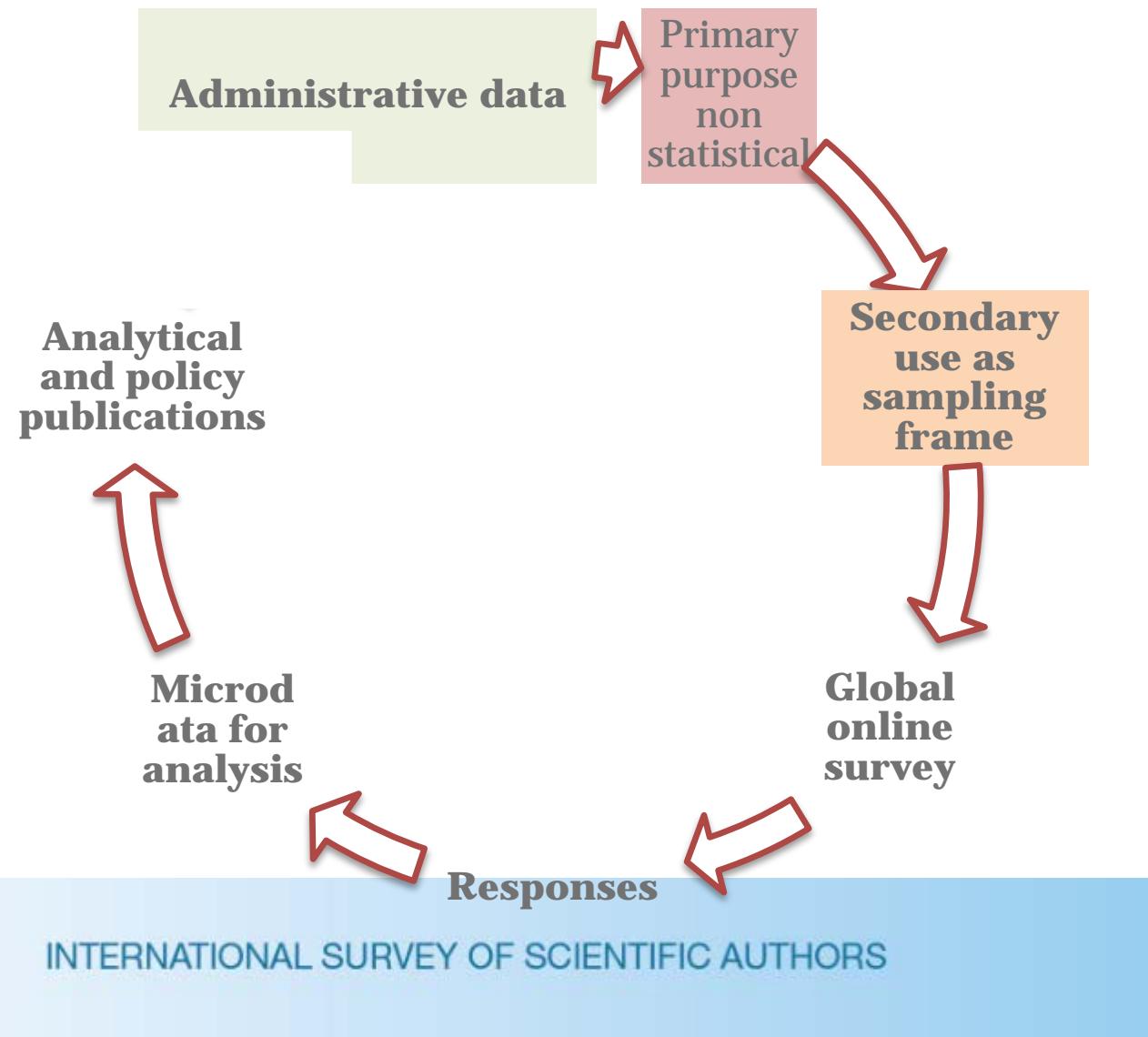
Note: Global shares based on fractional counts by economy.

Source: OECD (2019). Measuring the digital transformation. OECD calculations based on Scopus Custom Data, Elsevier.



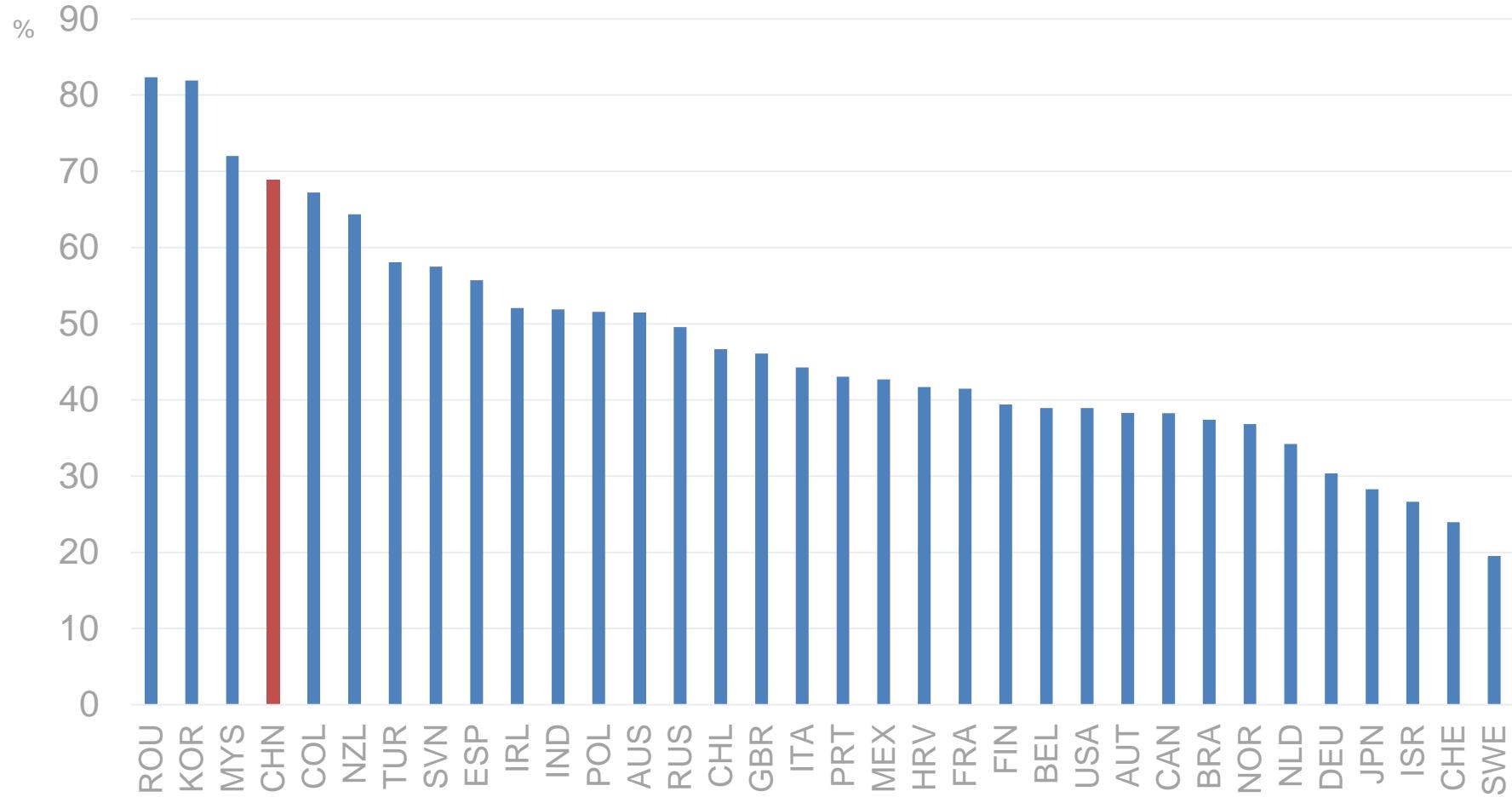
A mixed approach

# The OECD International Survey of Scientific authors





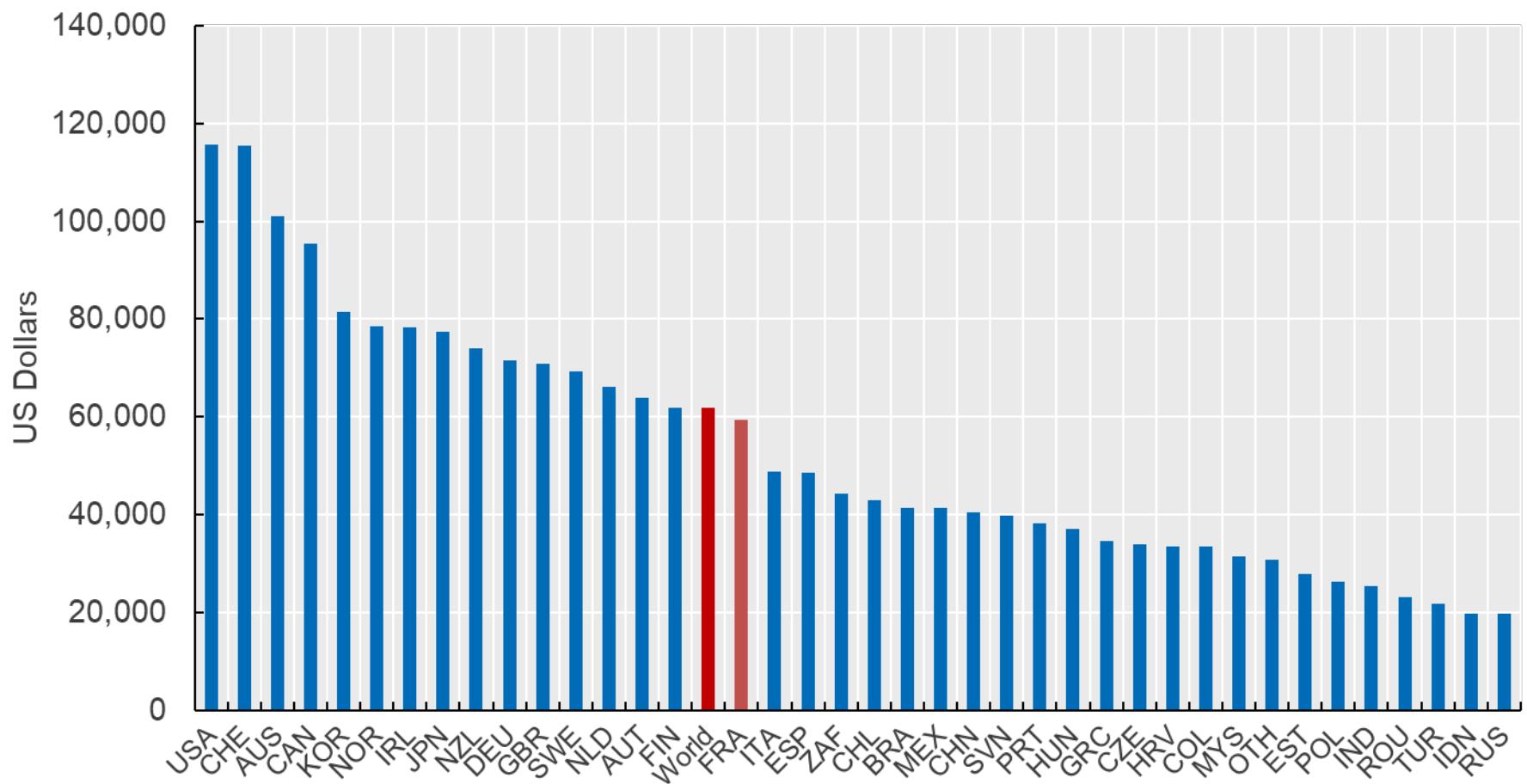
# Scientific authors involved in consultancy work - As % of respondents resident in each country





# Earnings of scientific authors

## Average per country, USD



Note: Gross annual earnings before taxes and deductions.

Source: OECD ISSA <http://oe.cd/issa>



# MEASUREMENT OF STI POLICIES



# Measuring STI policies

---

- Frascati R&D surveys capture funding flows
  - They can be extended/adapted to cover other dimensions.
- Oslo-innovation surveys can be designed to capture business experience of government policies.
  - Funding and other policies
  - See OM Chapter 7.
- Extended efforts to capture instruments and initiatives.



# Indicators of R&D tax support policies

- R&D tax incentives database <http://oe.cd/rds> integrated in the new OECD Corporate Tax Statistics database (<https://oe.cd/corporate-tax-stats>).

ORGANISATION  
FOR ECONOMIC  
CO-OPERATION  
AND DEVELOPMENT



Data by theme      Popular queries

Find in Themes      » Reset

Science, Technology and Patents

- Science, Technology and Patents
  - OECD Science Technology and Industry Outlook
  - Patents Statistics
  - Research and Development Statistics
- R&D Tax Incentive Indicators
  - Implied tax subsidy rates on R&D expenditures
  - R&D tax expenditure and direct government funding of BERD
- Science and Technology Indicators

## R&D tax expenditure and direct government funding

Customise    Export    Draw chart    My O

Measure: National Currency

Variable: Indirect government support through R&D tax expenditures

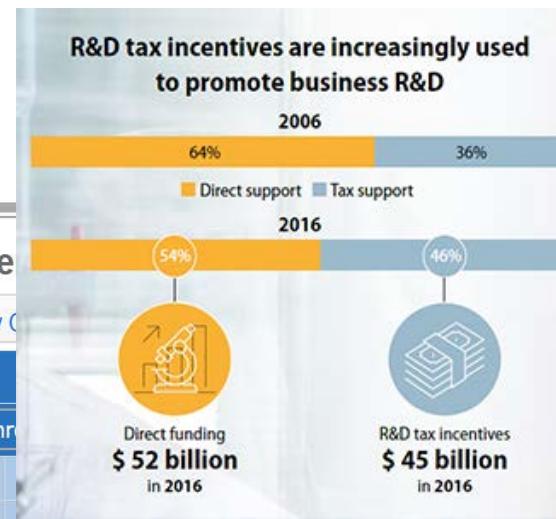
Year: 2000, 2001, 2002, 2003

Country: Unit

Country	Unit	2000	2001	2002	2003
Australia	Australian Dollar, Millions	430	430	370	
Austria	Euro, Millions	237	222	228	

Legend:  
E Estimated value  
P Provisional value

Click on brochure to access



Average tax subsidy rates for R&D in OECD countries, 2018





# Oecd.stat sources

- **OECD R&D tax incentives database** <https://oe.cd/rdtax>  
launched in November 2018

ORGANISATION  
FOR ECONOMIC  
CO-OPERATION  
AND DEVELOPMENT



[Click here to Login](#) | [Contact us](#) | [User Guide](#) | [Help](#)

English | Français

Search

[Getting Started](#)

**R&D tax expenditure and direct government funding of BERD** ⓘ

Customise Export Draw chart My Queries

Measure	National Currency	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Variable	Indirect government support through R&D tax incentives											
Year		▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼	▲▼
Country	Unit											
Australia	Australian Dollar, Millions	430	430	370	587	665	729	897	1 005	1 236	1 749	
Austria	Euro, Millions	237	222	228	216.4	191.4	166.3	186.8	270.3	356.6	337.8	

Legend:

E Estimated value

P Provisional value

**Data by theme** Popular queries

Find in Themes » Reset

Science, Technology and Patents

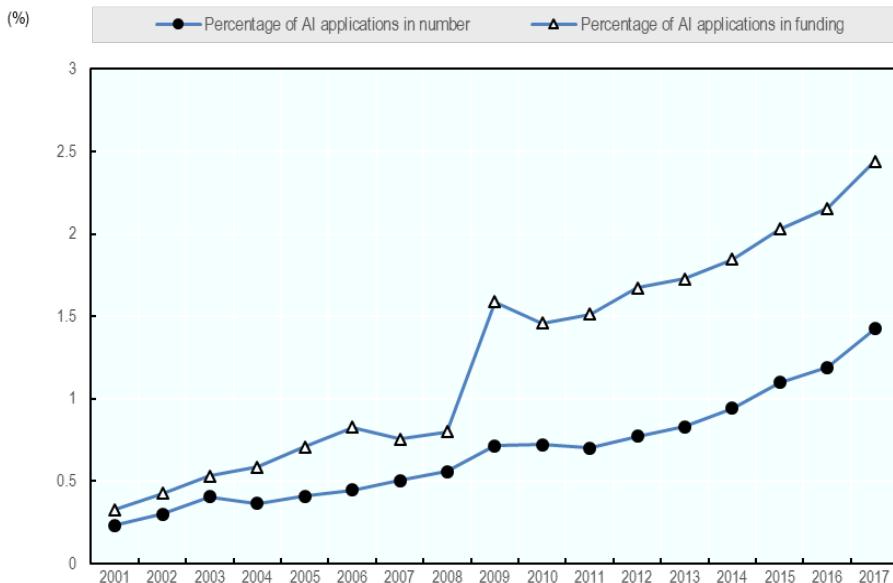
- Science, Technology and Patents
  - OECD Science Technology and Industry Outlook
  - Patents Statistics
  - Research and Development Statistics
- R&D Tax Incentive Indicators
  - Implied tax subsidy rates on R&D expenditures
  - R&D tax expenditure and direct government funding of BERD
- Science and Technology Indicators



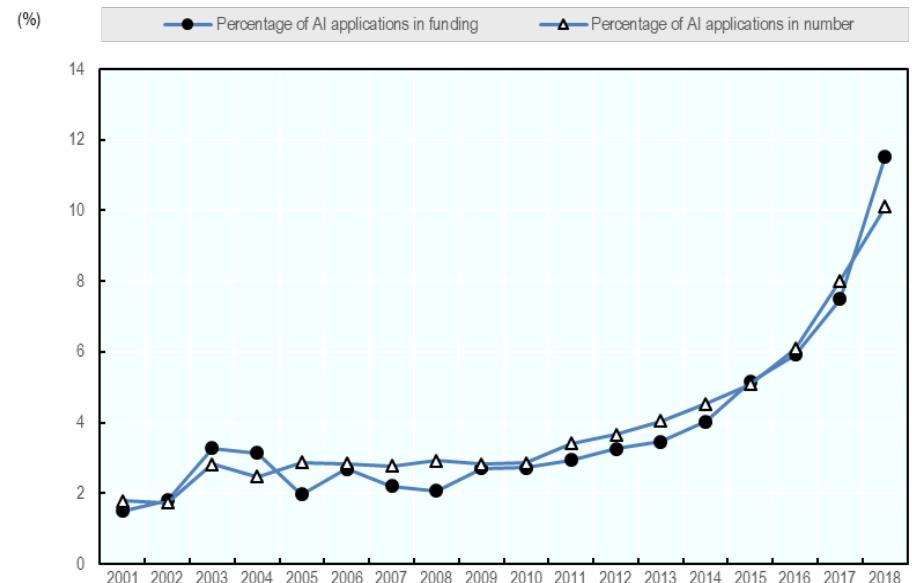
# Activating alternative sources of administrative data

## AI-related project funding at US NIH and NSF

NIH



NSF



Note: These are experimental indicators

Source: OECD analysis based on NIH Reporter and NSF Award Search data.



# Where to find OECD R&D statistics

---

- R&D statistics database <http://oe.cd/rds>
  - Expenditures
  - Personnel
  - Government R&D budgets
- R&D in biotech and nanotech <http://oe.cd/kbi> and <http://oe.cd/kni>
- R&D tax incentive database <http://oe.cd/rdtax>
- Selected R&D indicators published:
  - OECD Main Science & Technology Indicators  
<http://oe.cd/msti> (updated every 6 months)
  - OECD Science, Technology and Industry Scoreboard  
[http://oe.cd/sti\\_scoreboard](http://oe.cd/sti_scoreboard) (every 2 years)



# Access through general statistical data repository

← → C ⌂ <https://stats.oecd.org>

Apps OECD Intranet Dropbox - Recent E... SyGMA - System for... Connect Meeting a... media OECDwebSTI

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

 **OECD.Stat**

Labour  
National Accounts  
Monthly Economic Indicators  
Productivity  
Prices and Purchasing Power Parities  
Public Sector, Taxation and Market Regulation  
Regions and Cities  
**Science, Technology and Patents**

- OECD Science Technology and Industry Outlook
- Patents Statistics
- Research and Development Statistics
- R&D Tax Incentive Indicators
- Science and Technology Indicators

Social Protection and Well-being  
Transport

*Welcome to OECD.Stat*

OECD.Stat includes data and metadata for OECD countries and selected non-member econor

**Ways to access the data:**

- By keyword using “search” (e.g. [GDP](#), [FDI](#), [Health](#), [unemployment](#), [income distribution](#), [Government Debt](#), [Social expenditure](#) ...)
- By selecting data in the left-hand menu (popular queries or data by theme)
- By accessing your saved queries under “My Queries” (for logged-in users)



# The metadata is just as important

← → C ⌂ https://rdmetadata.oecd.org Paused F : Apps OECD Intranet Dropbox - Recent E... SyGMA - System for... Connect Meeting a... »

 **Metadata Application**

*Select a base:*

**OECD R&D Sources and Methods Database**

This database relates to the measurement of research and development (R&D) according to the standard methodology for R&D statistics recommended by OECD in the *Guidelines for Collecting and Reporting Data on Research and Experimental Development - Frascati Manual 2015 (OECD)*.

The database provides detail on methods used in the Member countries and selected non-member economies when compiling the R&D data reported to OECD/Eurostat in the framework of the *International Survey of the Resources devoted to R&D*, underlining both current and historical national specificities of the data stored in the OECD STI/EAS R&D database. Selected data and metadata are regularly published in *Main Science and Technology Indicators - MSTI* (released twice yearly) as well as *Research and Development Statistics - RDS*.

**OECD GBARD Sources and Methods Database**

This database relates to Government budget allocations for R&D (GBARD) data as reported to OECD in line with the standard methodology recommended in Chapter 12 of the *Guidelines for Collecting and Reporting Data on Research and Experimental Development - Frascati Manual 2015 (OECD)*.

The database provides detail on methods used in the Member countries and selected non-member economies when compiling the GBARD data reported to OECD/Eurostat in the framework of the *International Survey of the Resources devoted to R&D*, underlining both current and historical national specificities of the data stored in the OECD STI/EAS R&D database. The classification used is the European Commission's Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets - NABS, specially developed for R&D analysis (see "Frascati Manual 2015", 12.50-71). Selected data and metadata



# The OECD STIP Compass policy repository

<https://stip.oecd.org/stip.html>

Best viewed in: Firefox and Chrome

STIP COMPASS  
INTERNATIONAL DATABASE ON STI POLICIES

HOME    ABOUT    INTERACTIVE DASHBOARDS    POLICY EXPLORER    DOWNLOAD DATA

## A simple yet powerful tool to support policy analysis and discovery for better decision-making

The STIP Compass is an initiative of the European Commission and the OECD to collect together in one place quantitative and qualitative data on national trends in science, technology and innovation (STI) policy. The portal supports the continuous monitoring and analysis of countries' STI policies and aims to become a central platform for policy research and advice supporting government officials, analysts and scholars. Data is freely accessible following the FAIR principles (Findable, Accessible, Interoperable, and Re-usable). The STIP Compass incorporates more than 500 interactive dashboards and provides a sophisticated search tool with smart filtering that facilitates policy discovery. These interfaces allow users to seamlessly query the database to identify country policies on a wide range of STI policy issues.

[See the infographics](#) | [Read more](#)

Explore by:



→ <https://stip.oecd.org/stip/countries/Australia>

Quick access to the territory dashboards:



Biennial EC-OECD STI Policy survey  
(Qualitative database)



# Thank you for your attention



[@oecdinnovation](https://www.oecd.org/sti/)

<https://www.oecd.org/sti/>