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

OECD
BETTER POLICIES FOR BETTER LIVES

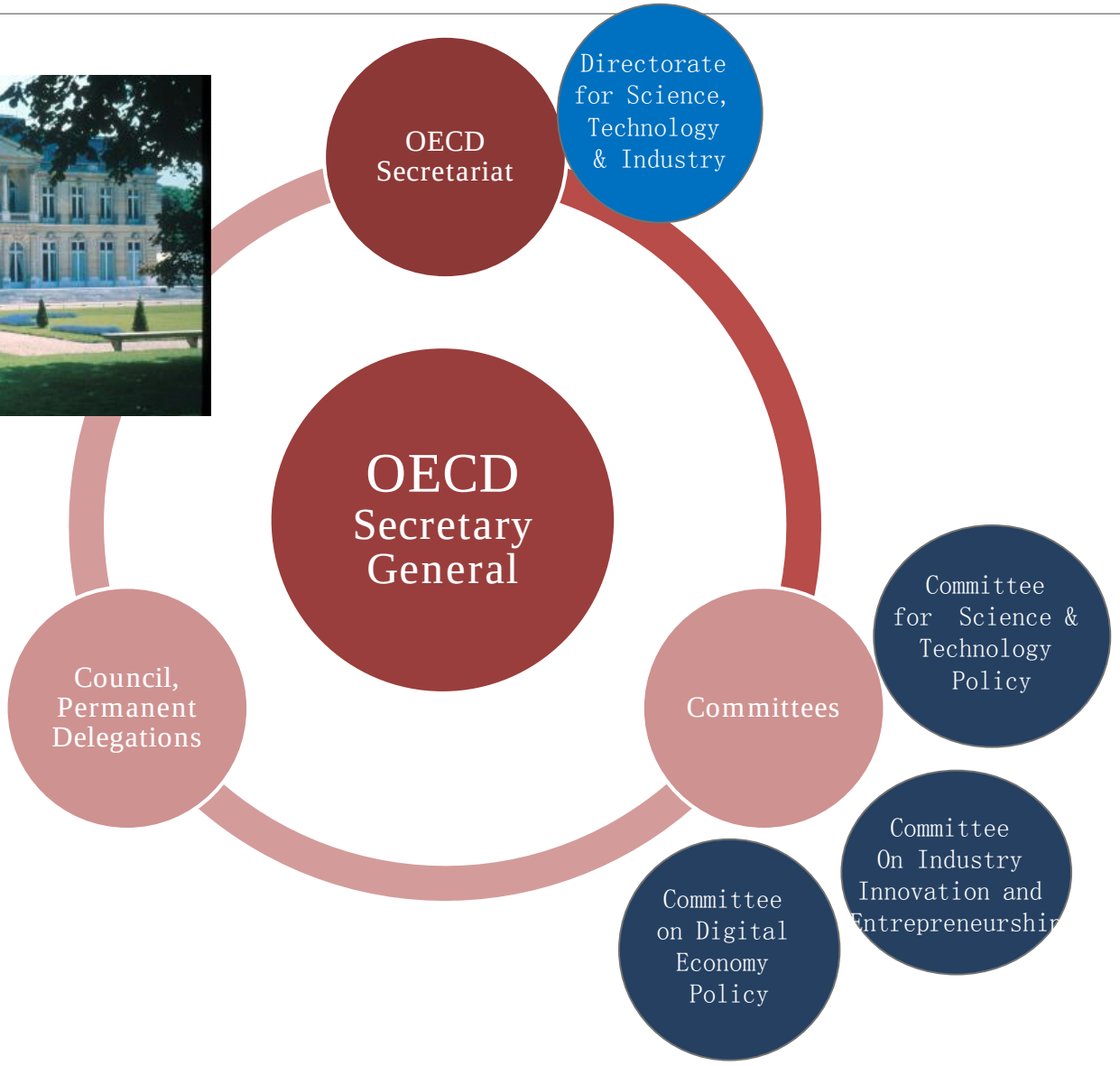
CONTEXT TO WORK ON STI STATISTICS AT OECD

Introduction – the OECD context

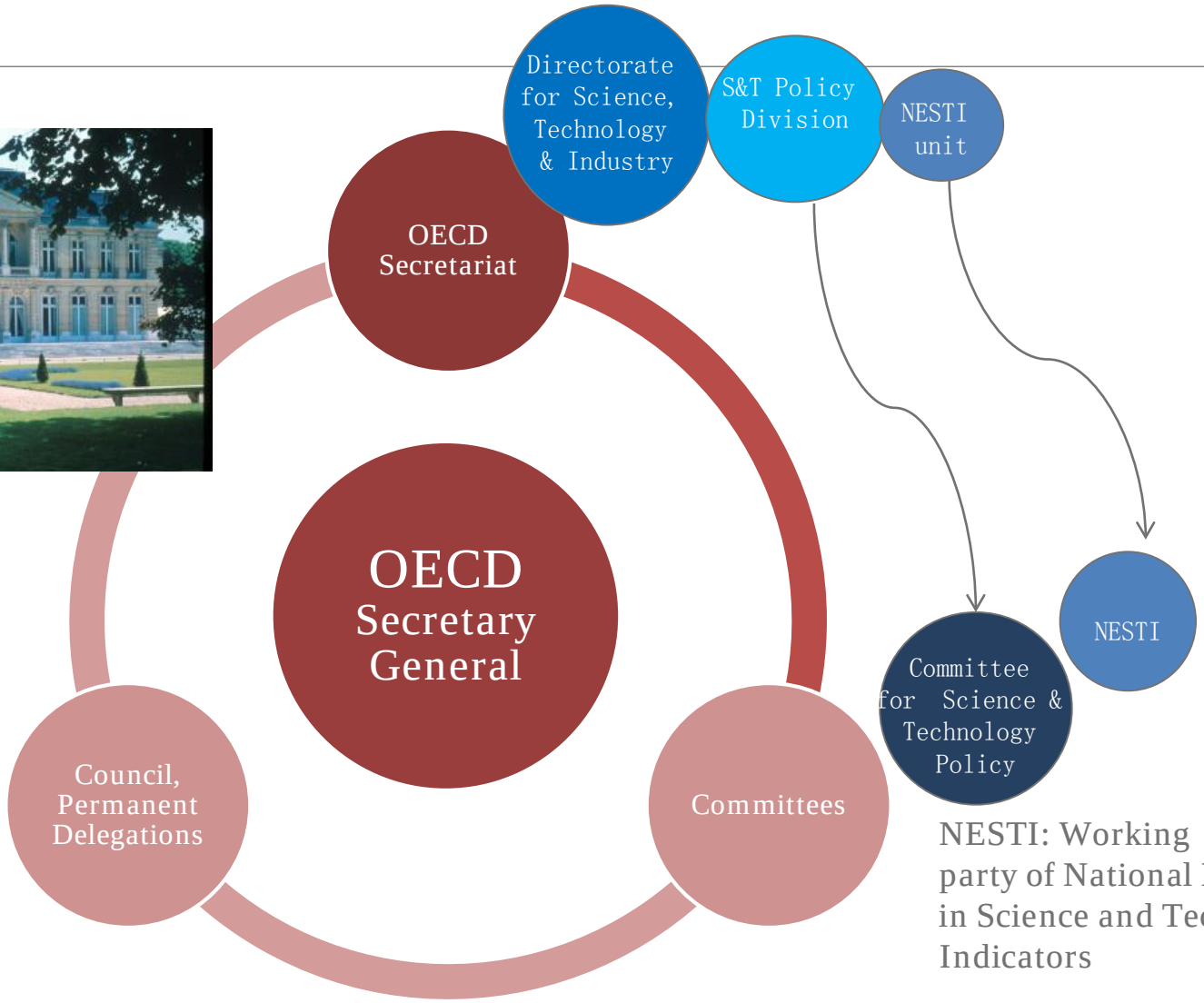
- Paris-based international organisation, created in 1962.
  - Predecessor in agency tasked with implementing the Marshall Plan in Europe

- 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 37th country.

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



Work on STI and STI statistics at the OECD



NESTI: Working party of National Experts in Science and Technology Indicators

NESTI: A community of practice for STI stats

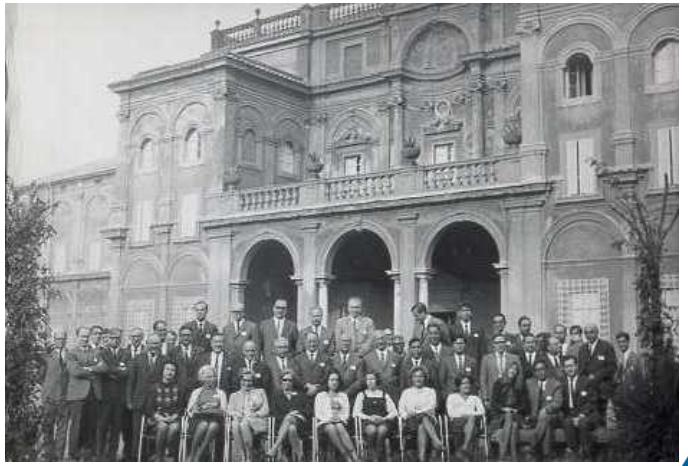
- NESTI. Since 1962 engaging users and producers of STI indicators
  - Common language
  - Common concerns and challenges
  - A network of networks

- 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.

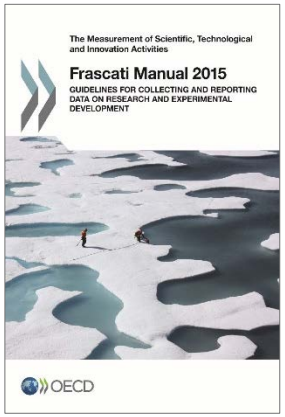
Modes of participation at NESTI

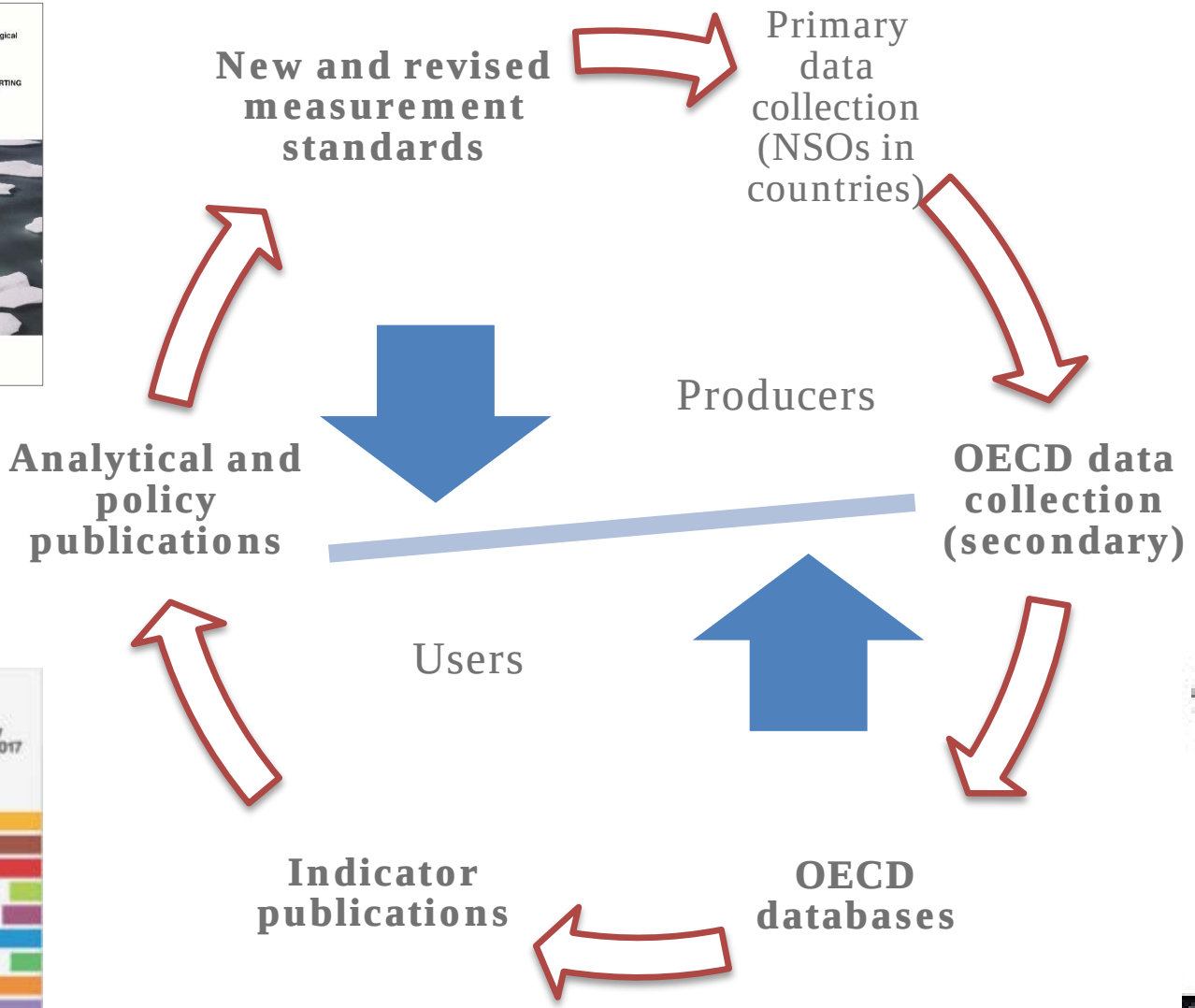
- Member countries (36) and EU
- Participation open to
  - Countries through OECD accession process
  - Key partners of the OECD
  - Argentina, Russian Federation…
- Invitees
  - Attendance on ad hoc basis, communication.
  - Recently Viet Nam, Egypt…
- International organisations
  - UNESCO, African Union, LAC expert newtork 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.

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*** for more information.

OECD*publishing*
www.oecd.org/publishing

ISBN 978-92-64-23880-0
92 2015 00 1 P

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

The Measurement of Scientific, Technological and Innovation Activities

Frascati Manual 2015

GUIDELINES FOR COLLECTING AND REPORTING DATA ON RESEARCH AND EXPERIMENTAL DEVELOPMENT

OECD

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.

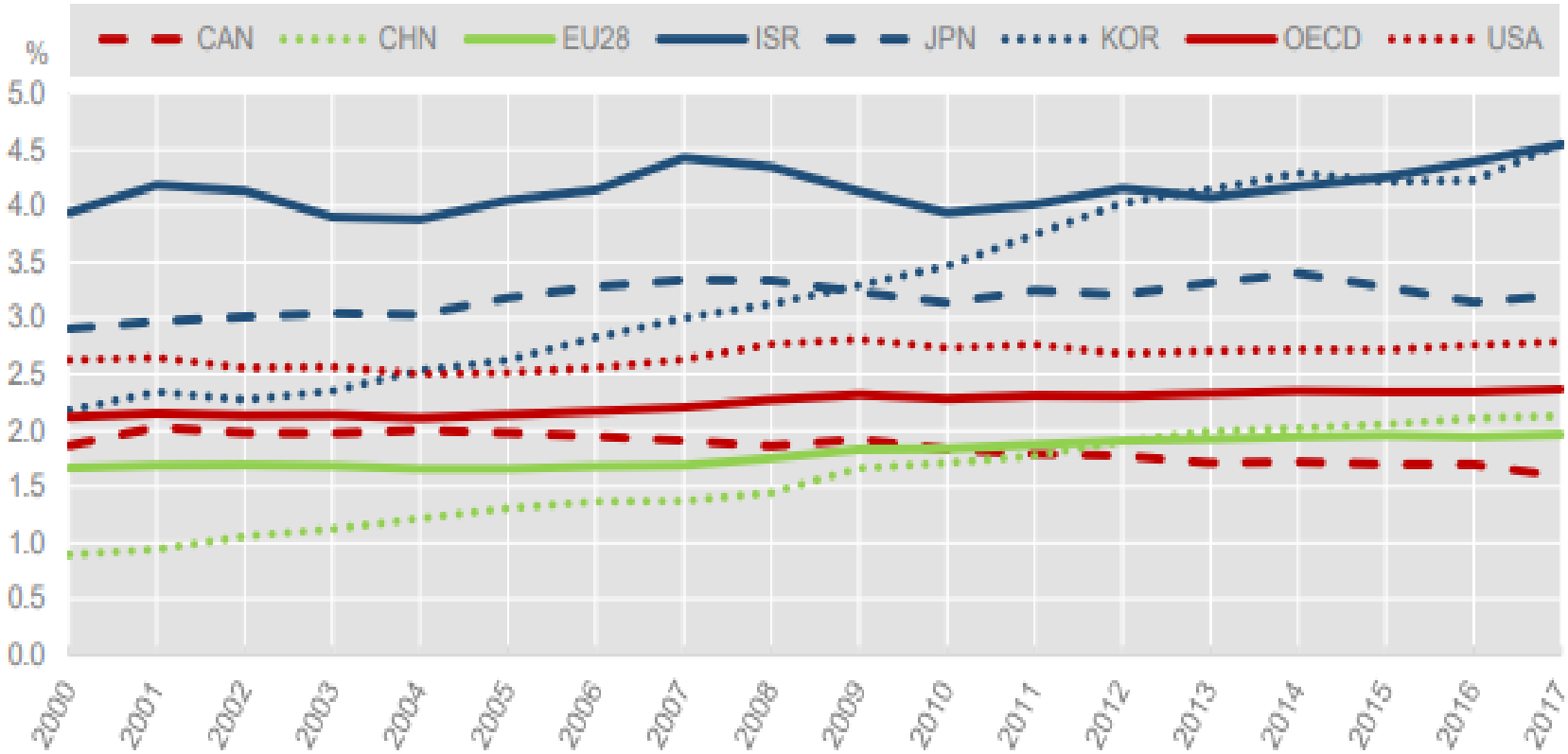
  - **Novel (aimed at new findings)**
  - **Creative (based on original concepts; not obvious)**
  - **Uncertain (outcome, cost, time allocation not known a priori)**
  - **Systematic (planned and budgeted)**
  - **Transferable and/or reproducible (there should be the potential to transfer results)**

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 rsearch 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

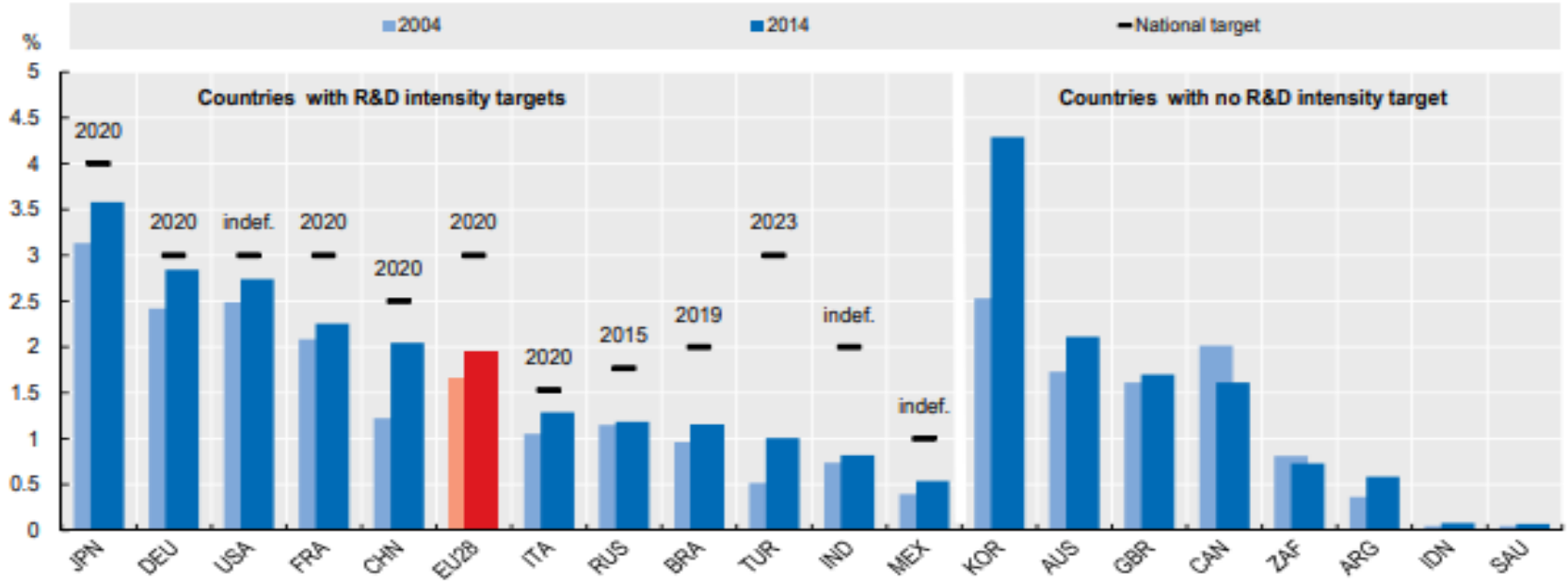


Source: OECD Main Science and Technology Indicators Database, February 2019. http://oe.cd/msti

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



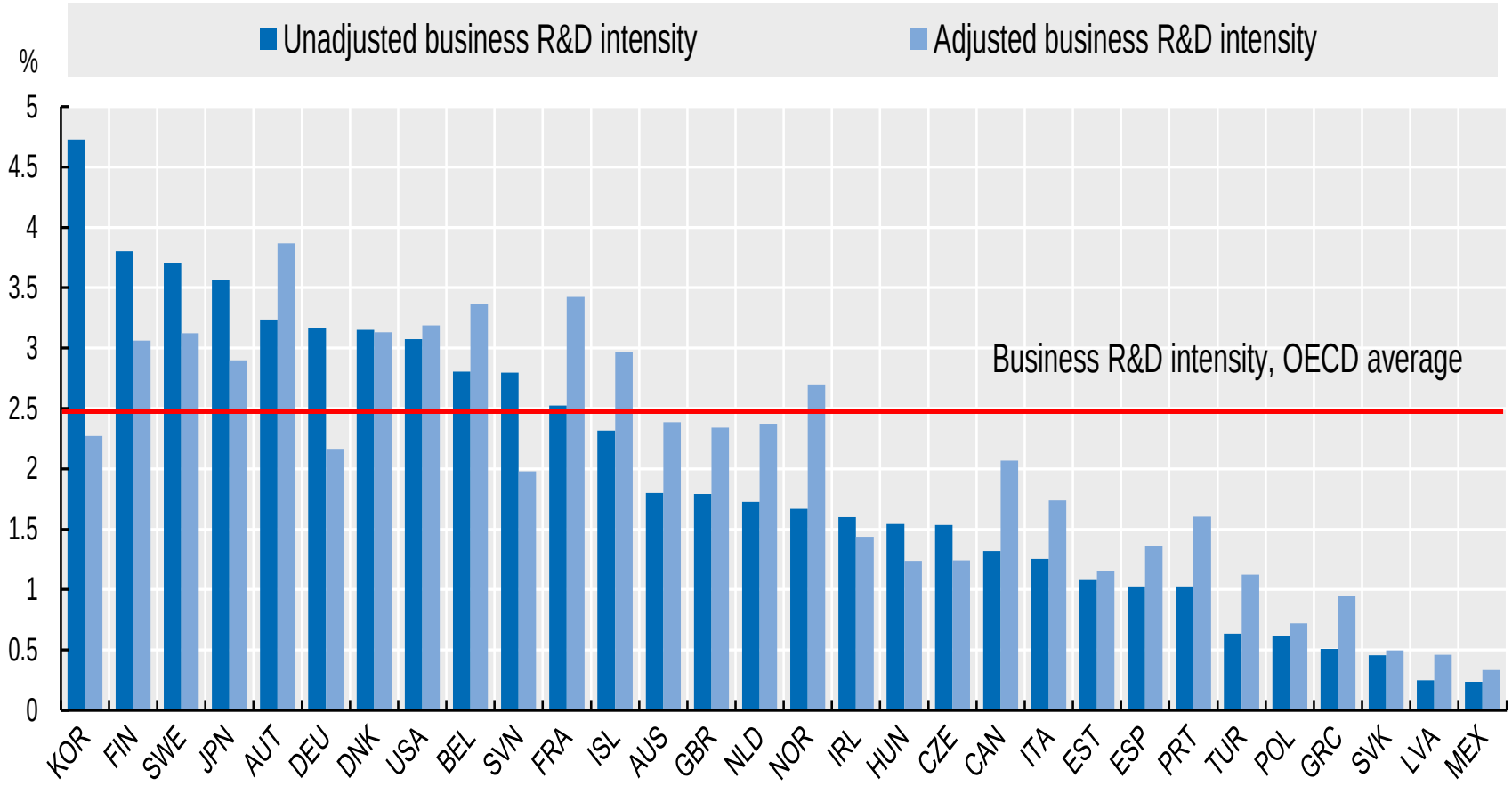
Note: "indef." is an abbreviation for indefinite or no fixed end date for reaching the target.

Sources: OECD, *Main Science and Technology Indicators* database, www.oecd.org/sti/msti.htm, 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).

OECD G20 Innovation Report

https://www.oecd.org/china/G20-innovation-report-2016.pdf

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



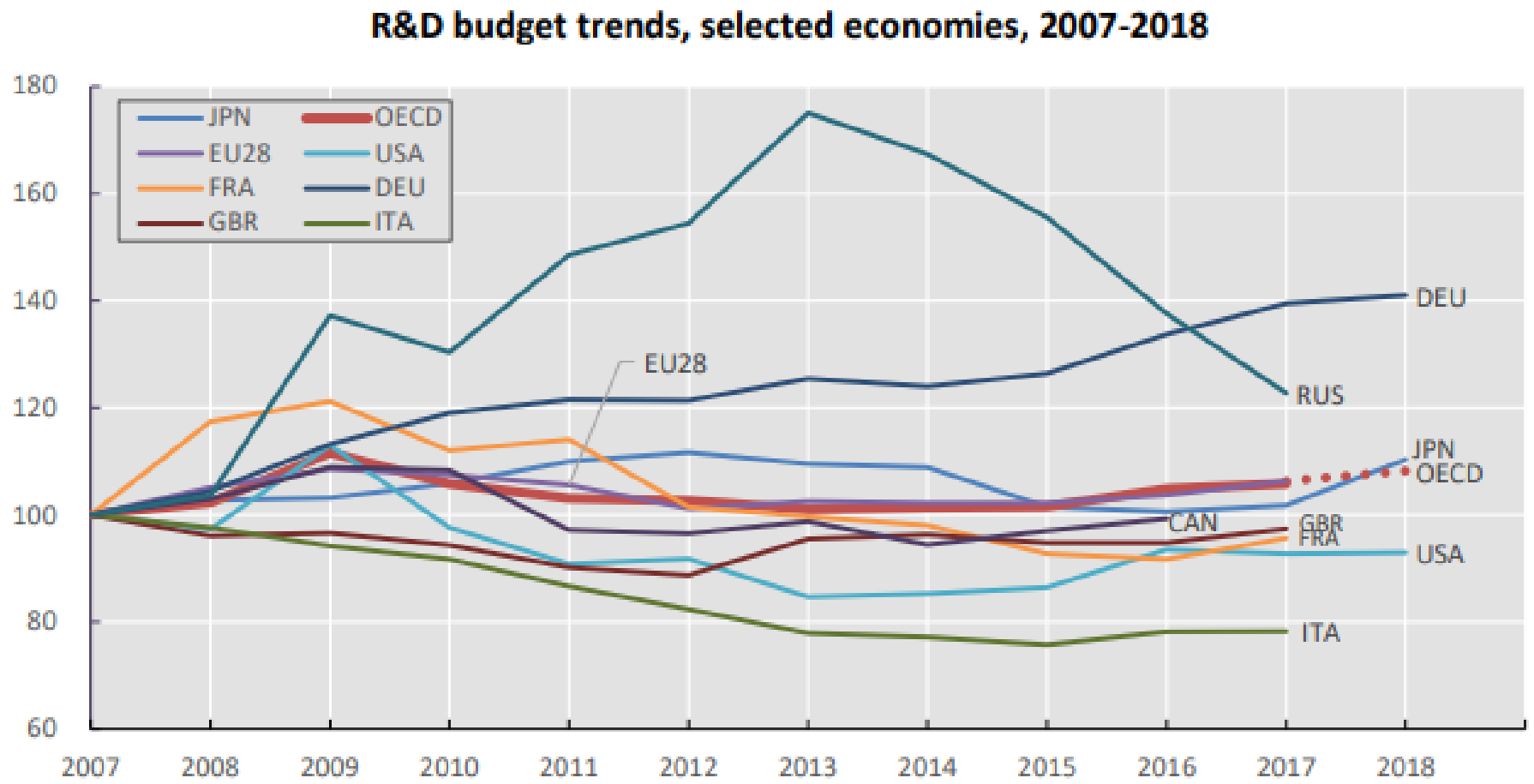
Source: OECD Science, Technology and Industry Scoreboard 2017

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



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

R&D statistics

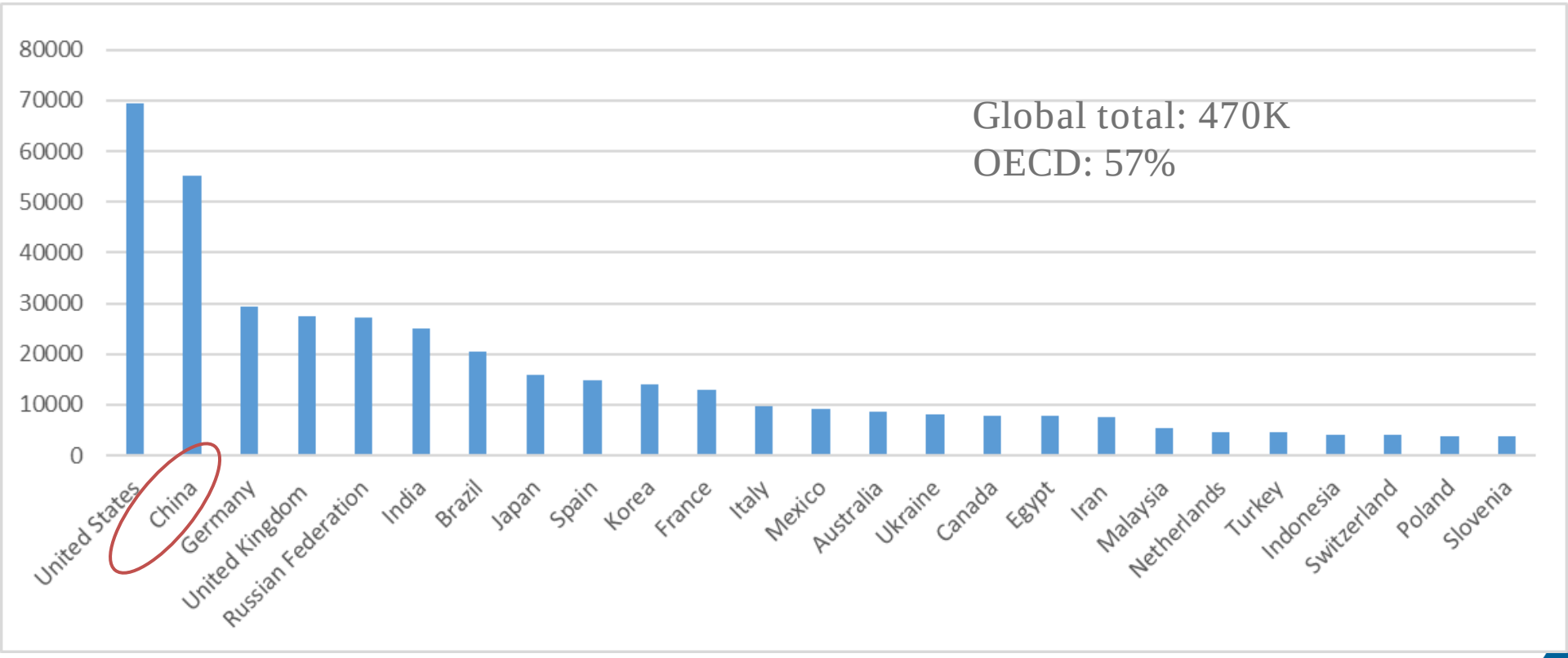
- Following adoption of the Frascati Manual 2015 edition, work has focused on implementation with NSOs
- Key areas driving current and future work:
  - R&D globalisation, esp role of MNEs
  - Digitalisation and R&D – R&D efforts on AI
  - Role of goverment research institutes
  - Relevance of R&D efforts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

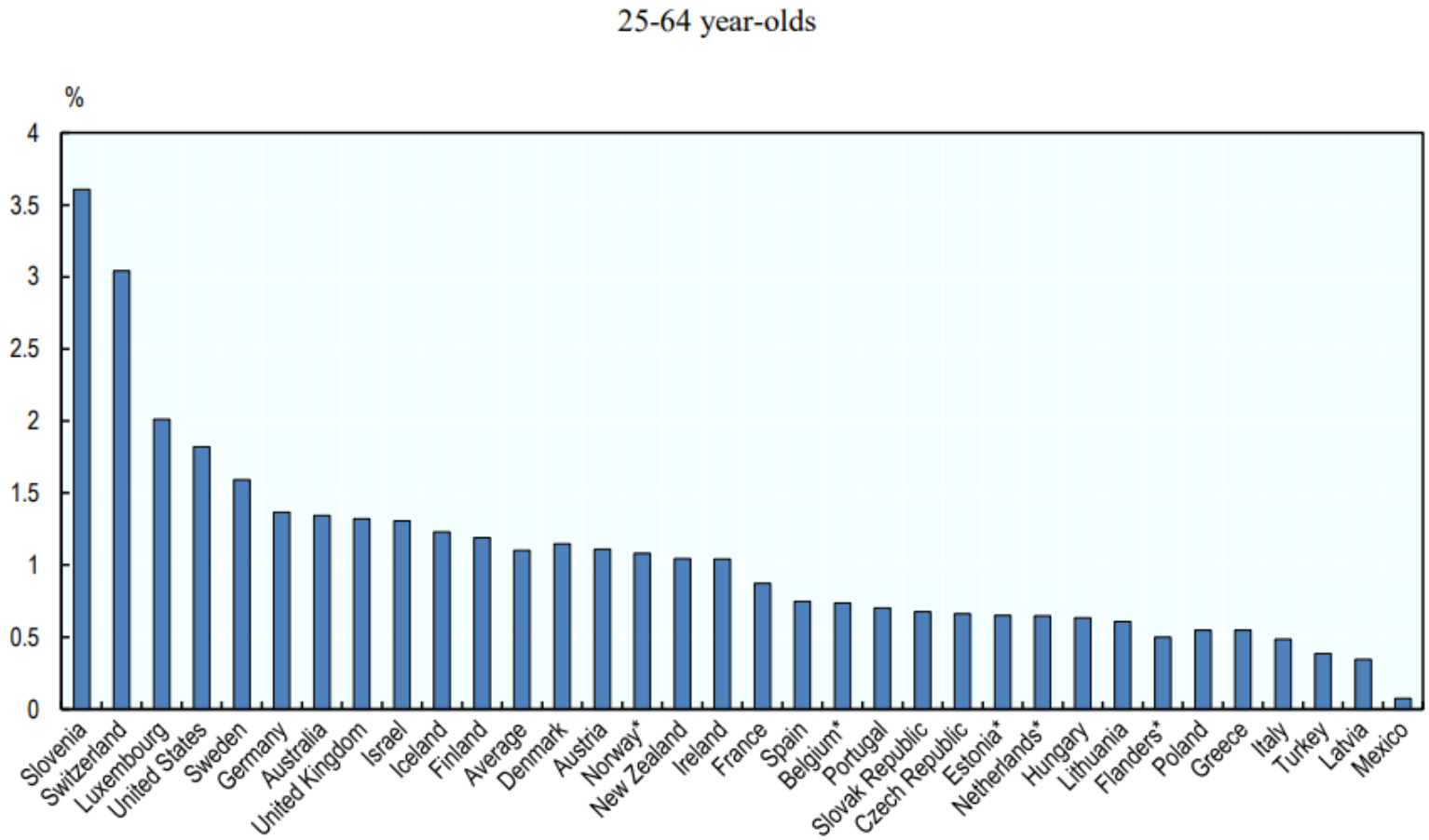


Source: EU/OECD/UNESCO.

http://data.uis.unesco.org/OECDStat_Metadata/ShowMetadata.ashx?Dataset=EDULIT_DS&ShowOnWeb=true&Lang=en

Doctorate holders in the population

Percentage of individuals with ISCED8, 2016



Note: *Participating in the Benchmarking Higher Education System Performance exercise 2017/2018.
Source: Adapted from OECD (2018[32]), *OECD Education Statistics*, http://dx.doi.org/10.1787/edu-data-en.

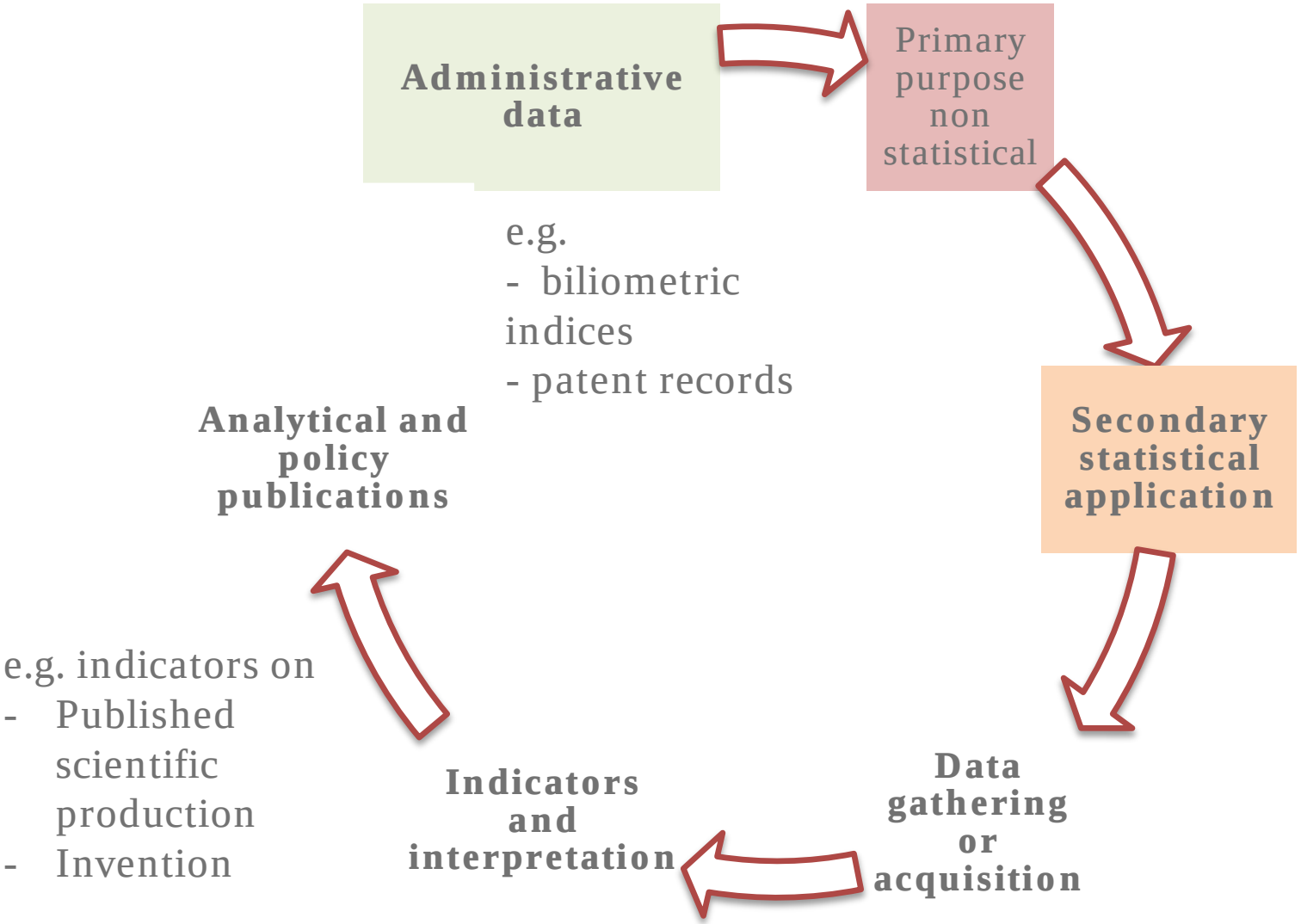
StatLink https://doi.org/10.1787/888933941538

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



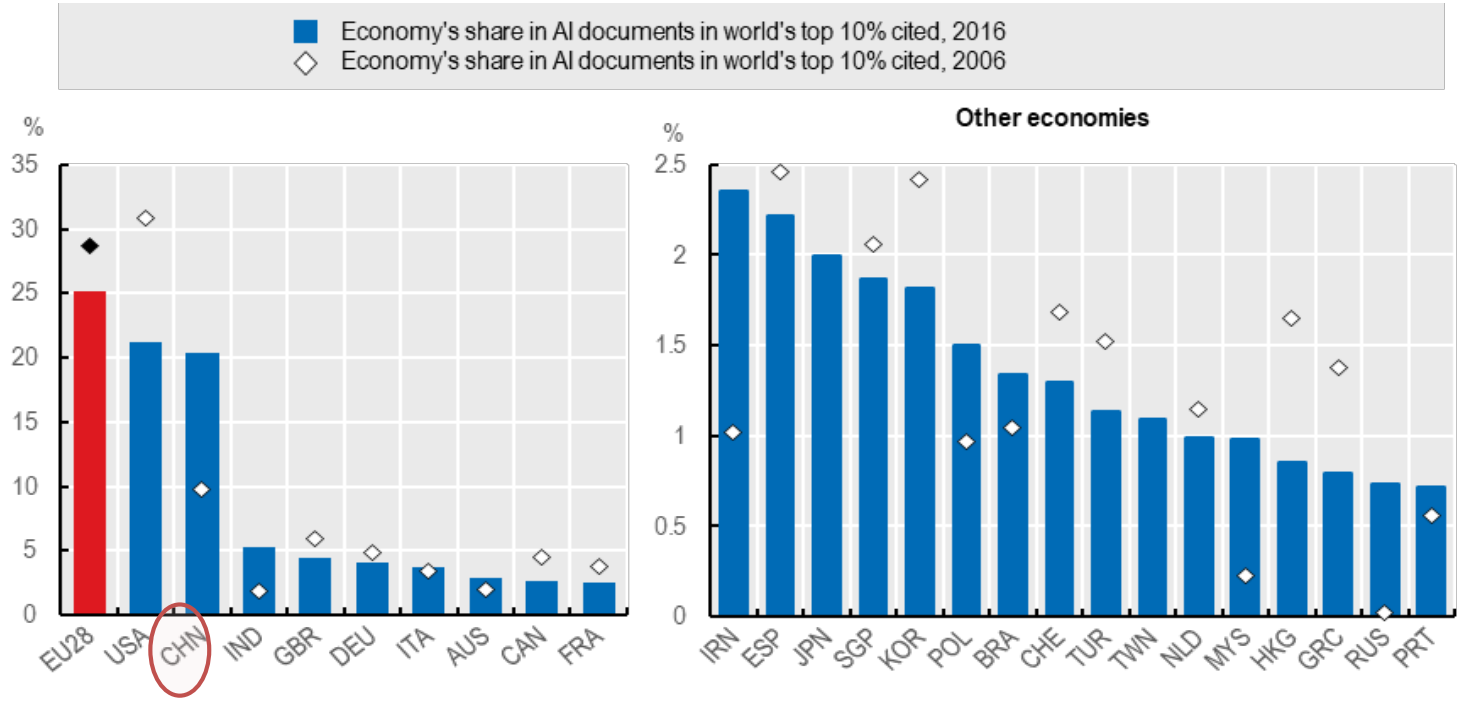
Types of bibliometric indicators produced by OECD

- 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

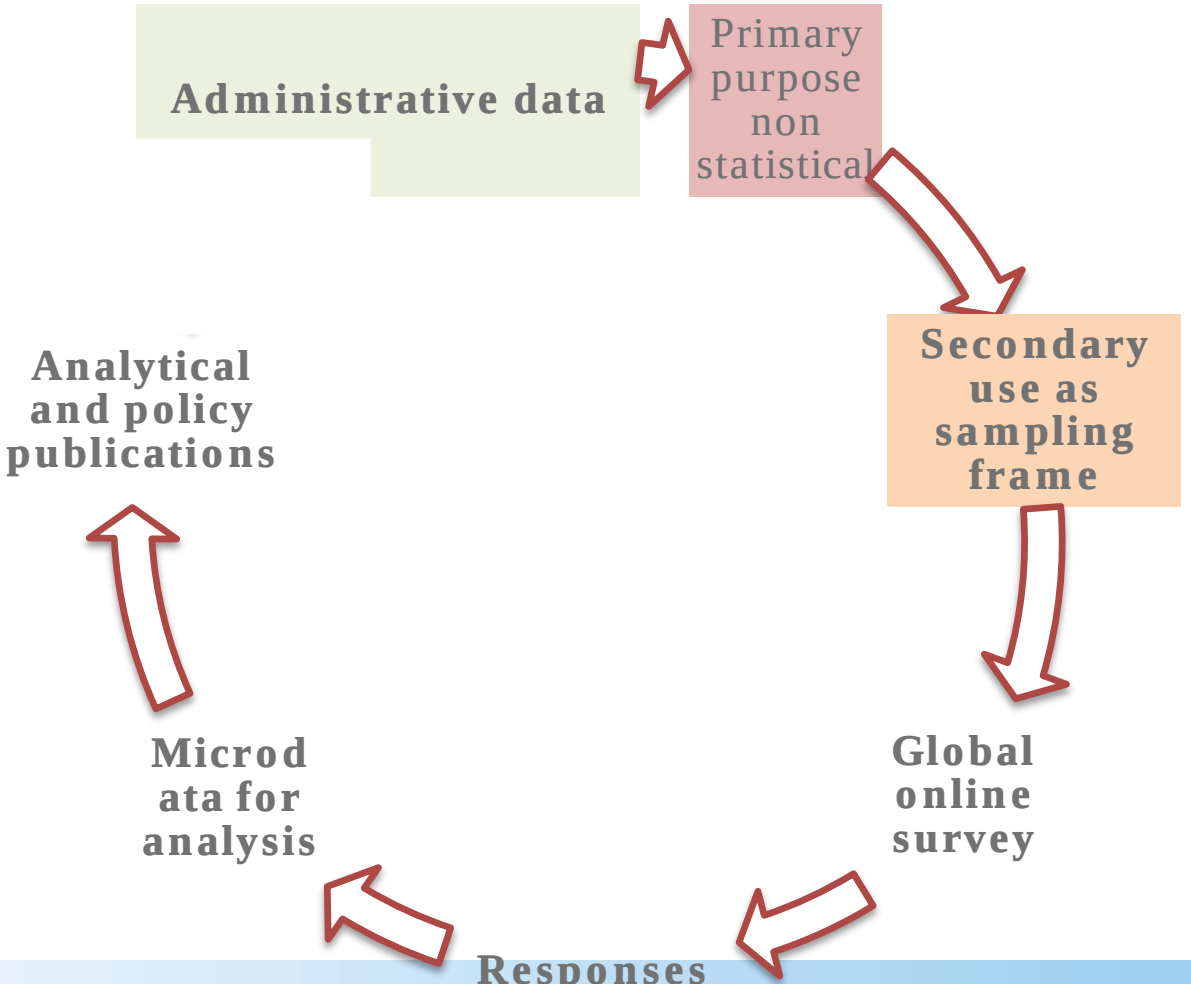


Note: Global shares based on fractional counts by economy.

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

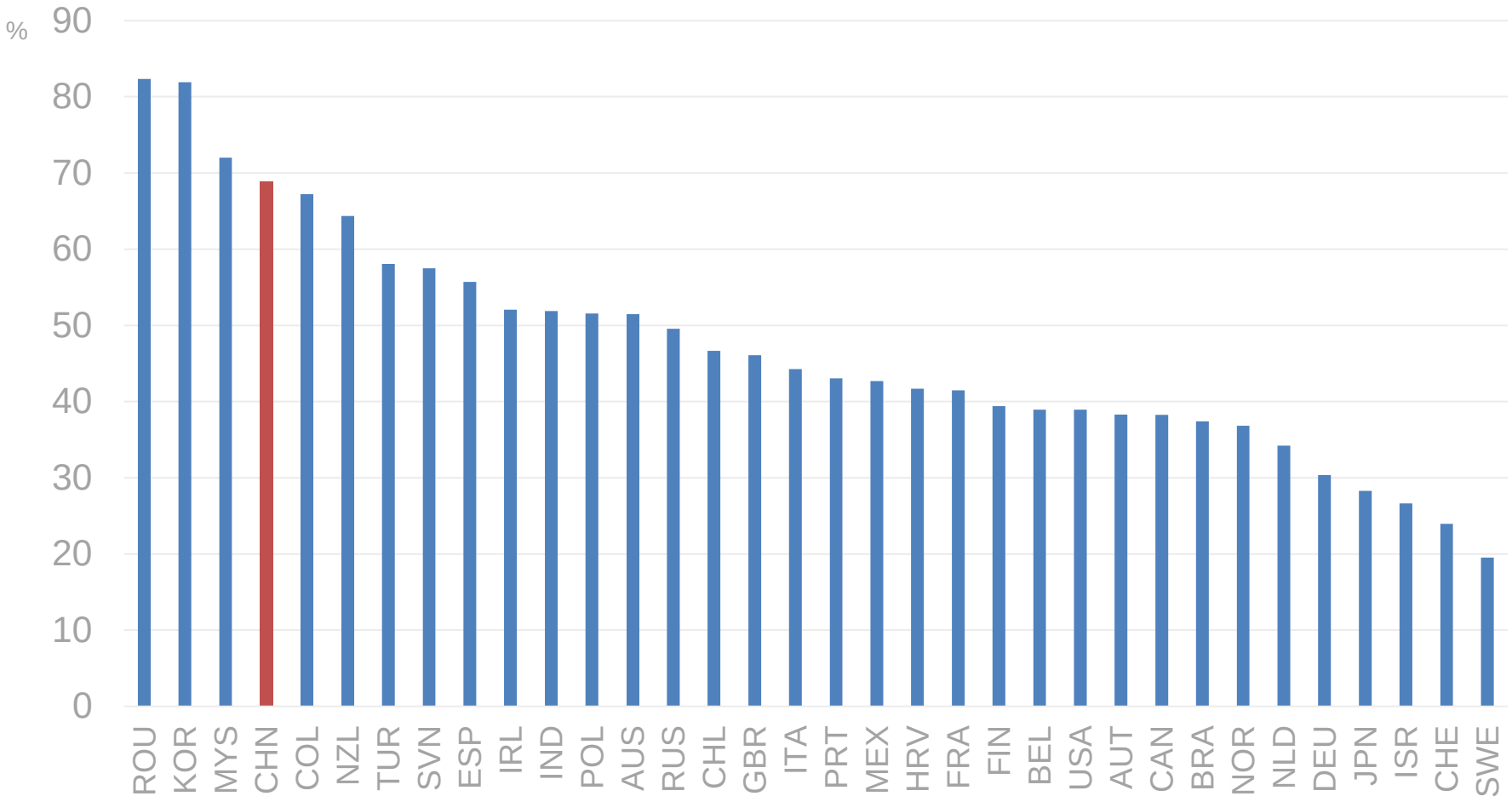
A mixed approach

The OECD International Survey of Scientific authors



INTERNATIONAL SURVEY OF SCIENTIFIC AUTHORS

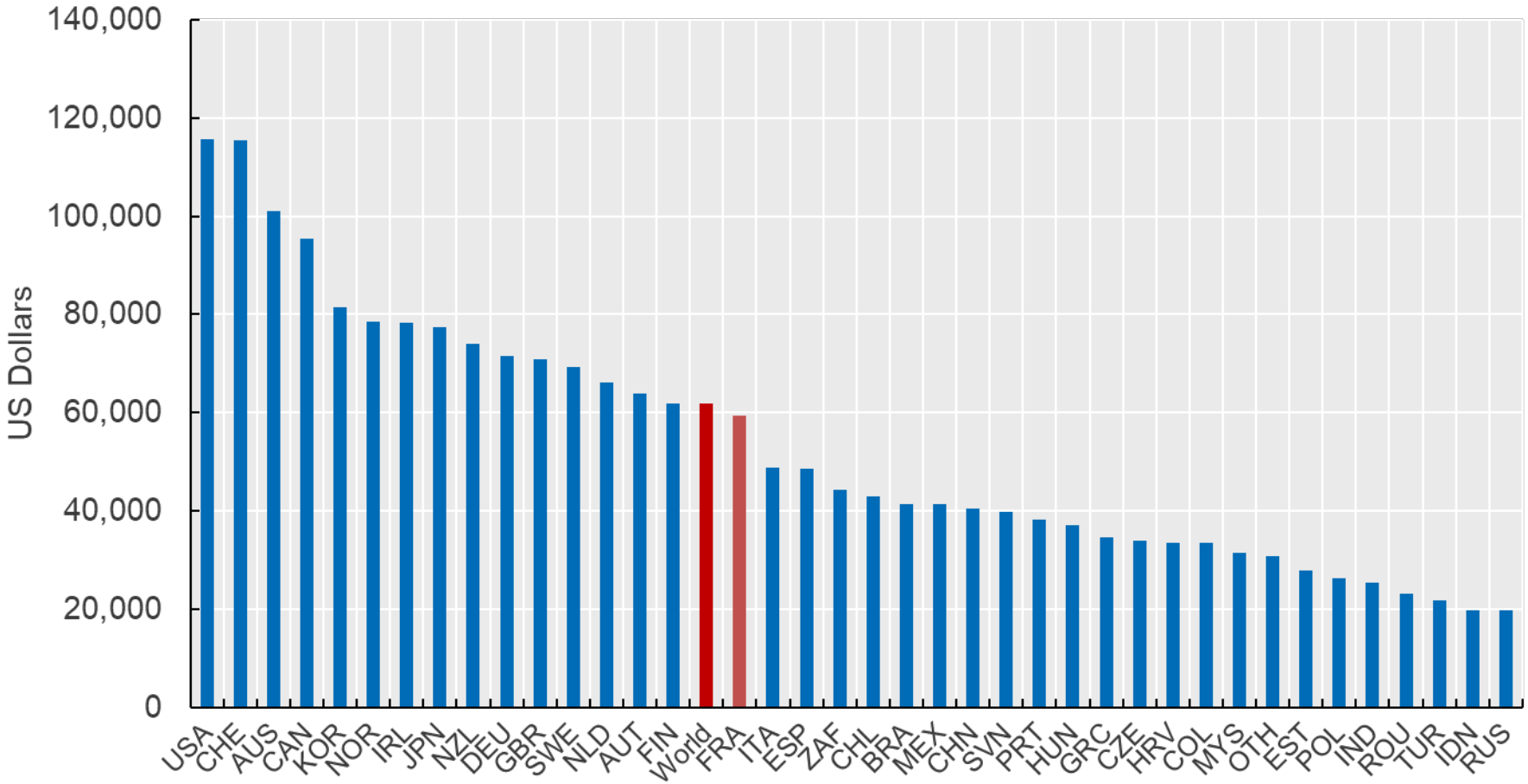
Scientific authors involved in consultancy work - As % of respondents resident in each country



Source: OECD International Survey of Scientific Authors (ISSA), 2018. http://oe.cd/issa

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

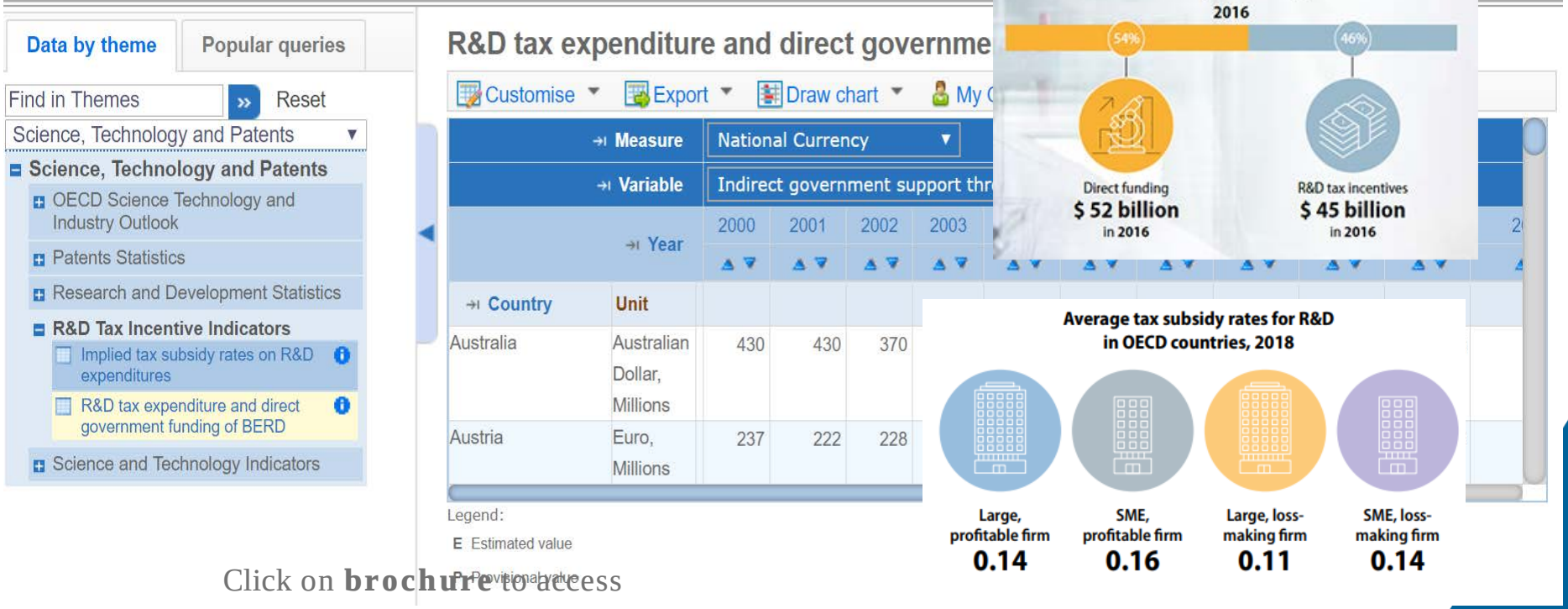
- Frascati R&D surveys capture funding flows
  - They can be extended/adapted to cover other dimensions.
- Oslo-innovation surveys can be designed to capture business experience of government policies.
  - Funding and other policies
  - See OM Chapter 7.
- Extended efforts to capture instruments and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

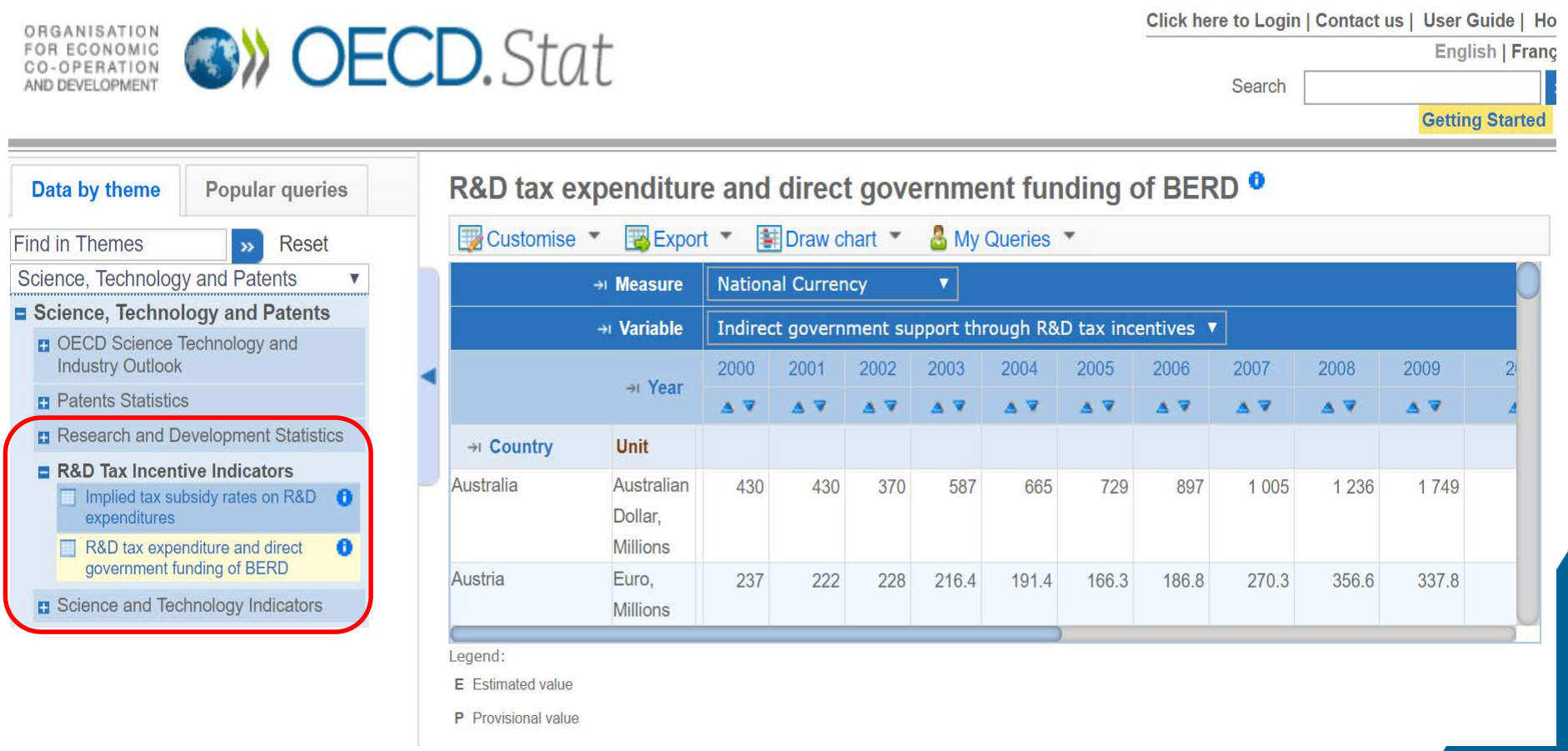
OECD.Stat



Click on **brochure** to access

Oecd.stat sources

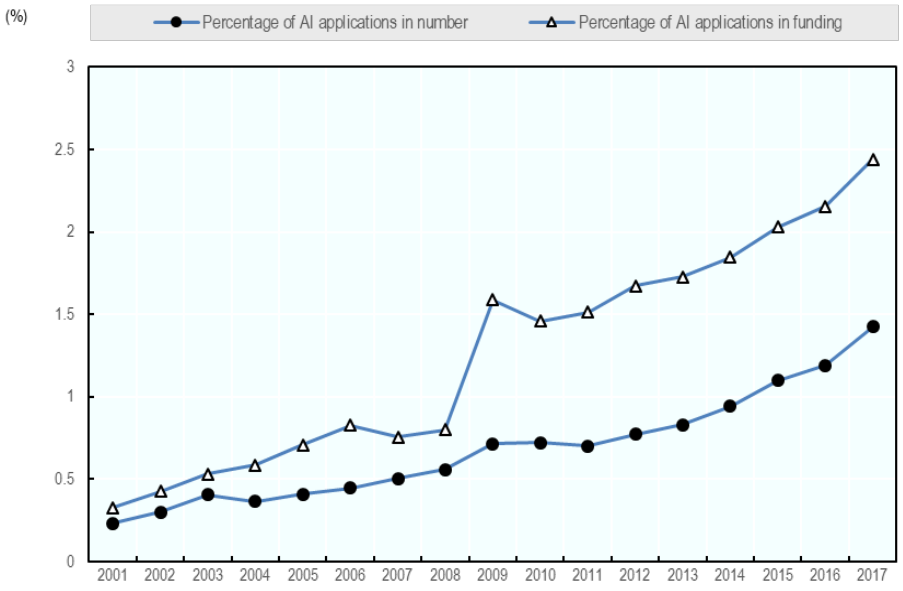
- **OECD R&D tax incentives database** https://oe.cd/rdtax launched in November 2018



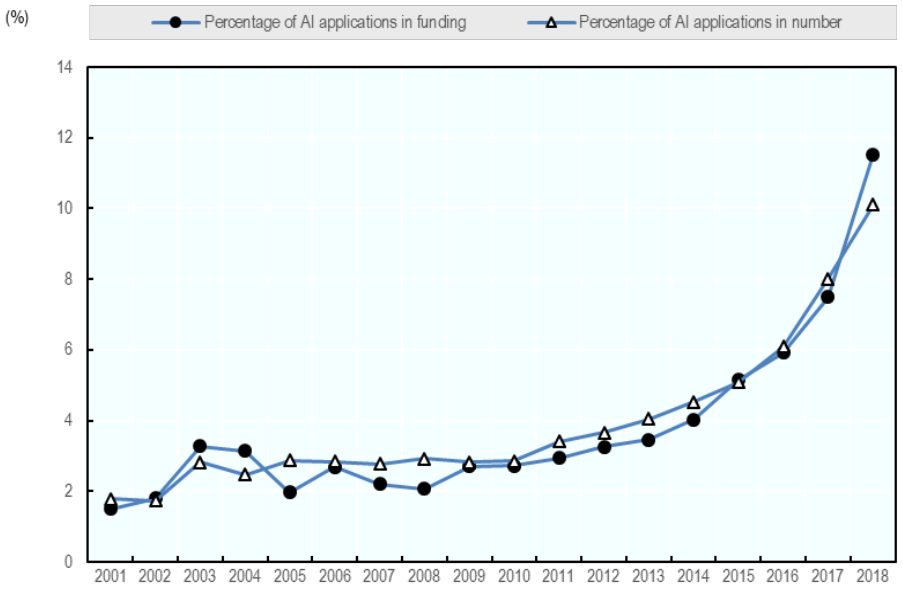
Activating alternative sources of administrative data

AI-related project funding at US NIH and NSF

NIH



NSF



Note: These are experimental indicators

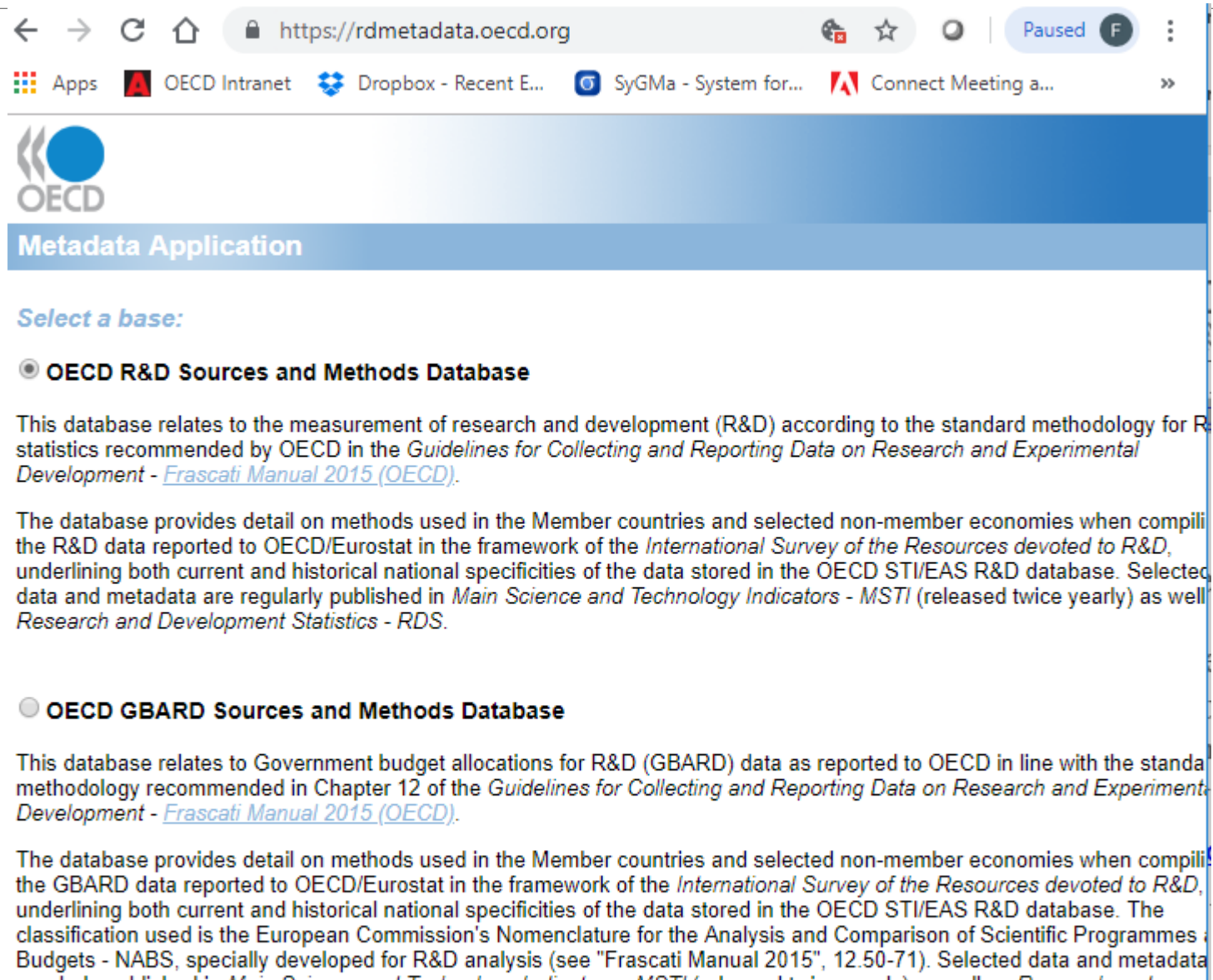
Source: OECD analysis based on NIH Reporter and NSF Award Search data.

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 (every 2 years)

Access through general statistical data repository

The metadata is just as important



The OECD STIP Compass policy repository

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

Biennial EC-OECD STI Policy survey

(Qualitative database)

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

Thank you for your attention

@oecdinnovation

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