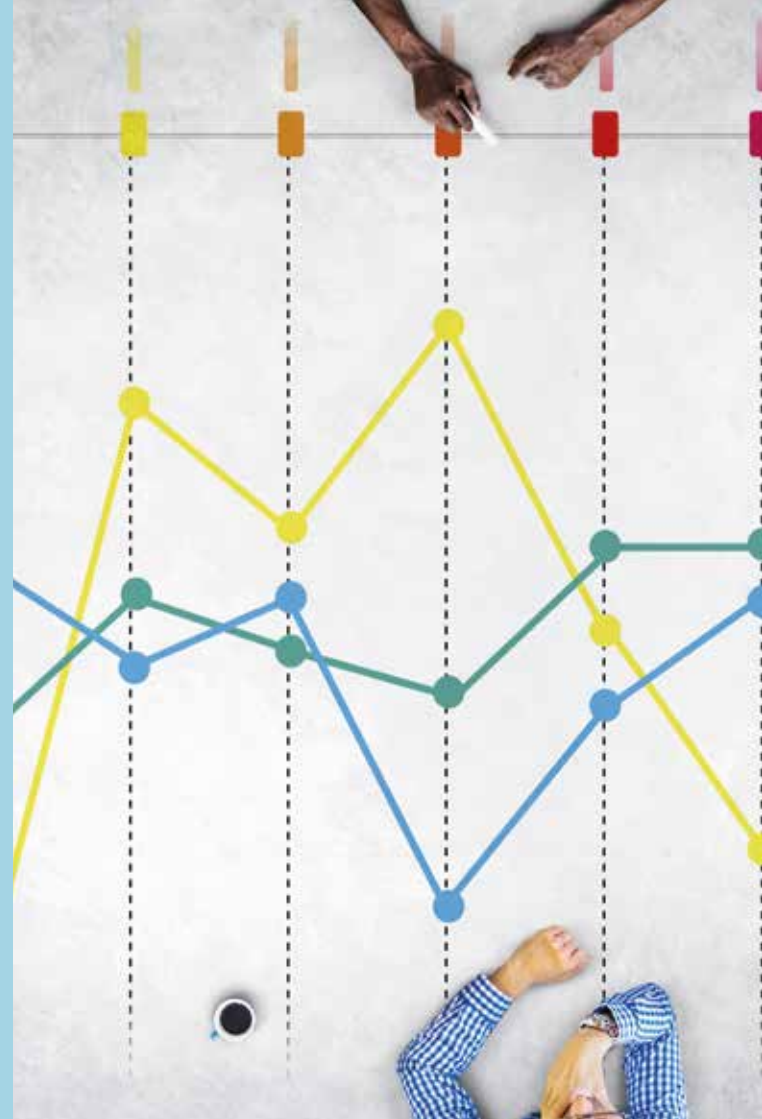**OECD**

BETTER POLICIES FOR BETTER LIVES

Science, Technology and Innovation

"Sound measurement is crucial for better policies in science, technology and innovation. Experimentation with metrics based on new tools and data, or new ways of using existing data, are needed to provide insights into emerging areas of policy interest, provoke debate and move the measurement agenda forward."

Andrew Wyckoff
Science, Technology and Innovation Director, OECD

OECD
BETTER POLICIES FOR BETTER LIVES

2016

Contents

www.oecd.org/sti

Measuring R&D

RESEARCH & DEVELOPMENT (R&D)

Measuring R&D – in a way that makes the data internationally comparable – is not an easy task; that's why the OECD *Frascati Manual* was first developed in 1963. Nowadays, this international standard is the basis of R&D statistics in OECD countries and beyond. It also underpins the definition of R&D used in accounting standards and in the UN System of National Accounts. The Frascati definition of R&D is widely used for policy purposes, too.

The OECD National Experts on Science and Technology Indicators (NESTI) recently oversaw the 6th revision of the *Frascati Manual* – improving its clarity and enhancing its relevance through greater compatibility with other statistics and new statistical guidance on R&D tax incentives and globalisation.

The OECD *Research & Development Statistics* (RDS) database, released annually in March-April, offers data exploration and extraction for analysis covering OECD members and other major economies fulfilling the standards of the OECD *Frascati Manual:* R&D spending and funding; R&D personnel numbers, qualifications, and gender;

government budgets for R&D; and historical OECD R&D data (1962-80).

The OECD *Analytical Business Enterprise Research & Development* (ANBERD) database builds upon RDS to give industry-level insights on R&D through detailed breakdowns covering both services and manufacturing.

The biannual OECD *Main Science and Technology Indicators* (*MSTI*) series presents a wide range of timely reference indicators used by policymakers and economic analysts. These cover the financial and human resources devoted to R&D since 1981 – alongside complementary indicators on patents and international aspects of science and technology.

What do we mean by R&D?

R&D comprises basic research (aimed at creating new knowledge with no specific application in view), applied research (new knowledge towards a specific practical aim) and experimental development (to develop new products or processes).

Did you know…?

According to OECD RDS historical data, in the 1960s nearly 70% of all business R&D in the largest OECD countries was directly funded by government. This figure is now close to 10%.

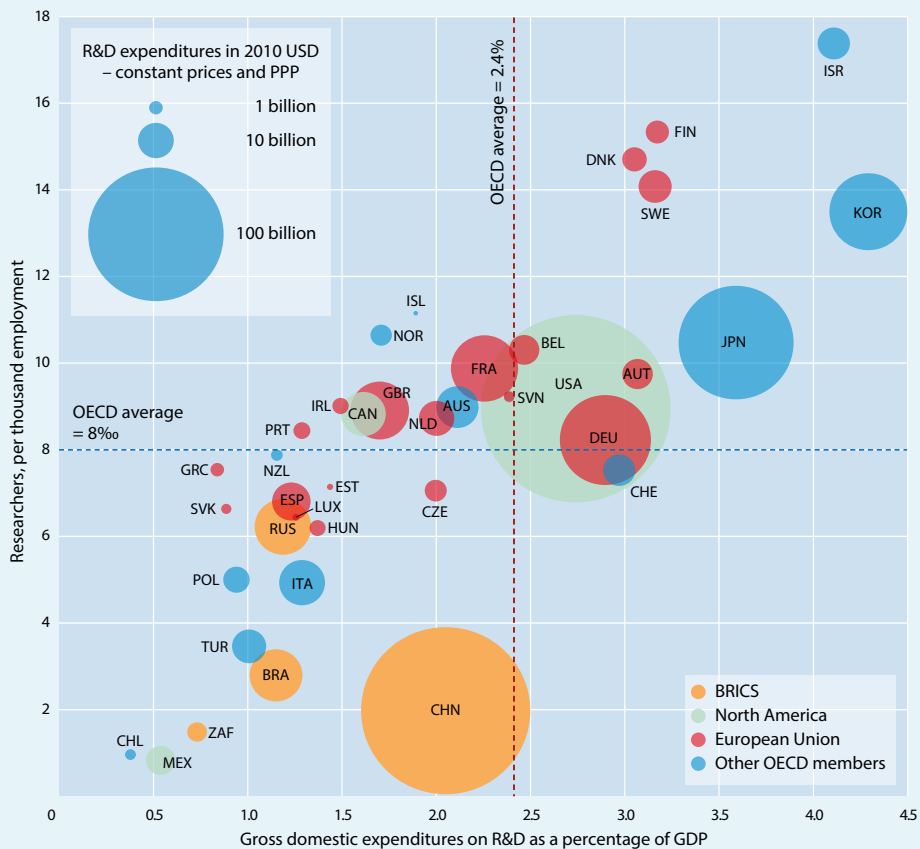*OECD R&D experts, Villa Falconieri, Frascati, in the 1960s.*

Find out more:

Frascati Manual – http://oe.cd/frascati

RDS – http://oe.cd/rds

ANBERD – http://oe.cd/anberd

MSTI – http://oe.cd/msti

Researchers and R&D spending, 2014

R&D expenditures in 2010 USD – constant prices and PPP

1 billion
10 billion
100 billion

OECD average = 2.4%

Researchers, per thousand employment

OECD average = 8‰

ISR, FIN, DNK, SWE, KOR, JPN, ISL, NOR, BEL, FRA, USA, AUT, GBR, IRL, CAN, AUS, SVN, NLD, DEU, PRT, CHE, GRC, NZL, EST, SVK, ESP, LUX, CZE, HUN, RUS, POL, ITA, TUR, BRA, CHN, CHL, ZAF, MEX

BRICS
North America
European Union
Other OECD members

Gross domestic expenditures on R&D as a percentage of GDP

Sources: OECD Main Science and Technology Indicators (MSTI); UNESCO Institute for Statistics, July 2016.

Digital readiness

ICT INFRASTRUCTURE

The OECD collects information and communication technology (ICT) infrastructure statistics to analyse the sector's development and to help policy makers in selecting best practices. Most OECD countries put national digital strategies high on their agendas in order to promote the development of telecommunication infrastructure and services. It is a priority for the OECD to monitor these objectives, which include: increased broadband capacity and speed; increased broadband coverage to better connect remote areas; and improved resilience of existing broadband infrastructure.

Main trends in communication policy and regulation as well as in communication markets, prices, broadband speeds and network development analysis are included in the *Digital Economy Outlook* (*DEO*).
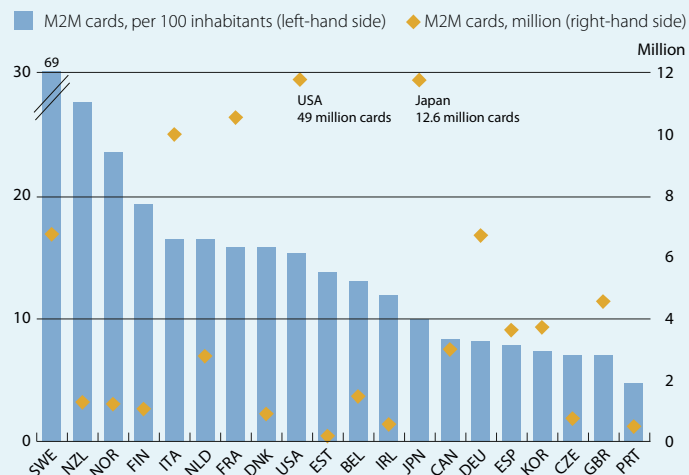
SIM cards for machine-to-machine (M2M) usage account for a growing segment of mobile data subscriptions. These devices connect millions of sensors, providing ever-greater amounts of "big data" to facilitate the monitoring of machines, environments and people's health.

M2M mobile cellular subscriptions, June 2015

Legend: ▪ M2M cards, per 100 inhabitants (left-hand side) ◆ M2M cards, million (right-hand side)

USA 49 million cards
Japan 12.6 million cards

Find out more:

DEO 2015 – http://oe.cd/deo2015

*OECD Broadband Portal* – http://oe.cd/broadband

Source: OECD Broadband Portal, http://oe.cd/broadband, August 2016.

SKILLS FOR THE DIGITAL ECONOMY

Greater use of digital technologies increases demand for ICT skills. Yet, the proportion of workers using office software (word processors, spreadsheets) daily differs significantly across countries, ranging from 38% in the Netherlands to 18% in Poland.

Daily users of office software at work, by ICT skills, 2013

As a percentage of all workers

%

All users ■ Of which, users with insufficient ICT skills
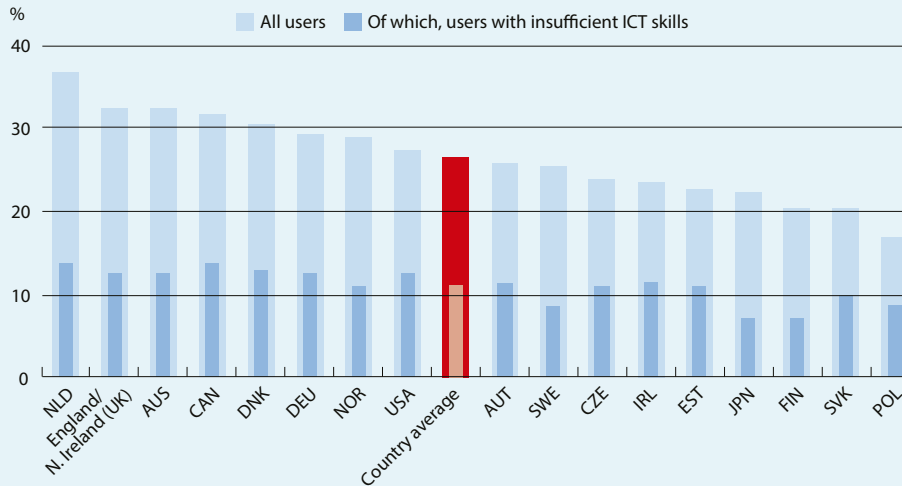
Source: OECD elaborations based on the PIAAC database, January 2016.

Data on the frequency of ICT use at work permit the measurement of ICT intensity in different occupations. Women typically use the Internet less than men and their participation in ICT occupations remains low as well (women account for 18% of ICT specialists in OECD countries).

Did you know…?

On average, only a quarter of all workers use office software daily. Of these, according to the OECD Survey of Adult Skills (PIAAC), over 40 % may lack the skills to use these tools effectively.

But "digital natives" are on the rise. On average, 15-year-olds in the OECD spend about three hours per day on the Internet on a typical weekday.

Find out more:
OECD (2016), "Skills for a Digital World", *OECD Digital Economy Papers,* No. 250, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlwz83z3wnw-en. OECD (2016), "New Skills for the Digital Economy", *OECD Digital Economy Papers,* No. 258, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlwnkm2fc9x-en.

ICT usage

ICT USE IN BUSINESSES AND HOUSEHOLDS

Almost no business today is run without the help of information and communication technologies (ICTs). However, while almost every enterprise has a broadband connection and near eight out of ten a web site, only four out of ten are purchasing online or use social media.

ICTs are now widely diffused also among households and individuals. Still, usage rates and online activities significantly vary across OECD countries and among social groups.
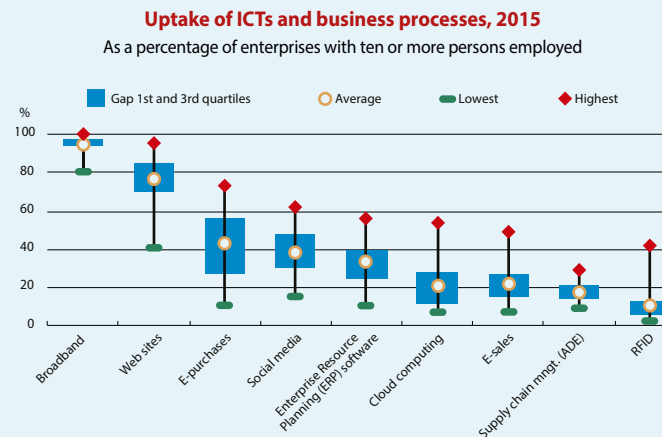
Data availability for specific indicators depends on surveys undertaken on a multi-year or occasional basis in some countries, and annually in others (EU28). Data collection practices also differ: ICT usage is not always monitored by means of a dedicated survey.

The OECD is actively engaged in work to facilitate the collection of comparable information in this field through its Model Survey on ICT Access and Usage by Households and Individuals and by Businesses. It also encourages the co-ordinated collection of statistics on usage – in particular – on emerging topics, such as privacy, security, children online, cloud computing or the sharing economy.

The OECD has been setting statistical standards in this area since 2008, encompassing definitions (electronic commerce transactions, content and media sector), classifications (ICT goods and services) and model surveys (ICT usage by households, individuals and businesses).

Find out more:

Measuring the Information Economy – http://oe.cd/ieconstat

Uptake of ICTs and business processes, 2015
As a percentage of enterprises with ten or more persons employed

Legend: Gap 1st and 3rd quartiles · Average · Lowest · Highest

X-axis categories: Broadband, Web sites, E-purchases, Social media, Enterprise Resource Planning (ERP) software, Cloud computing, E-sales, Supply chain mngt. (ADE), RFID
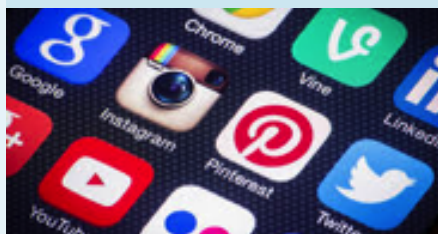
Sources: OECD, ICT Database; Eurostat, *Information Society Statistics* database, April 2016.

Did you know…?

Whose YouTube content are they watching? YouTube data can be used to show how much content is viewed outside the country in which it was uploaded. In 2014, 85% of the hours watched for videos uploaded by users in Japan were from users located in Japan, while in Australia and Canada only 8% of watched YouTube content was locally uploaded. On average people watch "a little bit of lots of things". But all watching countries in 2014 spent 10% or more of their watch hours on US-uploaded content.

Internet-based statistics can be used to generate real-time experimental indicators of usage patterns with global coverage that complement official survey data based on statistical sampling.

Internet users by age, 16-24 and 65-74 year-olds, 2014, G20 economies

As a percentage of population in each age group
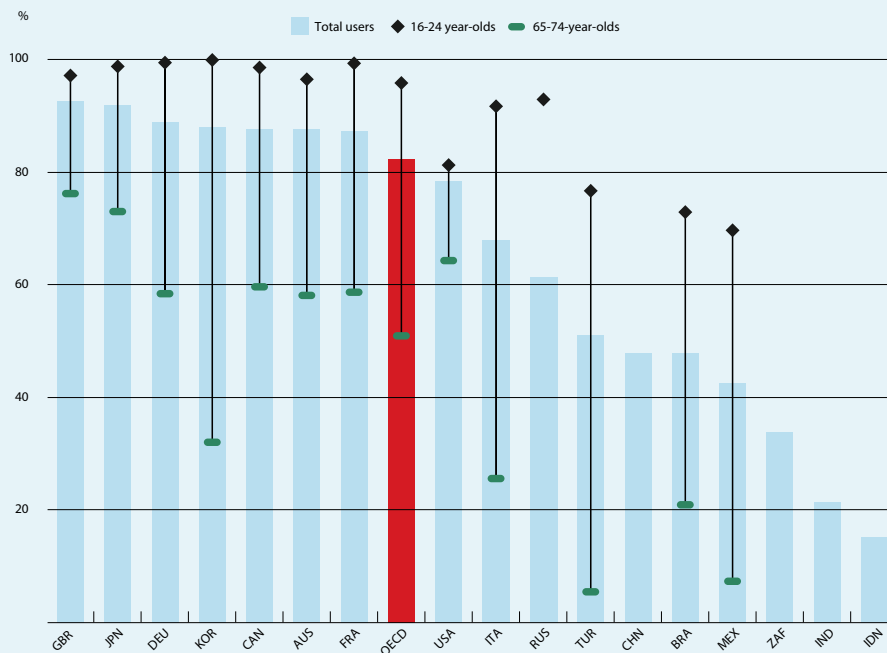
Sources: OECD, *ICT Database; Eurostat, Information Society Statistics Database,* April 2016.

Find out more:

OECD (2016), "Economic and social benefits of Internet Openness", *OECD Digital Economy Papers,* No. 257, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlwqf2r97g5-en.

Emerging and converging technologies

BIO AND NANOTECHNOLOGIES

Following its seminal work on information and communication technologies (ICTs), the OECD continued addressing the measurement of enabling technologies via its work to develop and implement a framework for biotechnology statistics. The OECD has been collecting data on biotechnology from national statistical organisations – the *Key Biotechnology Indicators* (KBI) – since 2001. This work has been more recently extended to nanotechnology. Since 2013, the OECD publishes an experimental collection of *Key Nanotechnology Indicators* (KNI) online.

Developing internationally harmonised definitions and comparable statistics on selected technology domains with a broad range of possible applications and mutual overlaps represents a challenge for statistical surveys. Having made considerable progress in capturing, through R&D surveys, how much firms dedicate to developing these technologies, a major priority is to measure in a consistent fashion how firms in all sectors use these technologies and what barriers they face in realising their full potential. Leveraging complementary data sources is also part of ongoing and planned OECD work.

The OECD approach is to draw on the contribution of its policy and statistical committees, as well as leading external experts. One aim of the newly created OECD Working Party on Biotechnology,

Nanotechnology and Converging Technologies (BNCT) is to advance the statistical work on emerging technologies, e.g. by connecting measurement more closely with policy agendas.

Find out more:
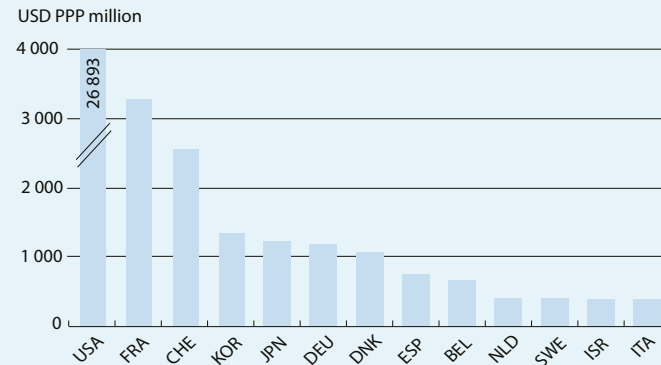OECD (2005), *A Framework for Biotechnology Statistics,* OECD, Paris, http://oe.cd/bioframework
KBI – http://oe.cd/kbi
KNI – http://oe.cd/kni
OECD BNCT – http://oe.cd/bnct

Biotechnology R&D in the business sector, selected countries, 2013

USD PPP million

Source: OECD, Key Biotechnology Indicators, http://oe.cd/kbi, June 2015.

EXPERIMENTAL METHODS: D.E.T.E.C.T.S.

Did you know...?

Technologies emerge, develop and mature at different paces. Some technologies stabilise while others find a wide array of applications that accelerate their development.

An experimental data-mining approach called D.E.T.E.C.T.S. exploits information contained in scientific publications and patents to identify innovative activities whose intensity increases sharply (i.e. bursts), compared to previous levels and to the development of innovations in other technology fields. It also maps the time it takes for such dynamics to unfold.

Since 2005, global inventive activity has accelerated in fields related to ICTs and environment, energy and enabling technologies.

Find out more:

Dernis, H., M. Squicciarini and R.J. de Pinho (2015), "Detecting the emergence of technologies and the evolution and co-development trajectories in science", *Journal of Technology Transfer,* http://dx.doi.org/10.1007/s10961-015-9449-0

Top players in emerging technologies, 2010-12

Share of top three economies' patents in top 20 technologies bursting from 2005 onwards
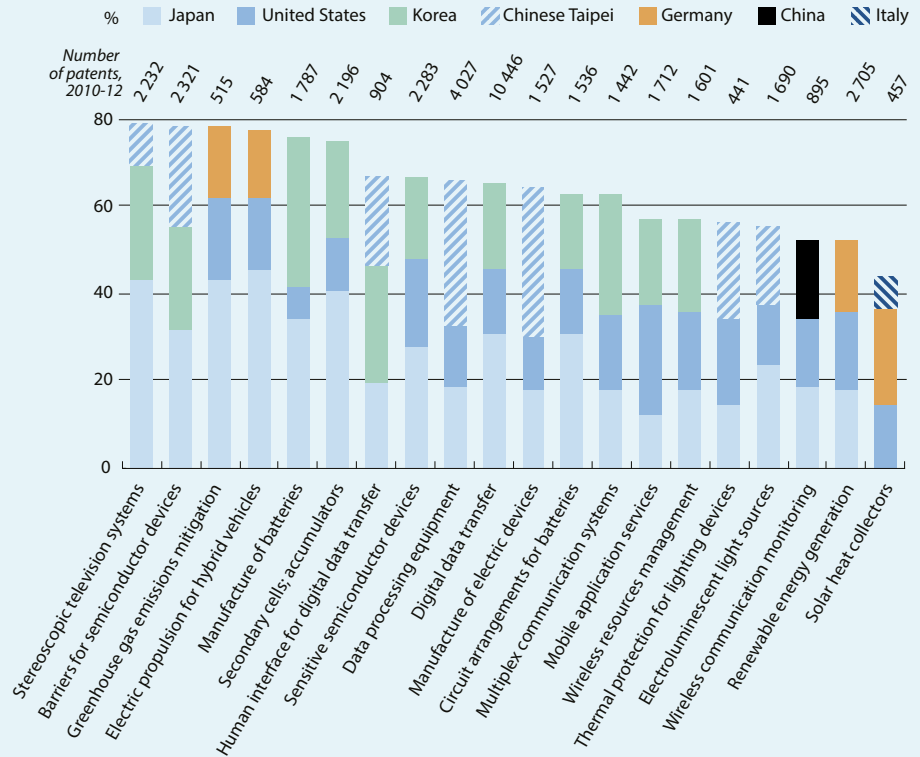
Human resources in S&T

60%
Between 2000 and 2012, the graduation rate for doctoral students across the OECD has increased by 60%, from 1.0% to 1.6%.

RESEARCHERS

People are key for the creation, diffusion and use of knowledge through science, technology and innovation. For policy makers it is important to understand the motivations and experience of individuals that have an expertise in science and technology (S&T), what drives their mobility and how their skills are being used.

To ensure relevant and robust evidence, administrative data and general social surveys need to be complemented by targeted approaches. In the light of the evidence gaps, the OECD has launched a series of initiatives in this area aimed at two key communities: doctorate holders and scientific authors.
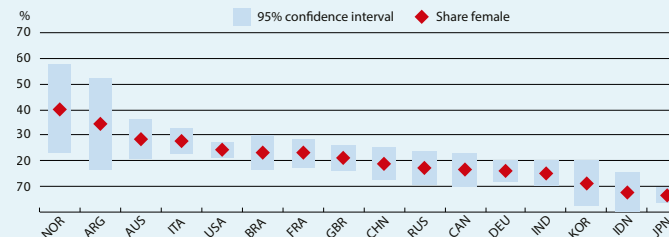
Doctorate holders have the highest educational attainment qualifications and are specifically trained to do research. After the Blue Sky Conference of 2006, the OECD launched a project aimed at developing internationally comparable indicators on their careers and mobility: Careers of Doctorate Holders (CDH). This work has influenced the emergence of surveys targeted to postgraduates in many countries.

Find out more:
Careers of Doctorate Holders – http://oe.cd/cdh
International survey of scientific authors – http://oe.cd/issa

Female scientific authors, 2011
Percentage of leading authors within selected countries

Legend: 95% confidence interval ◆ Share female

Countries (x-axis): NOR, ARG, AUS, ITA, USA, BRA, FRA, GBR, CHN, RUS, CAN, DEU, IND, KOR, IDN, JPN

Source: OECD (2015), *OECD STI Scoreboard 2015, O*ECD Publishing, Paris, http://dx.doi.org/10.1787/888933273335, based on preliminary analysis of the "OECD Pilot Survey of Scientific Authors".

The OECD international survey of scientific authors (ISSA)

Through an online experimental survey, the OECD targets corresponding authors of peer-reviewed papers and collects, in a cost effective fashion, microdata of high relevance for science policy, e.g. on access to results of scientific research, gender equality or impacts of research beyond publications. A first pilot was carried out in 2015; a second study focusing on the digitalisation of science is planned for 2017.

Innovation

INNOVATION STATISTICS

Most people view innovation in businesses as the process of generating new ideas and implementing them on the market. The OECD plays a key role in the development of international guidelines for surveys of business innovation – the *Oslo Manual* – and the design of indicators constructed with data from such surveys.

Innovation surveys attempt to capture the broad and systematic nature of innovation in firms. Most firms introducing an innovation do neither R&D nor protect their innovations through patents. The OECD/Eurostat *Oslo Manual* is currently undergoing its fourth revision, which is expected to be completed by end 2017. The OECD is also working on measuring innovation outside the business sectors.

In addition, the OECD carries out analytical and methodological studies of innovation data, including multi-country microdata distributed analysis. Examples of recent work include studies on the links between design and innovation and the role of public procurement.
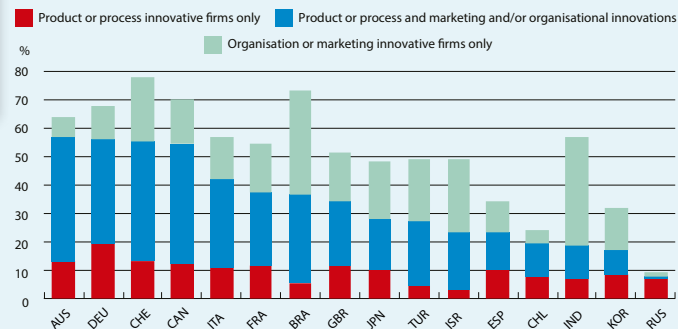
Find out more:

Oslo Manual – http://oe.cd/oslo-manual
Innovation indicators – http://oe.cd/inno-stats

Types of innovation in firms, selected countries, 2010-12
As a percentage of all firms

- Product or process innovative firms only
- Product or process and marketing and/or organisational innovations
- Organisation or marketing innovative firms only

Source: OECD, based on the Eurostat Community Innovation Survey (CIS-2012) and national data sources.

What do we measure with innovation surveys?

The definitions developed in the *Oslo Manual* are aimed at statistical measurement in the business sector: "*An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.*"

Knowledge-based capital

1.5 times

In 2013, in the US and the UK, investment in KBC amounted to about 1.5 times the investment in machinery, equipment and buildings.

A HUMAN CAPITAL APPROACH

Non-tangible forms of capital, such as knowledge-based capital (KBC), are increasingly the largest form of business investment. Assessing their role for economic growth and value creation for firms requires properly measuring such assets. In the absence of internationally agreed methodologies, the OECD is working to devise comparable measures of key KBC types to provide evidence for policy making.

Experimental use of the OECD Survey of Adult Skills (PIAAC) has led to first-time estimates of industry-level investment in organisational capital and training (i.e. formal and on-the-job training, and informal learning), for both the public and private sectors.

These estimates can be used to analyse the contribution of investment in KBC to innovation and economic performance, and to investigate the role of investment in KBC for economies' participation and positioning in global value chains.
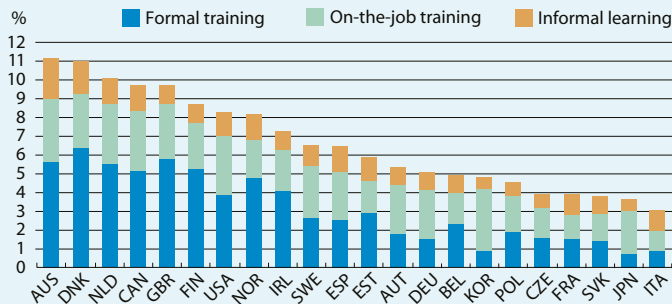
Existing estimates of firm-specific training mainly focus on on-the-job training. OECD work suggests that by doing so, total investment in training is underestimated by about 60%. Formal training, i.e. structured training leading to the acquisition of formal certificates

(e.g. MBA), represents a substantial part of firms' investment in training but typically goes unaccounted for.

The "routine" content of occupations influences the way firms organise production across borders. Occupations are said to be "routine intensive" when the tasks undertaken follow a set of well-defined

Investment in training, 2011-12
Percentage of gross value added

Source: Squicciarini, M., L. Marcolin and P. Horvát, "Estimating cross-country investment in training", *OECD Science, Technology and Industry Working Papers*, N° 2015/09, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jrs3sftp8nw-en.

Find out more:

Firm-specific training – http://oe.cd/stitraining

Organisational capital – http://oe.cd/stioc

rules or sequences (e.g. hand packers), whereas non-routine occupations typically entail performing more complex tasks, such as creative problem solving and decision making (e.g. managers).

Recent OECD work, based on PIAAC data, distinguishes between what workers do on their jobs and the skills with which they are endowed; from there it develops new indicators of the routine intensity of occupations. It sheds new light on the role that skills and the routine content of occupations play for industry, the labour market and trade dynamics.

Contrary to some common perceptions, offshoring does not necessarily make routine workers redundant. Especially in manufacturing, offshoring of inputs can have a positive impact on routine-intensive jobs.
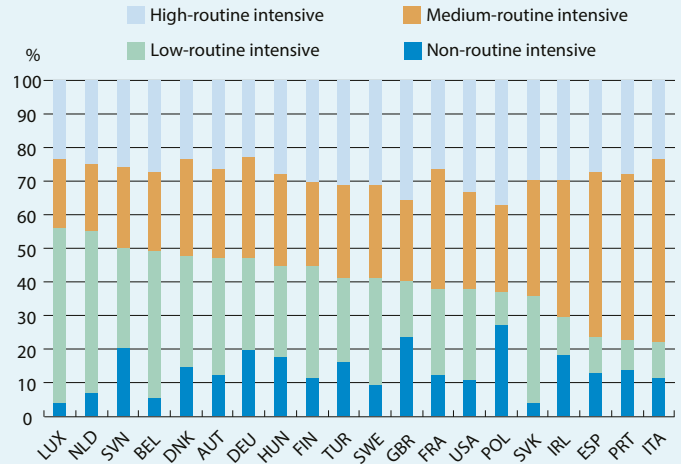
Also, technological innovation is found to relate positively to employment in all types of occupations.

Did you know…?

Manufacturing accounts for higher shares of workers in high-routine occupations: 41% on average, as compared to 28% in services.

Shares of employment by routine intensity of jobs
Average of years 2000, 2005, 2008-11

Source: Marcolin, L., S. Miroudot and M. Squicciarini (2016), "GVCs, Jobs and Routine Content of Occupations", *OECD Trade Policy Papers*, No. 187, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jm0mq7kr6s8-en.

The share of non-routine and low-routine-intensive workers ranged between about 22% and 56% over 2000-11. The average share of workers in high routine-intensive occupations ranged between 21% and 37%.

Find out more:
Routine jobs – http://oe.cd/routineindex
Routine jobs and GVCs – http://oe.cd/routinegvc and
www.oecd.org/sti/ind/GVC-Jobs-Routine-Content-Occupations.pdf

Global interdependencies

50%
Inter- and intra-regional movements of intermediate goods represent about 50% of world trade in manufacturing.

TIVA DATA INFRASTRUCTURE

For over 20 years, the OECD Directorate for Science, Technology and Innovation has maintained a suite of databases for industrial analyses: the *STAN* family. Taken together, these databases provide key inputs into the Trade in Value Added (TiVA) initiative and data infrastructure.

The *STAN* (*Structural Analysis*) database includes annual measures – from 1970 onwards – of output, value added, employment and investment that allow researchers to analyse industrial performance at a relatively detailed level of activity across OECD countries. Primarily based on national accounts statistics, estimates are made to extend series back in time and include more industry detail.

The latest set of harmonised national input-output and *ICIO* (*Inter-Country Input-Output*) tables presents current price matrices of inter-industry flows of goods and services (domestically produced and imported) for all OECD countries and 27 non-member economies, in a common format and covering the years 1995 to 2011.

BTDIxE (*Bilateral Trade Database by Industry and End-Use*) uses standard conversion keys to allocate official trade statistics by product to industries and end-uses (intermediate inputs, consumption and capital goods). The data are on a "gross basis", e.g. the value of

exports as recorded by customs with no account taken of any implicit value originating from imported intermediate goods.

Find out more:

STAN database – http://oe.cd/stan   BTDIxE database – http://oe.cd/btd
ICIO tables – http://oe.cd/i-o

China's gross trade in intermediate and final ICT products

USD billion

Legend:
- Exports - intermediates
- Imports - intermediates
- Exports - final goods
- Imports - final goods

Source: OECD, *Bilateral Trade Database by Industry and End-Use*, April 2016.
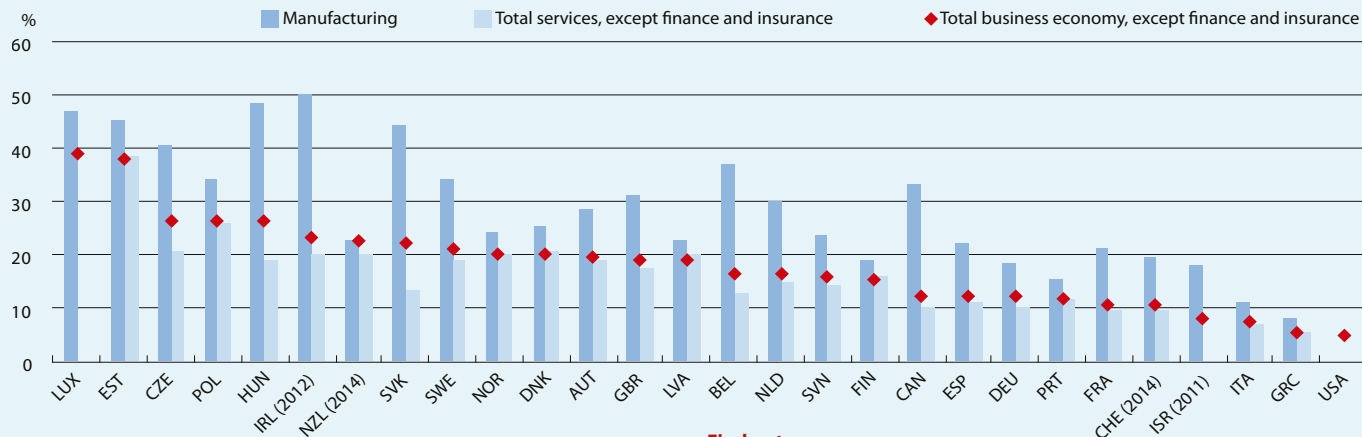
Growth in the People's Republic of China's (hereafter: "China") reported gross exports of ICT final products is similar to growth in imports of ICT intermediates (parts and components), reflecting its major role in product assembly for multinational enterprises (MNEs).

Even though foreign affiliates account for a small share of enterprises, their contribution to host countries' activity is substantial in many countries. In 2013, in all OECD countries for which data is available, the share of foreign-controlled employment ranged from 5% to almost 40%. The importance of foreign affiliates is larger in manufacturing than in services.

Did you know...?

The *Activity of Multinational Enterprises* (*AMNE*) database provides relatively detailed information on the inward and outward activity of MNEs. It contains 17 variables such as employment, sales, value added, investment, labour compensation and R&D, broken down by industry and partner countries. It covers 31 OECD countries from 1995 to 2013.

Linking foreign affiliates data to the TiVA data infrastructure will allow to identify the contribution of domestic versus foreign owned enterprise groups to value added.

Share of national employment under control of foreign affiliates, 2013
By manufacturing and services

Legend: Manufacturing | Total services, except finance and insurance | Total business economy, except finance and insurance

Sources: OECD, "Inward activity of multinationals by industry", *Activity of Multinational Enterprises* database; Eurostat, *Inward FATS* database, July 2016.

Find out more:
AMNE database – http://oe.cd/amne   Global value chains – http://oe.cd/gvc

Global interdependencies

40%
In Germany, 40% of business sector jobs are sustained by foreign demand for German final products, up from 30% the previous decade.

TRADE IN VALUE ADDED (TIVA)

Tracing the flows of value added that arise from global production provides new insights for analysing global value chains (GVCs) that are not always evident from conventional trade statistics.

The *Trade in Value Added* (TiVA) database developed under the OECD-WTO TiVA initiative provides indicators on the origin – both domestic and foreign – of value added embodied in exports and in final demand. The indicators are derived from the OECD's *Inter-Country Input-Output* (*ICIO*) database, which provides estimates of the flows of goods and services between 61 countries and 34 industries from 1995 to 2011.

The infrastructure developed to produce TiVA indicators can also be used to estimate how many jobs in a country are used in production to meet final demand in other countries; and, ultimately, to derive the type of occupations that are in demand.
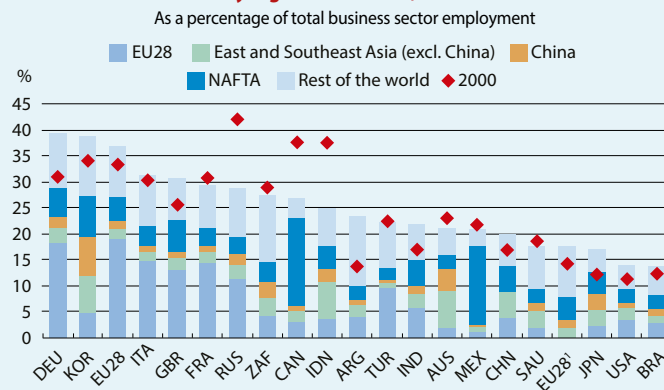
Find out more:

TiVA database – http://oe.cd/tiva
Work on global value chains – http://oe.cd/gvc
Trade in employment – http://oe.cd/io-emp

Jobs in the business sector sustained by foreign final demand, by region of demand, 2011
As a percentage of total business sector employment

Legend: EU28 | East and Southeast Asia (excl. China) | China | NAFTA | Rest of the world | 2000

1. Excludes intra-EU trade.
Source: OECD, Trade in employment, April 2016, http://oe.cd/io-emp.

A new look at global interdependencies
Estimates of foreign value added in exports, sometimes referred to as backward linkages in GVCs, highlight the importance of imports for export performance. A significant share of foreign value added in exports originates from the same region, reflecting increasing regional integration of economies (notably the European Union or "Factory Europe", NAFTA and "Factory Asia").
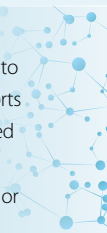
Did you know...?

The *ICIO* tables can be combined with the International Energy Agency emission and energy statistics to estimate international transfers of embodied CO_2 emissions as well as embodied energy. This allows the development of a consumption perspective, as opposed to an exclusively production-based view of emissions.

Rather than allocating emissions to the country where they are produced, the consumption approach allocates them to the country in which the goods and services embodying the emissions are eventually consumed as final demand.
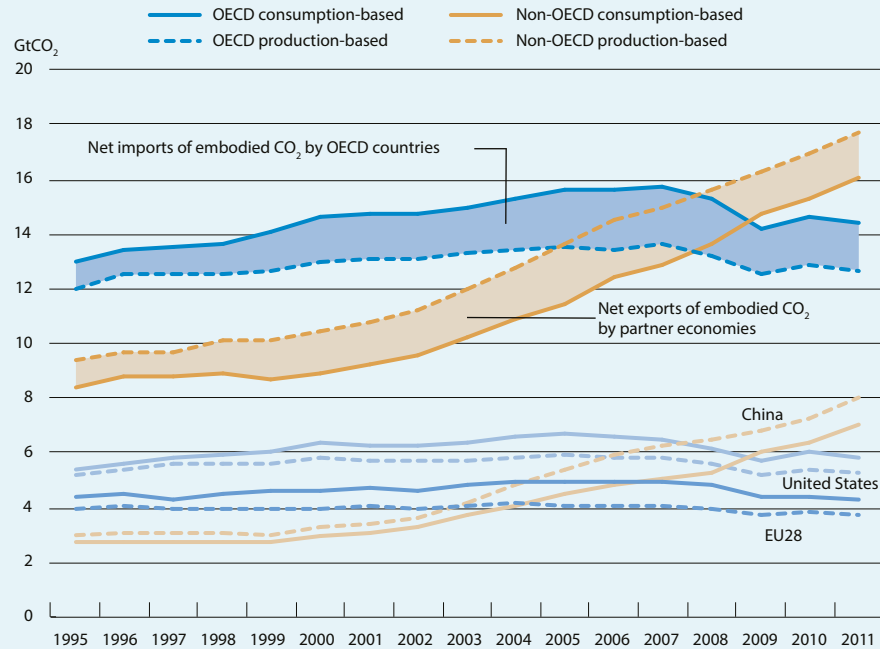
Find out more:
ICIO tables – http://oe.cd/io-co2

Trends in production- and consumption-based CO_2 emissions, 1995-2011

CO_2 emissions from fuel emissions, Gigatonnes (Gt)

Legend:
- OECD consumption-based
- OECD production-based
- Non-OECD consumption-based
- Non-OECD production-based

Net imports of embodied CO_2 by OECD countries

Net exports of embodied CO_2 by partner economies

China
United States
EU28

The OECD area has long been a net importer of CO_2 emissions, i.e. OECD consumption has been significantly higher than OECD production. Since the early 2000s, China has been a notable net exporter of emissions, as its industrial base has expanded to meet worldwide demand for its output.
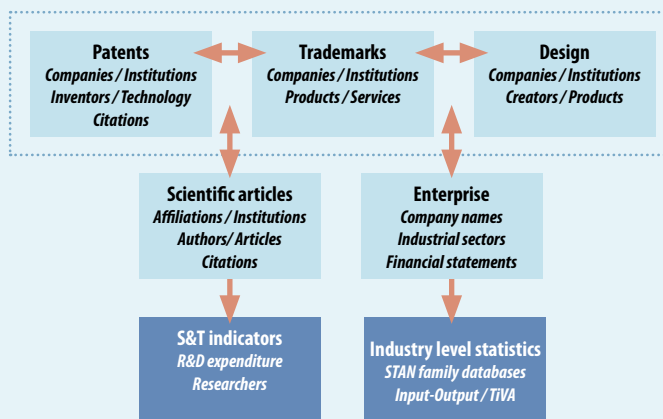
The Micro-data Lab

THE DATA INFRASTRUCTURE

The *STI Micro-data Lab*, a data infrastructure project of the OECD Directorate for Science, Technology and Innovation (STI), collects and links large-scale administrative and commercial micro-level datasets. These mainly relate to administrative data such as intellectual property (IP) assets, including patents, trademarks and registered designs; scientific publications; and companies' information from private providers. These micro-data, which complement and enhance official statistics such as macro-aggregated or survey-based data, have the advantage of being granular in nature and comprehensive in time and geographical coverage.

By providing detailed information about economic agents' behaviours and the way science and technology develop, these data help to address policy-relevant questions, such as those related to the generation and diffusion of new technologies; the different ways in which firms innovate; science-industry links; researchers' mobility patterns; or the role of knowledge-based assets in the economic performance of firms.

The *STI Micro-data Lab* serves as a platform for the development of new metrics and methodologies and feeds into a large range of analyses. Experimental indicators built using this infrastructure are regularly published by the OECD, notably in the *OECD Science, Technology and Industry Scoreboard*.

Patents
Companies / Institutions
Inventors / Technology
Citations

Trademarks
Companies / Institutions
Products / Services

Design
Companies / Institutions
Creators / Products

Scientific articles
Affiliations / Institutions
Authors / Articles
Citations

Enterprise
Company names
Industrial sectors
Financial statements

S&T indicators
R&D expenditure
Researchers

Industry level statistics
STAN family databases
Input-Output / TiVA

The matching algorithm

Companies and IP assignees' names are matched using the *Imalinker* system, developed for the OECD by Seville-based company IDENER in 2013. Names are first harmonised using country-specific dictionaries to correct for misspellings and duplications. Sequences of token and string-metric-based matching algorithms are used to compare the harmonised names in the different datasets and assign IP rights to firms.

Did you know...?

The *STI Micro-data Lab* is open to visiting researchers. Access is granted free of charge upon the submission of a formal request, and subject to the respect of confidentiality rules and to the project being of mutual interest to the OECD and the visiting fellow(s).

Specific micro-data sets are made available upon request (for instance: the OECD's *REGPAT, HAN* or *Patent Quality* databases as well as the *EC-JRC/OECD COR&DIP©* database).
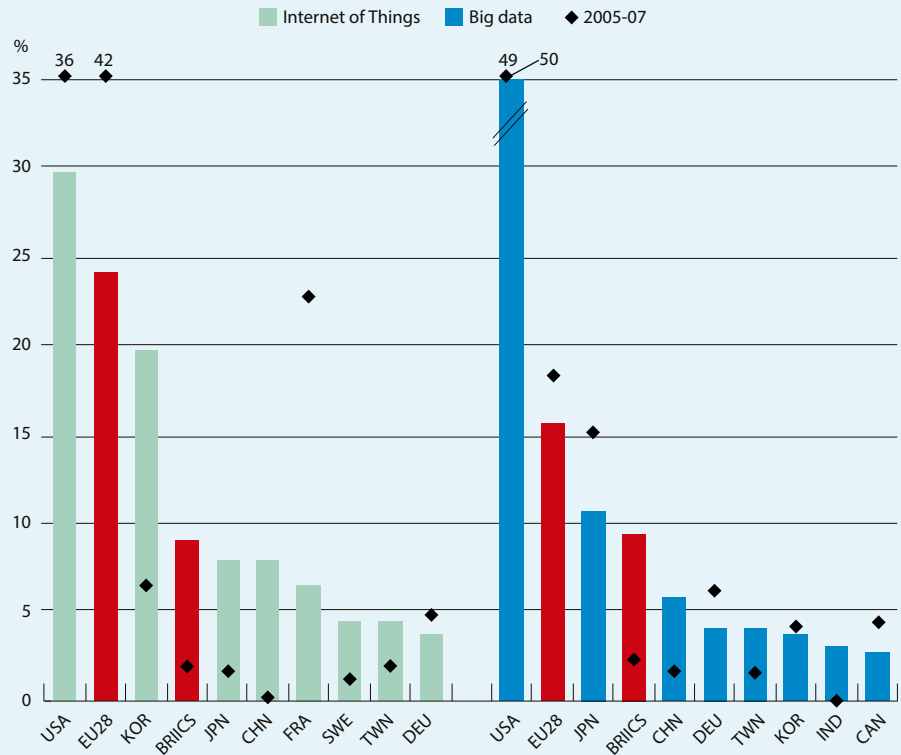
Find out more:

Intellectual Property database
– http://oe.cd/ipstats
Scientometrics – http://oe.cd/scientometrics

Top players in Internet of Things, big data and quantum computing technologies, 2005-07 and 2010-12

Economies' share of IP5 patent families

Legend: Internet of Things | Big data | ◆ 2005-07

Sources: OECD (2015), *OECD STI Scoreboard 2015*, OECD Publishing, Paris, http://dx.doi.org/10.1787/888933273495, based on IPO (2014), *Eight Great Technologies: the Patent Landscapes*, United Kingdom; *STI Micro-data Lab: Intellectual Property* database, June 2015.

The Micro-data Lab

IP STATISTICS

IP statistics are collected in the framework of the OECD-led IP Statistics Task Force, which gathers representatives from IP Offices worldwide and organises the annual conference IP Statistics for Decision Making.

Patents represent a unique and detailed source of information on inventive activity and its main features, including the technology fields covered by inventions or the geographical location of inventors.

The OECD patent data collection mostly relies on the *Worldwide Patent Statistical Database* (PATSTAT) maintained by the European Patent Office (EPO), which contains the bibliographic records of patent applications filed in most IP offices worldwide since the late 1970s. Data are further harmonised and refined at the OECD to enhance accuracy, coverage and granularity.

Trademarks represent good proxies of service innovations, as well as of product and marketing ones. The trademark datasets featured in the *STI Micro-data Lab* currently include records from the EU Intellectual Property Office (EU IPO), IP Australia, the Japan Patent Office (JPO), and the US Patent and Trademark Office (USPTO).

Industrial design registrations have recently been integrated in the *STI Micro-data Lab* to allow for the analysis of design activities and creative industries. To date, design data cover registered designs from the EU IPO, IP Australia and the JPO.

Linking IP statistics with company information allows characterising the "IP bundle", i.e. the extent to which different types of intellectual property are used by firms.

Trends in IP statistics, 2005-14
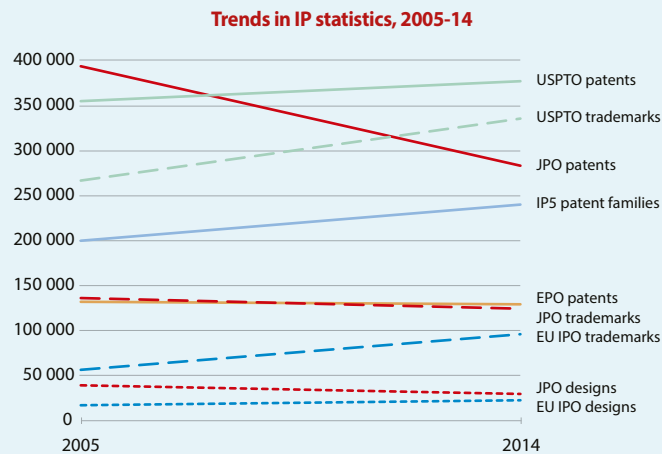
Source: OECD, *STI Micro-data Lab: Intellectual Property* database, June 2015.

Did you know...?

In the *REGPAT* database addresses are linked to administrative regions using string comparison algorithms based on postal codes and city names. Regionalisation is performed at territorial level 3 (TL3), covering about 5 500 regions in more than 40 countries.

The *OECD Patent Statistics Manual* (2009) provides guiding principles for the use of patent data in science and technology measurement, and recommendations for the compilation and interpretation of a number of patent indicators.

Recent methodological work has exploited information contained in patent documents to construct indicators mirroring the technological and economic value of patented inventions, and their possible impact on subsequent technological developments.

Find out more:

OECD Patent Statistics Manual – http://oe.cd/patentmanual

Squicciarini, M., H. Dernis and C. Criscuolo (2013), "Measuring Patent Quality: Indicators of Technological and Economic Value", *OECD Science, Technology and Industry Working Papers*, No. 2013/03, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k4522wkw1r8-en

IP bundle of top 5 applicants, 2011-13 European, Japanese and US markets
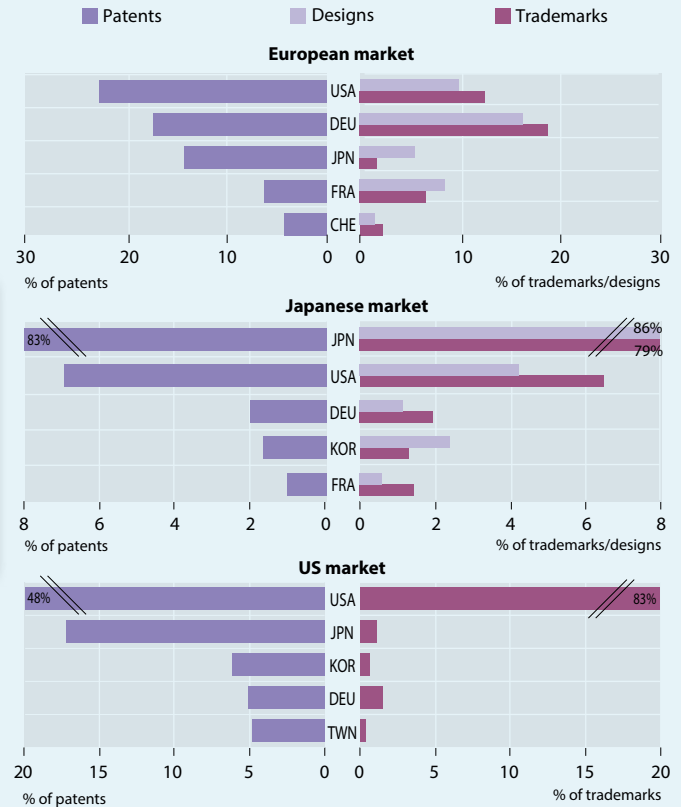
Sources: OECD (2015), *OECD STI Scoreboard* 2015, OECD Publishing, Paris, http://dx.doi.org/10.1787/888933274256, based on *STI Micro-data Lab: Intellectual Property* database, June 2015; EPO and JPO annual reports, 2012-14.

The Micro-data Lab

70%

In 2012, the top 250 R&D corporations (worldwide) and their affiliates accounted for more than 70% of R&D and patents, and for 44% of trademarks.

THE IP BUNDLE OF TOP R&D PLAYERS

The joint EC-JRC/OECD report *World Corporate Top R&D Investors: Innovation and IP Bundles* looks at the innovative output of the top research and development (R&D) investors worldwide. The analysis encompasses the sample of the top 2000 corporate investors worldwide, published in the *2013 EU Industrial R&D Investment Scoreboard*, and uses patents and trademarks as proxies of innovation output. The IP portfolio of companies is obtained by means of matching IP applicants' names to the list of the top R&D performers and their affiliates.

The report contains a wide array of statistics related to features such as the technological profile of companies, their trademark strategies, and the extent to which these two forms of IP rights are bundled to protect and appropriate the returns from investment in knowledge-based assets.
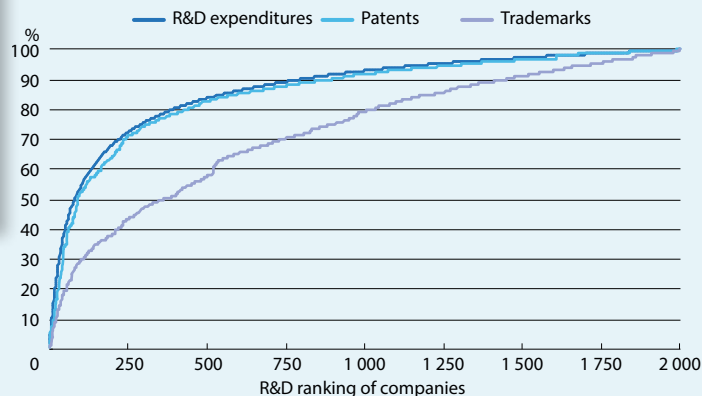
Find out more:

Report

– www.oecd.org/sti/inno/World-Corporate-Top-RD-Investors-Innovation-and-IP.pdf
EC-JRC/OECD COR&DIP© database
– http://survey.oecd.org/ViewContent.aspx?contentID=2172

R&D expenditures and the IP bundle of the top R&D companies, 2012

Source: OECD (2015), *OECD STI Scoreboard 2015,* OECD Publishing, Paris, http://dx.doi.org/10.1787/888933273408, based on *STI Micro-data Lab: Intellectual Property* database, June 2015.

What is a trademark™?

A trademark is a distinctive sign (e.g. a word or image) denoting goods and services produced or provided by a specific person, enterprise, or institution. It helps customers identify products or services meeting their needs and expectations in terms of e.g. nature, quality or price.

BIBLIOMETRICS AND SCIENTOMETRICS

Scientometrics – the quantitative study of science – has expanded from the bibliometric analysis of indices of peer-reviewed scientific publications to the study of several dimensions of scholarly activity, including mobility patterns using scientific authors' affiliations.

As a user and producer of bibliometric indicators, the OECD works with leading scientometric experts to contribute to indicator development and data analysis for policy.

The *Compendium of Bibliometric Science Indicators* brings together a new collection of statistics depicting recent trends and the structure of scientific production across OECD countries and other major economies.

Find out more:

Scientometrics – http://oe.cd/scientometrics

Appelt et al., 2015, "Which factors influence the international mobility of research scientists?", *OECD Science, Technology and Industry Working Papers*, N° 2015/02, OECD Publishing, Paris, http://dx.doi.org/10.1787/5js1tmrr2233-en
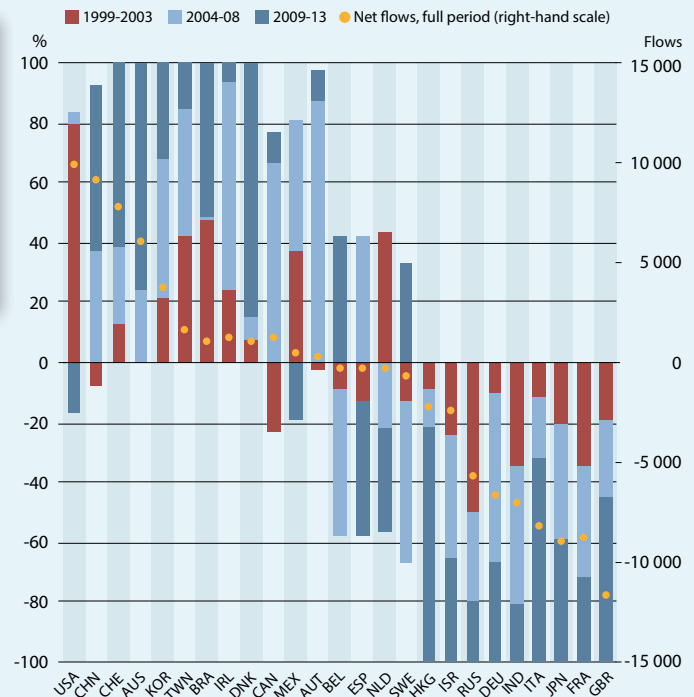
International net flows of scientific authors, selected economies, 1999-2013

Difference between annual inflows and outflows, as percentage of cumulative net flows

Note: The diamond in the figure represents the net flow of scientific authors for economies with largest inflows (>0) or outflows (<0).The breakdown into three sub-periods helps identify the timing and intensity of net flows.

Source: OECD (2015), *OECD STI Scoreboard 2015*, OECD Publishing, Paris, http://dx.doi.org/10.1787/888933273360, based on Scopus Custom Data, Elsevier.

Distributed micro-data analysis

OECD "DISTRIBUTED" FIRM-LEVEL PROJECTS

In recent years, the policy and research communities' interest in harmonised cross-country micro-data has increased significantly. Significant obstacles remain, however, for access to official micro-level data from multiple countries. Thus, when cross-country studies are performed, it is generally via the formation and co-ordination of networks of national researchers, with each team having access to their respective national micro-data. International comparability is insured via the use of a commonly specified protocol and a commonly specified model.

In ongoing cross-country studies, the OECD Directorate for Science, Technology and Innovation follows exactly this approach. The advantages are manifold: it puts very little burden on national statistical agencies and hence involves low running costs on their side. Importantly, it also avoids potential confidentiality issues of national micro-level statistical databases while achieving a high degree of cross-country harmonisation and comparability. Ongoing distributed micro-data analysis projects include:

- DynEmp: provides new evidence on the employment growth dynamics of start-ups and incumbents.

- MultiProd: investigates productivity patterns and the extent to which different policy frameworks can shape productivity.

- MicroBERD: measures the incidence and impact of public support for business R&D.

EMPLOYMENT DYNAMICS: DYNEMP

With sluggish employment growth in most OECD countries, the central role played by start-ups and young firms in creating jobs has acquired renewed importance in the policy debate. DynEmp shows that firms five years old or younger account for a disproportionate amount of job creation. But behind aggregate figures, it is only a tiny fraction of start-ups that is responsible for new jobs, while the majority either fails in the first years of activity or remain very small.

Did you know…?

On average, firms five years old or younger account for only 21% of total employment, but are responsible for 47% of job creation.

Find out more:
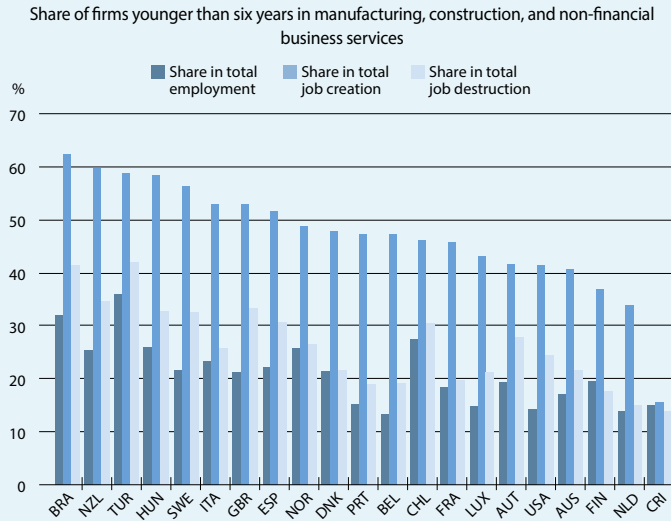
DynEmp – http://oe.cd/dynemp   MultiProd – http://oe.cd/multiprod
MicroBERD – http://oe.cd/rdtax

THE MICRODRIVERS OF PRODUCTIVITY: MULTIPROD

By depicting the entire firm-level productivity distribution over time, the MultiProd project describes the process of creative destruction and the role of frontier firms as well as that of entry and exit for aggregate productivity growth across countries. Over 15 countries participate in the MultiProd project.

Young firms contribute disproportionally to job creation in all countries between 1998 and 2013

Share of firms younger than six years in manufacturing, construction, and non-financial business services

Notes: Figures for Chile are preliminary. Owing to methodological differences, figures may deviate from officially published national statistics.
Source: OECD, *DynEmp* version 2 database, http://oe.cd/dynemp, June 2016.

An example of productivity and wage dispersion in manufacturing: evidence from Sweden, 2002-12
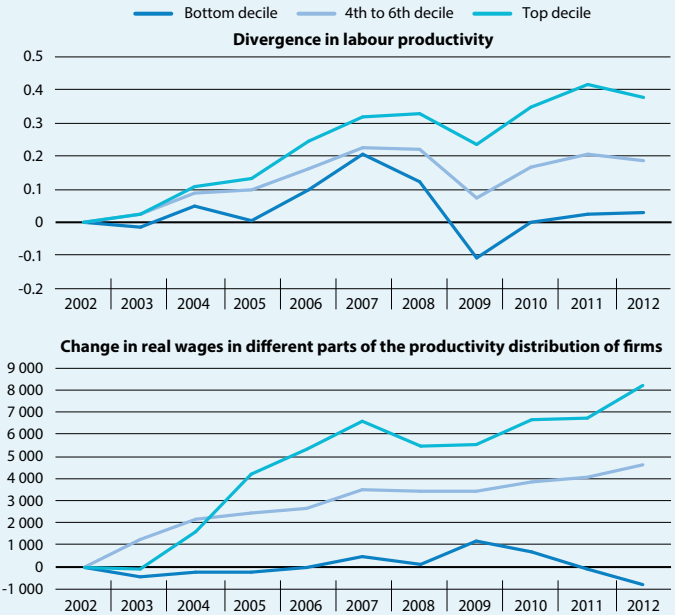
Source: OECD, MultiProd dataset, http://oe.cd/multiprod, June 2016.

The top figure points to a divergence in productivity growth across different firms in the productivity distribution. The bottom figure suggests that productivity dispersion and wage dispersion at the firm level go hand in hand: wage inequality between firms with different productivity performance has increased.

Public support to innovation

R&D TAX INCENTIVES

Governments worldwide adopt various support instruments to promote business R&D. In addition to providing grants and buying R&D services ("direct" support), many also offer tax incentives. The OECD has developed a detailed database on R&D tax incentives with the latest information provided by national experts on the cost and key design features of R&D tax incentives.

OECD measurement work on other innovation policy instruments, such as public procurement, complements the body of evidence on R&D and innovation tax incentives.

Find out more:

R&D Tax Incentives – http://oe.cd/rdtax

Procurement for innovation – http://oe.cd/pub-procure-inno

Direct government funding of business R&D and tax incentives for R&D, 2014

As a percentage of GDP

Legend: Indirect government support through tax incentives · Direct government funding of BERD · Data on tax incentive support not available · Indirect government support to business R&D, 2006 or nearest year, where available
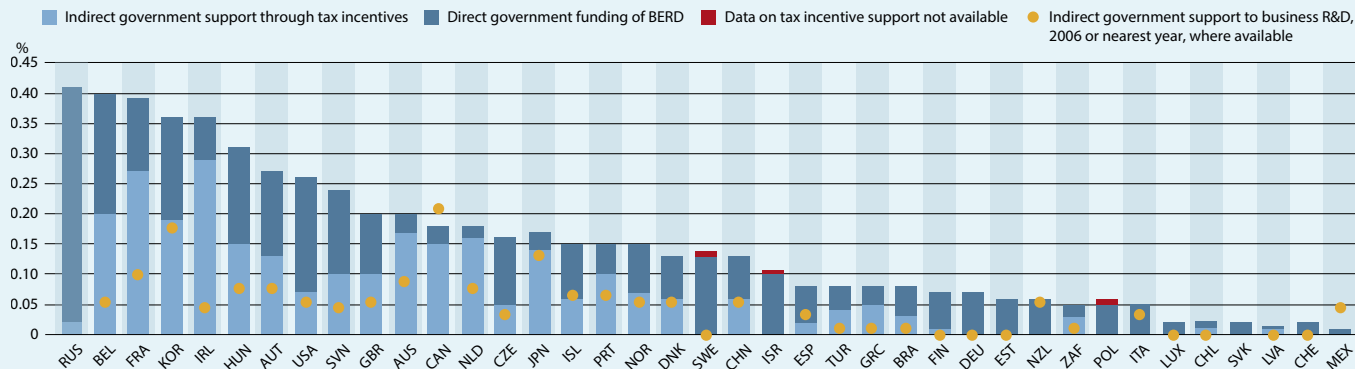
Sources: R&D Tax Incentives, http://oe.cd/rdtax; *Main Science and Technology Indicators*, http://oe.cd/msti, July 2016.

Did you know…?

MicroBERD

The OECD has launched a new micro-data project based on a "distributed" approach to empirical analysis of confidential micro-data. The project investigates and models the incidence and impact of public support for business R&D in collaboration with national experts with access to R&D and public support micro-data.

This approach facilitates a co-ordinated statistical analysis of the impact of tax incentive design features and their interaction with direct forms of public R&D funding by exploiting variation in support within and across countries. This project is partly funded by the European Union's Horizon 2020 Programme.

Find out more:

Appelt, S., M. Bajgar, C. Criscuolo and F. Galindo-Rueda (2016), "R&D tax incentives: Evidence on design, incidence and impacts", *OECD Science, Technology and Industry Policy Papers*, No. 32, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlr8fldqk7j-en

Business R&D (BERD) intensity and government support for R&D, 2014

As a percentage of GDP

Volume of tax support to business R&D, USD million PPP, 2014

• No incentive   x No data available   • USD 75 million   ● USD 250 million   ⬤ USD 2 500 million

BERD, as % of GDP

Total government support (direct and tax) to business R&D, as % of GDP

Public support to innovation

INNOVATION POLICIES DATABASE (STIP)

The international *Science, Technology and Innovation Policy* (STIP) database provides a mapping of national policy mixes and governance arrangements in support of STI.

Every two years, the OECD reviews key global trends in STI policies on the basis of a policy survey. The conclusions of this review are presented in the *OECD Science, Technology and Innovation Outlook* and have been published every other year since 1998. Starting in 2015, the OECD and the European Commission have joined forces with a common survey and the former *OECD STI Outlook* policy questionnaire has become the EC/OECD International Survey on Science, Technology and Innovation Policies.

The *STIP* database provides thematic and country-specific access to structured qualitative and quantitative STI policy information, as well as links to official web sites and to a wealth of national reports and documents.

Find out more:
STIP database – http://oe.cd/STIP

The *STIP* database helps policy makers and other users find answers to issues such as:

- On what do STI governments put priority in 2016?
- How do they address the global lack of funding for innovation?
- How do they encourage small firms to integrate global value chains?
- Which countries have R&D tax incentives in place?
- What are the most recent legislative changes for open science?
- Have big STI players gone through major policy evaluation recently?
- What has been done to improve childrens' education in science or engineering?
- Where are OECD countries regarding their green agenda?

Did you know...?

Canada will contribute a historical USD 2.2 billion over the next five years to help developing countries tackle climate change.

The STIP survey addresses all STI policy areas, involving ministries and agencies with competence over domains as broad as research, innovation, education, industry, environment, labour, finance/budget, etc.
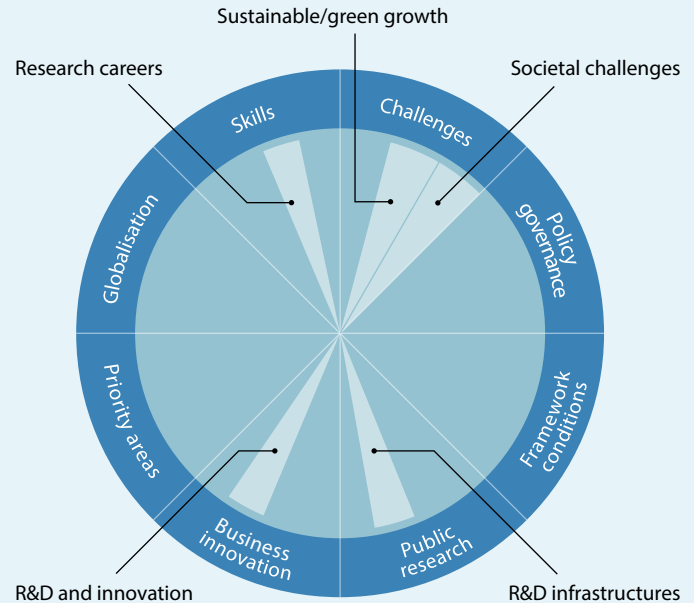
The survey maps the mix of major national STI policy initiatives and provides a broad variety of information, including programme descriptions, typologies of policy instruments, target populations, sector- or technology-orientation, budgets, and evaluation results. Information has been collected in 2012, 2014 and 2016.

The EC-OECD co-operation brings coverage to 54 countries, including OECD and EU countries and several emerging economies (i.e. Argentina, Brazil, China, Colombia, Costa Rica, Egypt, India, Indonesia, Malaysia, Peru, the Russian Federation, South Africa and Thailand).

The STIP survey and database are unique in their nature, coverage and scope.

The next release will take place end 2016.

China's STI policy priorities: its transition to an ecologically sustainable mode of development, and facing its societal challenges in terms of food security, public health and ageing.

Sustainable/green growth
Research careers
Societal challenges
Skills
Challenges
Globalisation
Policy governance
Priority areas
Framework conditions
Business innovation
Public research
R&D and innovation
R&D infrastructures

Platforms, databases and publications

THE INNOVATION POLICY PLATFORM

Growth that is driven by science, technology and innovation (STI) requires the right mix of cross-functional and multidisciplinary policy actions across such diverse areas as education, research, finance and public procurement. The challenge is to identify the policy solutions that work in a given national context.

The Innovation Policy Platform (IPP) is a joint project between the OECD and the World Bank to build a web-based, open-data interactive platform to facilitate collective learning processes around STI policy. Its goal is to provide policy makers with tailored support in analysing and developing national innovation systems.

The IPP is built around a set of modules that cover core areas of STI policy, as well as frontier topics. Content includes:

- policy analyses from the OECD, the World Bank and other relevant institutions

- case studies using written narratives and video to highlight specific experiences in tackling problems

- policy briefs to provide short evidence-based descriptions of policy instruments and topics

- country profiles with snapshots of the main indicators characterising countries' innovation performance

- the international *STI Policy* database with recent mapping of the national policy mix for STI

- an interactive version of the *OECD Science, Technology and Innovation Outlook*, with access to its policy and country profiles, interactive benchmarking tools and the international STIP database

- quantitative indicators to support policy analysis and benchmarking. Interactive visualisation tools on the statistical platform – IPP.Stat – enable users to explore and download data.
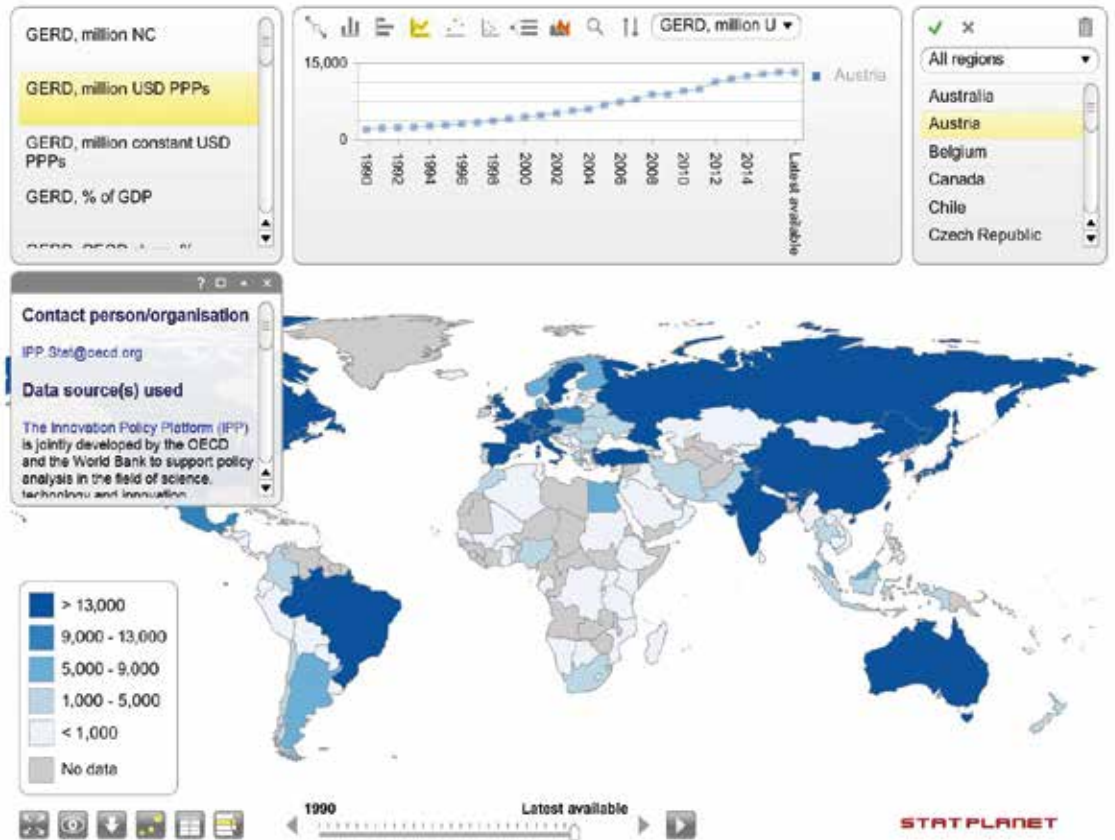
Find out more:
http://oe.cd/IPP
http://oe.cd/IPPstat
Contact: IPP.Stat@oecd.org

Statistics in the IPP

| GERD, million NC |
| GERD, million USD PPPs |
| GERD, million constant USD PPPs |
| GERD, % of GDP |

GERD, million U ▾

15,000

■ Austria

0

1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 Latest available

All regions ▾

| Australia |
| Austria |
| Belgium |
| Canada |
| Chile |
| Czech Republic |

Contact person/organisation

IPP.Stat@oecd.org

Data source(s) used

The Innovation Policy Platform (IPP) is jointly developed by the OECD and the World Bank to support policy analysis in the field of science, technology and innovation.

Legend	
■	> 13,000
■	9,000 - 13,000
■	5,000 - 9,000
■	1,000 - 5,000
□	< 1,000
■	No data

1990   Latest available

STATPLANET

Platforms, databases and publications

DATABASES

Main Science and Technology Indicators (*MSTI*) database
http://oe.cd/msti
The *MSTI* provides the timeliest indicators for OECD countries and other major economies on research and experimental development (R&D) personnel and expenditures, as well as patents, technology balance of payments and international trade in R&D-intensive industries. It is updated biannually.

Research & Development Statistics (*RDS*) database
http://oe.cd/rds
Based on the *Frascati Manual* guidelines, RDS is the most comprehensive collection of international data on R&D expenditure, government R&D budgets and personnel for OECD countries and other major economies. Data is available from 1981 onwards and is updated annually. Historical series from 1962 are also available.

Analytical Business Enterprise Research & Development (*ANBERD*) database
http://oe.cd/anberd
ANBERD analyses industrial R&D expenditure by industry, with data broken down in up to 100 manufacturing and services sectors for OECD countries and selected non-member economies from 1987 onwards. It is updated on a rolling basis.

R&D Tax Incentives
http://oe.cd/rdtax
This resource offers the latest indicators on R&D tax incentives as well as complementary information on their design. R&D tax incentives have become an important policy instrument to encourage firms to invest in R&D. Data is updated annually.

Innovation indicators
http://oe.cd/inno-stats
These indicators cover several dimensions of innovation activity in enterprises and are broken down by firm size, economic sector and R&D status of the enterprise. They are collected and updated for OECD countries and other major economies every second year.

OECD Broadband Portal
http://oe.cd/broadband
The portal provides access to a range of broadband-related statistics gathered by the OECD. It is updated biannually.

ICT access and use
http://oe.cd/hhind
Households and Individuals presents 78 presets on ICT access and use by households and individuals in OECD countries and Colombia, including computer and Internet access and usage, activities, e-commerce, e-government, ICT skills, and security and privacy. Data is presented by socio-economic variables and is updated annually.

http://oe.cd/bus

Businesses features 42 indicators on ICT access and use by businesses in OECD countries and Colombia, among which connectivity, uptake of ICT tools, e-commerce, e-government, ICT skills, and security and privacy. Data is organised by size and main industry and is updated annually.

Key Biotechnology Indicators (KBI)

http://oe.cd/kbi

These key indicators cover everything biotechnology-related, from the number of firms to R&D expenditures, to patents etc. They are updated annually.

Key Nanotechnology Indicators (KNI)

http://oe.cd/kni

These nanotechnology key indicators address topics such as the number of firms, R&D expenditures or patents. They are updated annually.

Intellectual Property database

http://oe.cd/ipstats

The *STI Micro-data Lab* database features IP rights-related micro data from several administrative sources, encompassing patents, trademarks and design-rights. It is updated twice a year.

Scientometrics

http://oe.cd/scientometrics

This resource offers relevant information on OECD work on scientometrics and bibliometrics that is updated on a rolling basis.

Structural Analysis (STAN) database

http://oe.cd/stan

The *STAN* database for industrial analysis allows researchers to analyse industrial performance at a relatively detailed level of activity across countries. It includes annual measures – from 1970 onwards – of output, value added, labour input and investment for deriving indicators of productivity, competitiveness and general structural change. Versions based on ISIC Rev. 3 and ISIC Rev. 4 classifications are provided.

Bilateral trade in goods by industry and end-use (BTDIxE)

http://oe.cd/btd

BTDIxE features current price values of imports and exports of goods broken down by partner countries, industrial activities and end-use categories (intermediate inputs, consumption and capital goods). Data is available for both Revisions 3 and 4 of the ISIC activity classification (1990-2015). The database is updated annually.

Inter-Country Input-Output (ICIO) database

http://oe.cd/icio

ICIO tables provide estimates of inter-country, inter-industry and industry-to-final demand flows of goods and services from 1995 to 2011. It is the principal source for developing indicators to measure Trade in Value Added (TiVA).

Platforms, databases and publications

Trade in Value Added (*TiVA*) indicators
http://oe.cd/tiva
The *TiVA* database provides indicators on the origin – both domestic and foreign (and by source industry) – of value added embodied in exports and in final demand. Tracing the flows of value added that arise from global production provides new insights for analysing global value chains that are not always evident from conventional trade statistics.

CO_2 emissions embodied in international trade
http://oe.cd/io-co2
Estimates of CO_2 embodied in international trade reveal the distribution, across economies, of final consumption of embodied CO_2 that has been emitted anywhere in the world along global production chains. Indicators are available for 1995 to 2011 and are constructed by combining *ICIO* tables with IEA statistics on CO_2 emissions from fuel combustion (www.iea.org/statistics/topics/co2emissions/).

Activity of Multinational Enterprises (*AMNE*) database
http://oe.cd/amne
AMNE provides data on the activities of foreign affiliates in OECD countries (inward and outward activity of multinationals), in 17 variables broken down by country of origin (inward investment) or location (outward investment) as well as by industrial sector. It is updated annually.

Employment Dynamics (*DynEmp*)
http://oe.cd/dynemp
This harmonised micro-aggregated database on employment dynamics from confidential micro-level data (typically national business registers) covers over 20 OECD countries and partner economies. It allows users to disentangle the role of firm age and size, and the different channels of employment changes (firms' entry, exit, growth, and shrinking). It is updated every two years.

Micro Drivers of Aggregate Productivity (*MultiProd*)
http://oe.cd/multiprod
MultiProd is a harmonised micro-aggregated database on productivity patterns from confidential micro-level data (typically national production surveys and business registers) covering over 15 OECD countries and partner economies. It allows for various decompositions of aggregate productivity level, growth and dispersion, which help understand how aggregate outcomes are affected by particular industries or groups of firms (e.g. small vs large; multinational corporations; old vs young; low vs high productivity).

International *Science, Technology and Innovation Policy* (*STIP*) database
http://oe.cd/STIP
STIP maps national policies and governance arrangements in support of STI and offers qualitative and quantitative data on major national STI policy initiatives (objectives, instruments, targets, budget, evaluation etc.). It features 54 countries, including OECD countries, EU member states plus several partner economies. Available time series are 2012, 2014 and 2016 (forthcoming).

FLAGSHIP PUBLICATIONS

OECD Science, Technology and Industry Scoreboard

The *OECD Science, Technology and Industry Scoreboard* brings together internationally comparable indicators. It has become a widely used reference that combines statistical rigour with easy access and readability.

This publication is released biennially on odd years. Thematic briefs and a selection of country notes, as well as online tools to visualise indicators, are available at the *STI Scoreboard* website: *www.oecd.org/sti/scoreboard.*

All figures and underlying data can be downloaded in Excel files via the Statlinks (hyperlink to a webpage) located at the bottom of each chart. Additional data expanding the coverage of countries and time periods are available at the same links as "more" data.

The *OECD STI Scoreboard* identifies the emerging players in science and innovation and the leaders in new, cutting-edge technologies. It shows how jobs and demand for skills depend on demand from your trading partners, or how a country contributes to global value chains. It tells you what happened to productivity, firm dynamics and jobs during the crisis and the recovery. It reveals how ready a country is for the future – based on investments in the knowledge infrastructure such as broadband, human capital and the research system; on the extent of knowledge diffusion; on the degree to which businesses innovate and the context in which they operate; or on countries' competitive strengths in the global economy and the use of technology in society.

The *OECD STI Scoreboard i*s not about ranking countries or developing composite indicators. With over 200 indicators it rather monitors each country's progress along several dimensions, which allows a differentiation on the basis of history, natural resources, industrial structure and firm heterogeneity. Its aim is also to develop novel and policy-relevant indicators, making use of new datasets and methodologies.

Platforms, databases and publications

OECD Science, Technology and Industry Outlook 2014

This review of key trends in STI includes thematic and country profiles for 54 OECD countries and partner economies. The 2016 edition of the *OECD Science, Technology and Innovation Outlook* will be more future-oriented, with a selection of megatrends, emerging technologies and a horizon scan of science systems.

The interactive version is available at: http://oe.cd/STIOutlook

OECD Digital Economy Outlook 2015

The *Digital Economy Outlook* assesses how countries can seize the potential of the digital economy as a driver for innovation and inclusive growth and discusses the emerging challenges that policy makers need to address as a part of national digital strategies.

http://oe.cd/deo2015

For more information

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