European Innovation Scoreboard 2018

Methodology Report

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1. Introduction

The annual European Innovation Scoreboard (EIS) provides a comparative assessment of the research and innovation performance of the EU Member States and the relative strengths and weaknesses of their research and innovation systems. It helps Member States assess areas in which they need to concentrate their efforts in order to boost their innovation performance.

Section 2 of this Methodology report discusses the definitions and the rationale of the indicators included in the EIS 2018. Section 3 provides a detailed discussion of the methodology used for calculating the Summary Innovation Index. Section 4 explains why the results for the same year in different EIS reports cannot be compared. Section 5 provides the definitions of the contextual indicators included in the EIS 2018 Country profiles.

2. EIS 2018 measurement framework

2.1 The innovation indicators

The EIS 2018 follows the methodology of the 2017 edition in distinguishing between four main types of indicators and ten innovation dimensions, capturing in total 27 different indicators (cf. Table 1).

Framework conditions captures the main drivers of innovation performance external to the firm and differentiates between three innovation dimensions:

- The *Human resources* dimension includes three indicators and measures the availability of a high-skilled and educated workforce. *Human resources* captures New doctorate graduates, Population aged 25-34 with completed tertiary education, and Population aged 25-64 involved in education and training.
- *Attractive research systems* includes three indicators and measures the international competitiveness of the science base by focusing on International scientific co-publications, Most cited publications, and Foreign doctorate students.
- *Innovation-friendly environment* captures the environment in which enterprises operate and includes two indicators - Broadband penetration among enterprises and Opportunity-driven entrepreneurship - measuring the degree to which individuals pursue entrepreneurial activities as they see new opportunities, for example resulting from innovation.

Investments captures investments made in both the public and business sector and differentiates between two innovation dimensions:

- *Finance and support* includes two indicators and measures the availability of finance for innovation projects by Venture capital expenditures, and the support of governments for research and innovation activities by R&D expenditures in universities and government research organisations.
- *Firm investments* includes three indicators of both R&D and non-R&D investments that firms make to generate innovations, and the efforts enterprises make to upgrade the ICT skills of their personnel.

Innovation activities captures different aspects of innovation in the business sector and differentiates between three dimensions:

- *Innovators* includes three indicators measuring the share of firms that have introduced innovations onto the market or within their organisations, covering both product and process innovators, marketing and organisational innovators, and SMEs that innovate in-house.
- *Linkages* includes three indicators measuring innovation capabilities by looking at collaboration efforts between innovating firms, research collaboration between the private and public sector, and the extent to which the private sector finances public R&D activities.
- *Intellectual assets* captures different forms of Intellectual Property Rights (IPR) generated in the innovation process, including PCT patent applications, Trademark applications, and Design applications.

Impacts captures the effects of firms' innovation activities and differentiates between two innovation dimensions:

- *Employment impacts* measures the impact of innovation on employment and includes two indicators measuring Employment in knowledge-intensive activities and Employment in fast-growing firms in innovative sectors.
- *Sales impacts* measures the economic impact of innovation and includes three indicators measuring Exports of medium and high-tech products, Exports of knowledge-intensive services, and Sales due to innovation activities.

Table 1: Measurement framework of the European Innovation Scoreboard

FRAMEWORK CONDITIONS	INNOVATION ACTIVITIES

• Human resources
  ○ 1.1.1 New doctorate graduates
  ○ 1.1.2 Population aged 25-34 with tertiary education
  ○ 1.1.3 Lifelong learning
• Attractive research systems
  ○ 1.2.1 International scientific co-publications
  ○ 1.2.2 Top 10% most cited publications
  ○ 1.2.3 Foreign doctorate students
• Innovation-friendly environment
  ○ 1.3.1 Broadband penetration
  ○ 1.3.2 Opportunity-driven entrepreneurship
	• Innovators
	  ○ 3.1.1 SMEs with product or process innovations
	  ○ 3.1.2 SMEs with marketing or organisational innovations
	  ○ 3.1.3 SMEs innovating in-house
	• Linkages
	  ○ 3.2.1 Innovative SMEs collaborating with others
	  ○ 3.2.2 Public-private co-publications
	  ○ 3.2.3 Private co-funding of public R&D expenditures
	• Intellectual assets
	  ○ 3.3.1 PCT patent applications
	  ○ 3.3.2 Trademark applications
	  ○ 3.3.3 Design applications

INVESTMENTS	IMPACTS

• Finance and support
  ○ 2.1.1 R&D expenditure in the public sector
  ○ 2.1.2 Venture capital expenditures
• Firm investments
  ○ 2.2.1 R&D expenditure in the business sector
  ○ 2.2.2 Non-R&D innovation expenditures
  ○ 2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel
	• Employment impacts
	  ○ 4.1.1 Employment in knowledge-intensive activities
	  ○ 4.1.2 Employment fast-growing enterprises of innovative sectors
	• Sales impacts
	  ○ 4.2.1 Medium and high-tech product exports
	  ○ 4.2.2 Knowledge-intensive services exports
	  ○ 4.2.3 Sales of new-to-market and new-to-firm product innovations

2.2 Definitions of EIS 2018 innovation indicators

Indicator	1.1.1 New doctorate graduates per 1000 population aged 25-34
Numerator	Number of doctorate graduates
Denominator	Population between and including 25 and 34 years
Interpretation	The indicator is a measure of the supply of new second-stage tertiary graduates in all fields of training (ISCED 8). For most countries, ISCED 8 captures PhD graduates.
Data source	Eurostat
Indicator	1.1.2 Percentage population aged 25-34 having completed tertiary education
Numerator	Number of persons in age class with some form of post-secondary education
Denominator	Population between and including 25 and 34 years
Interpretation	This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields, because the adoption of innovations in many areas, in particular in the service sectors, depends on a wide range of skills. The indicator focuses on a relatively young age cohort of the population, aged 25 to 34, and will therefore easily and quickly reflect changes in educational policies leading to more tertiary graduates.
Data source	Eurostat
Indicator	1.1.3 Percentage population aged 25-64 participating in lifelong learning
Numerator	The target population for lifelong learning statistics refers to all persons in private households aged between 25 and 64 years. The information collected relates to all education or training, whether or not relevant to the respondent's current or possible future job. Data are collected through the EU Labour Force Survey. The reference period for the participation in education and training is the four weeks preceding the interview, as is usual in the Labour Force Survey.
Denominator	Total population of the same age group, excluding those who did not answer the question concerning participation in (formal and non-formal) education and training
Interpretation	Lifelong learning encompasses all purposeful learning activity, whether formal, non-formal or informal, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence. The intention or aim to learn is the critical point that distinguishes these activities from non-learning activities, such as cultural or sporting activities.
Data source	Eurostat
Indicator	1.2.1 International scientific co-publications per million population
Numerator	Number of scientific publications with at least one co-author based abroad (where abroad is non-EU for the EU28)
Denominator	Total population
Interpretation	International scientific co-publications are a proxy for the quality of scientific research as collaboration increases scientific productivity.
Data source	Data provided by CWTS (Leiden University) as part of a contract to the European Commission (DG Research and Innovation)
Indicator	1.2.2 Scientific publications among the top-10% most cited publications worldwide as percentage of total scientific publications of the country
Numerator	Number of scientific publications among the top-10% most cited publications worldwide
Denominator	Total number of scientific publications
Interpretation	The indicator is a measure for the efficiency of the research system, as highly cited publications are assumed to be of higher quality. There could be a bias towards small or English-speaking countries given the coverage of Scopus' publication data.

Data source	Data provided by CWTS (Leiden University) as part of a contract to the European Commission (DG Research and Innovation)
Indicator	1.2.3 Foreign doctorate students as a percentage of all doctorate students
Numerator	Number of doctorate students from foreign countries
Denominator	Total number of doctorate students
Interpretation	The share of foreign doctorate students reflects the mobility of students as an effective way of diffusing knowledge. Attracting high-skilled foreign doctorate students will secure a continuous supply of researchers.
Data source	Eurostat
Indicator	1.3.1 Broadband penetration
Numerator	Number of enterprises with a maximum contracted download speed of the fastest fixed internet connection of at least 100 Mb/s
Denominator	Total number of enterprises
Interpretation	Realising Europe's full e-potential depends on creating the conditions for electronic commerce and the Internet to flourish. This indicator captures the relative use of this e-potential by the share of enterprises that have access to fast broadband.
Data source	Eurostat, Community Survey of ICT Usage and E-commerce in Enterprises
Indicator	1.3.2 Opportunity-driven entrepreneurship (Motivational index)
Definition	This index is calculated as the ratio between the share of persons involved in improvement-driven entrepreneurship and the share of persons involved in necessity-driven entrepreneurship.
Interpretation	Data from GEM distinguish between two types of entrepreneurship: 1) opportunity-driven entrepreneurship and 2) necessity-driven entrepreneurship. The first includes persons involved in TEA (Total Early-Stage Entrepreneurial Activity) who (i) claim to be driven by opportunity as opposed to finding no other option for work; and (ii) who indicate the main driver for being involved in this opportunity is being independent or increasing their income, rather than just maintaining their income; the second includes persons involved in TEA who are involved in entrepreneurship because they had no other option for work. GEM has constructed the Motivational index to measure the relative degree of improvement-driven entrepreneurship.
Comment	Three-year averages have been used for calculating the normalised scores for this indicator, which are used for calculating the Summary Innovation Index.
Data source	Global Entrepreneurship Monitor (GEM)
Indicator	2.1.1 R&D expenditure in the public sector (percentage of GDP)
Numerator	All R&D expenditures in the government sector (GOVERD) and the higher education sector (HERD)
Denominator	Gross Domestic Product
Interpretation	R&D expenditure represents one of the major drivers of economic growth in a knowledge-based economy. As such, trends in the R&D expenditure indicator provide key indications of the future competitiveness and wealth of the EU. Research and development spending is essential for making the transition to a knowledge-based economy as well as for improving production technologies and stimulating growth.
Data source	Eurostat
Indicator	2.1.2 Venture capital expenditures (percentage of GDP)
Numerator	Venture capital expenditures is defined as private equity being raised for investment in companies. Management buyouts, management buy-ins, and venture purchase of quoted shares are excluded. Venture capital includes early-stage (seed + start-up) and expansion and replacement capital.

Denominator	Gross Domestic Product
Interpretation	The amount of venture capital is a proxy for the relative dynamism of new business creation. In particular for enterprises using or developing new (risky) technologies, venture capital is often the only available means of financing their (expanding) business.
Comment	Three-year averages have been used for calculating the normalised scores for this indicator, which are used for calculating the Summary Innovation Index.
Data source	Venture capital data from Invest Europe. GDP data from Eurostat
Indicator	2.2.1 R&D expenditure in the business sector (percentage of GDP)
Numerator	All R&D expenditures in the business sector (BERD)
Denominator	Gross Domestic Product
Interpretation	The indicator captures the formal creation of new knowledge within firms. It is particularly important in the science-based sectors (pharmaceuticals, chemicals and some areas of electronics) where most new knowledge is created in or near R&D laboratories.
Data source	Eurostat
Indicator	2.2.2 Non-R&D innovation expenditures (percentage of turnover)
Numerator	Sum of total innovation expenditure for enterprises, excluding intramural and extramural R&D expenditures
Denominator	Total turnover for all enterprises
Interpretation	This indicator measures non-R&D innovation expenditure as a percentage of total turnover. Several of the components of innovation expenditure, such as investment in equipment and machinery and the acquisition of patents and licenses, measure the diffusion of new production technology and ideas.
Data source	Eurostat (Community Innovation Survey)
Indicator	2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel
Numerator	Number of enterprises that provided any type of training to develop ICT related skills of their personnel
Denominator	Total number of enterprises
Interpretation	ICT skills are particularly important for innovation in an increasingly digital economy. The share of enterprises providing training in that respect is a proxy for the overall skills development of employees.
Data source	Eurostat, Community Survey of ICT Usage and E-commerce in Enterprises
Indicator	3.1.1 SMEs introducing product or process innovations (percentage of SMEs)
Numerator	Number of Small and medium-sized enterprises (SMEs) who introduced at least one product innovation or process innovation either new to the enterprise or new to their market. A product innovation is the market introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components or sub-systems . A process innovation is the implementation of a new or significantly improved production process, distribution method, or supporting activity.
Denominator	Total number of Small and medium-sized enterprises (SMEs)
Interpretation	Technological innovation, as measured by the introduction of new products (goods or services) and processes, is a key ingredient to innovation in manufacturing activities. Higher shares of technological innovators should reflect a higher level of innovation activities.
Comment	SMEs are defined here as including all enterprises with 10 to 249 employees.
Data source	Eurostat (Community Innovation Survey)

Indicator	3.1.2 SMEs introducing marketing or organisational innovations (percentage of SMEs)
Numerator	Number of Small and medium-sized enterprises (SMEs) who introduced at least one new organisational innovation or marketing innovation. An organisational innovation is a new organisational method in an enterprise's business practices (including knowledge management), workplace organisation or external relations that has not been previously used by the enterprise. A marketing innovation is the implementation of a new marketing concept or strategy that differs significantly from an enterprise's existing marketing methods and which has not been used before.
Denominator	Total number of Small and medium-sized enterprises (SMEs)
Interpretation	Many firms, in particular in the services sectors, innovate through other non-technological forms of innovation. Examples of these are marketing and organisational innovations. This indicator captures the extent to which SMEs innovate through non-technological innovation.
Comment	SMEs are defined here as including all enterprises with 10 to 249 employees.
Data source	Eurostat (Community Innovation Survey)
Indicator	3.1.3 SMEs innovating in-house (percentage of SMEs)
Numerator	Number of Small and medium-sized enterprises (SMEs) with in-house innovation activities. In-house innovating enterprises are defined as enterprises which have introduced product or process innovations either themselves or in co-operation with other enterprises or organisations.
Denominator	Total number of Small and medium-sized enterprises (SMEs)
Interpretation	This indicator measures the degree to which SMEs, that have introduced any new or significantly improved products or production processes, have innovated in-house. The indicator is limited to SMEs, because almost all large firms innovate and because countries with an industrial structure weighted towards larger firms tend to do better.
Comment	SMEs are defined here as including all enterprises with 10 to 249 employees.
Data source	Eurostat (Community Innovation Survey)
Indicator	3.2.1 Innovative SMEs collaborating with others (percentage of SMEs)
Numerator	Number of Small and medium-sized enterprises (SMEs) with innovation co-operation activities, i.e. those firms that had any co-operation agreements on innovation activities with other enterprises or institutions in the three years of the survey period
Denominator	Total number of Small and medium-sized enterprises (SMEs)
Interpretation	This indicator measures the degree to which SMEs are involved in innovation co-operation. Complex innovations, in particular in ICT, often depend on the ability to draw on diverse sources of information and knowledge, or to collaborate in the development of an innovation. This indicator measures the flow of knowledge between public research institutions and firms, and between firms and other firms. The indicator is limited to SMEs, because almost all large firms are involved in innovation co-operation.
Comment	SMEs are defined here as including all enterprises with 10 to 249 employees.
Data source	Eurostat (Community Innovation Survey)
Indicator	3.2.2 Public-private co-publications per million population
Numerator	Number of public-private co-authored research publications. The definition of the "private sector" excludes the private medical and health sector. Publications are assigned to the country/countries in which the business companies or other private sector organisations are located.
Denominator	Total population
Interpretation	This indicator captures public-private research linkages and active collaboration activities between business sector researchers and public sector researchers resulting in academic publications.

Data source	Data provided by CWTS (Leiden University) as part of a contract to the European Commission (DG Research and Innovation)
Indicator	3.2.3 Private co-funding of public R&D expenditures (percentage of GDP)
Numerator	All R&D expenditures in the government sector (GOVERD) and the higher education sector (HERD) financed by the business sector
Denominator	Gross Domestic Product
Interpretation	This indicator measures public-private co-operation. University and government R&D financed by the business sector are expected to explicitly serve the more short-term research needs of the business sector.
Data source	Eurostat
Indicator	3.3.1 PCT patent applications per billion GDP (in PPS)
Numerator	Number of patent applications filed under the PCT, at international phase, designating the European Patent Office (EPO). Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
Denominator	Gross Domestic Product in Purchasing Power Standard
Interpretation	The capacity of firms to develop new products will determine their competitive advantage. One measure of the rate of new product innovation is the number of patents. This indicator measures the number of PCT patent applications.
Data source	Patent data from the OECD. GDP data from Eurostat
Indicator	3.3.2 Trademark applications per billion GDP (in PPS)
Numerator	Number of trademark applications applied for at European Union Intellectual Property Office (EUIPO) plus number of trademark applications applied for at World Intellectual Property Office (WIPO) ("yearly Madrid applications by origin")
Denominator	Gross Domestic Product in Purchasing Power Standard
Interpretation	Trademarks are an important innovation indicator, especially for the service sector. The Community trademark gives its proprietor a uniform right applicable in all Member States of the European Union through a single procedure which simplifies trademark policies at European level. It fulfils the three essential functions of a trademark: it identifies the origin of goods and services, guarantees consistent quality through evidence of the company's commitment vis-à-vis the consumer, and it is a form of communication, a basis for publicity and advertising.
Comment	Two-year averages have been used for calculating the normalised scores for this indicator, which are used for calculating the Summary Innovation Index.
Data source	Trademark data from European Union Intellectual Property Office (EUIPO) and World Intellectual Property Office (WIPO). GDP data from Eurostat
Indicator	3.3.3 Design applications per billion GDP (in PPS)
Numerator	Number of individual designs applied for at European Union Intellectual Property Office (EUIPO)
Denominator	Gross Domestic Product in Purchasing Power Standard
Interpretation	A design is the outward appearance of a product or part of it resulting from the lines, contours, colours, shape, texture, materials and/or its ornamentation. A product can be any industrial or handicraft item including packaging, graphic symbols and typographic typefaces but excluding computer programmes. It also includes products that are composed of multiple components, which may be disassembled and reassembled. Community design protection is directly enforceable in each Member State and it provides both the option of an unregistered and a registered Community design right for one area encompassing all Member States.

Comment	Two-year averages have been used for calculating the normalised scores for this indicator, which are used for calculating the Summary Innovation Index.
Data source	Design data from European Union Intellectual Property Office (EUIPO). GDP data from Eurostat
Indicator	4.1.1 Employment in knowledge-intensive activities (percentage of total employment)
Numerator	Number of employed persons in knowledge-intensive activities in business industries. Knowledge-intensive activities are defined, based on EU Labour Force Survey data, as all NACE Rev.2 industries at 2-digit level where at least 33% of employment has a tertiary education degree (ISCED 5-8).
Denominator	Total employment
Interpretation	Knowledge-intensive activities provide services directly to consumers, such as telecommunications, and provide inputs to the innovative activities of other firms in all sectors of the economy.
Data source	Eurostat
Indicator	4.1.2 Employment in fast-growing enterprises (percentage of total employment)
Numerator	Number of employees in high-growth enterprises in 50% 'most innovative' industries, including the following NACE industries: B06 (Extraction of crude petroleum and natural gas); B09 (Mining support service activities); C11 (Manufacture of beverages); C12 (Manufacture of tobacco products); C19 (Manufacture of coke and refined petroleum product); C20 (Manufacture of chemicals and chemical products); C21 (Manufacture of basic pharmaceutical products and pharmaceutical preparations); C26 (Manufacture of computer, electronic and optical products); C27 (Manufacture of electrical equipment); C28 (Manufacture of machinery and equipment not elsewhere classified); C29 (Manufacture of motor vehicles, trailers and semi-trailers); C30 (Manufacture of other transport equipment); C32 (Other manufacturing); D35 (Electricity, gas, steam and air conditioning supply); E39 (Remediation activities and other waste management services); G46 (Wholesale trade, except of motor vehicles and motorcycle); H51 (Air transport); J58 (Publishing activities); J59 (Motion picture, video and television programme production, sound recording and music publishing activities); J60 (Programming and broadcasting activities); J61 (Telecommunications); J62 (Computer programming, consultancy and related activities); J63 (Information service activities); K64 (Financial service activities, except insurance and pension funding); K65 (Insurance, reinsurance and pension funding, except compulsory social security); K66 (Activities auxiliary to financial services and insurance activities); L68 (Real estate activities); M69 (Legal and accounting activities); M70 (Activities of head offices; management consultancy activities); M71 (Architectural and engineering activities; technical testing and analysis); M72 (Scientific research and development); M73 (Advertising and market research); M74 (Other professional, scientific and technical activities); M75 (Veterinary activities); N79 (Travel agency, tour operator and other reservation service and related activities)
Denominator	Total employment for enterprises with 10 or more employees
Interpretation	This indicator provides an indication of the dynamism of fast-growing firms in innovative sectors as compared to all fast-growing business activities. It captures the capacity of a country to rapidly transform its economy to respond to new needs and to take advantage of emerging demand.
Data source	Eurostat
Indicator	4.2.1 Exports of medium and high technology products as a share of total product exports
Numerator	Value of medium and high tech exports, in national currency and current prices, including exports of the following SITC Rev.3 products: 266, 267, 512, 513, 525, 533, 54, 553, 554, 562, 57, 58, 591, 593, 597, 598, 629, 653, 671, 672, 679, 71, 72, 731, 733, 737, 74, 751, 752, 759, 76, 77, 78, 79, 812, 87, 88 and 891
Denominator	Value of total product exports

Interpretation	The indicator measures the technological competitiveness of the EU, i.e. the ability to commercialise the results of research and development (R&D) and innovation in international markets. It also reflects product specialisation by country. Creating, exploiting and commercialising new technologies are vital for the competitiveness of a country in the modern economy. Medium and high technology products are key drivers for economic growth, productivity and welfare, and are generally a source of high value added and well-paid employment.
Data source	Eurostat (ComExt) for Member States, UN ComTrade for non-EU countries
Indicator	4.2.2 Knowledge-intensive services exports as percentage of total services exports
Numerator	Exports of knowledge-intensive services is defined as the sum of credits in EBOPS 2010 (Extended Balance of Payments Services Classification) items: SC1 (Sea transport); SC2 (Air transport); SC3A (Space transport); SF (Insurance and pension services); SG (Financial services); SH (Charges for the use of intellectual property); SI (Telecommunications, computer, and information services); SJ (Other business services); SK1 (Audio-visual and related services)
Denominator	Total value of services exports
Interpretation	The indicator measures the competitiveness of the knowledge-intensive services sector. Competitiveness-enhancing measures and innovation strategies can be mutually reinforcing for the growth of employment, export shares, and turnover at the firm level. The indicator reflects the ability of an economy, notably resulting from innovation, to export services with high levels of value added, and successfully take part in knowledge-intensive global value chains.
Data source	Eurostat
Indicator	4.2.3 Sales of new-to-market and new-to-firm innovations as percentage of turnover
Numerator	Sum of total turnover of new or significantly improved products, either new-to-the-firm or new-to-the-market, for all enterprises
Denominator	Total turnover for all enterprises
Interpretation	This indicator measures the turnover of new or significantly improved products and includes both products which are only new to the firm and products which are also new to the market. The indicator thus captures both the creation of state-of-the-art technologies (new-to-market products) and the diffusion of these technologies (new-to-firm products).
Data source	Eurostat (Community Innovation Survey)

3. Methodology for calculating composite scores

The overall performance of each country's innovation system has been summarised in a composite indicator, the Summary Innovation Index. Section 3.1 provides details on data availability per country and per indicator. Section 3.2 explains the methodology used for calculating the SII and performance relative to the EU.

3.1 Data availability

The EIS uses the most recent statistics from Eurostat and other internationally recognised sources as available at the time of analysis. International sources have been used wherever possible in order to ensure comparability between countries.

For the calculation of normalised scores, data have been used for an eight-year period.[1] The availability of data by indicator for this eight-year period covered in the EIS 2018 is shown in Table 2. Data availability is below 60% for several indicators. For the indicators marked with an '#', full eight-year time series are not available. Data availability for shorter time series is shown between brackets.

For the six indicators using CIS data, data are available for at most four years, as CIS data are collected only once every two years (CIS 2008, CIS 2010, CIS 2012 and CIS 2014). For Percentage population aged 25-34 having completed tertiary education, data are available for four years (2014-2017); for Broadband penetration, data are available for four years (2014-2017); for Enterprises providing ICT skills, data are available for five years (2012 and 2014-2017); for Employment in fast-growing enterprises, data are available for at most four years (2012-2015); and for Exports of knowledge-intensive services, data are available for at most seven years (2010-2016).

For several indicators, there are also breaks in series for several countries, where the data before the break are not directly comparable with the data after the break. In most cases, data from before the break are excluded from the database and are thus counted as not available, even if Eurostat published data for these years. All missing data have been imputed as explained in step 3 in Section 3.2.

Table 2: Data availability by indicator

Innovation dimension / Indicator	Most recent year for which data are available	EU Member States	Other European and neighbouring countries
Human resources			
1.1.1 New doctorate graduates	2016	93%	80%
1.1.2 Percentage population aged 25-34 having completed tertiary education #	2017	46% (92%)	31% (63%)
1.1.3 Percentage population aged 25-64 participating in lifelong learning	2017	75%	56%
Attractive research systems			
1.2.1 International scientific co-publications per million population	2017	100%	100%
1.2.2 Top 10% most cited publications	2015	100%	100%
1.2.3 Foreign doctorate students	2016	93%	78%
Innovation-friendly environment			
1.3.1 Broadband penetration #	2017	50% (100%)	28% (56%)
1.3.2 Opportunity-driven entrepreneurship	2017	75%	48%
Finance and support			
2.1.1 R&D expenditure in the public sector	2016	90%	64%

[1] To ensure consistency with previous EIS reports, data have been used for an eight-year period in the normalisation process, resulting in Summary Innovation Index scores for 2010 to 2017. Performance relative to the EU is measured by comparing the SII in 2017 to the SII in 2010.

Innovation dimension / Indicator	Most recent year for which data are available	EU Member States	Other European and neighbouring countries
2.1.2 Venture capital expenditures	2017	100%	44%
Firm investments			
2.2.1 R&D expenditure in the business sector	2016	92%	61%
2.2.2 Non-R&D innovation expenditures #	2014	57% (91%)	27% (43%)
2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel #	2017	63% (100%)	19% (30%)
Innovators			
3.1.1 SMEs introducing product or process innovations #	2014	60% (96%)	38% (60%)
3.1.2 SMEs introducing marketing or organisational innovations #	2014	58% (93%)	33% (53%)
3.1.3 SMEs innovating in-house #	2014	49% (79%)	31% (50%)
Linkages			
3.2.1 Innovative SMEs collaborating with others #	2014	61% (98%)	36% (58%)
3.2.2 Public-private co-publications	2017	100%	100%
3.2.3 Private co-funding of public R&D expenditures	2015	89%	39%
Intellectual assets			
3.3.1 PCT patent applications	2015	100%	88%
3.3.2 Trademark applications	2017	100%	92%
3.3.3 Design applications	2017	100%	100%
Employment impacts			
4.1.1 Employment in knowledge-intensive activities	2017	83%	73%
4.1.2 Employment in fast-growing enterprises in innovative sectors #	2015	48% (96%)	9% (19%)
Sales impacts			
4.2.1 Medium and high technology product exports	2017	100%	92%
4.2.2 Knowledge-intensive services exports #	2016	86% (98%)	77% (88%)
4.2.3 Sales of new-to-market and new-to-firm innovations #	2014	60% (96%)	36% (58%)

For this indicator', full eight-year time series data are not available. Data availability for the shorter time series is shown between brackets.

The availability of data by country for this eight-year period covered in the EIS 2018 is shown in Table 3. For almost all Member States, data availability is between 70% and 80%, but for Greece and Luxembourg, it is below 70%. For non-EU countries, data availability is relatively high for Norway and low for Serbia and Ukraine. However, correcting for the fact that for several indicators eight-year time series are not available, data availability is much better, as shown by the percentages between brackets. For most Member States, data availability is above 85%, only for Greece it is below 85%. For non-EU countries, data availability is above 90% for Norway, between 70% and 80% for Switzerland, and Turkey, and below 70% for the other non-EU countries.

Table 3: Data availability by country

		Data availability			Data availability
BE	Belgium	75% (89%)	NL	Netherlands	75% (91%)
BG	Bulgaria	79% (94%)	AT	Austria	78% (93%)
CZ	Czech Republic	79% (94%)	PL	Poland	81% (97%)
DK	Denmark	75% (89%)	PT	Portugal	78% (93%)
DE	Germany	80% (96%)	RO	Romania	78% (93%)
EE	Estonia	81% (97%)	SI	Slovenia	76% (91%)
IE	Ireland	74% (89%)	SK	Slovakia	80% (96%)
EL	Greece	68% (81%)	FI	Finland	81% (97%)
ES	Spain	80% (96%)	SE	Sweden	78% (93%)
FR	France	75% (89%)	UK	United Kingdom	77% (92%)
HR	Croatia	75% (89%)	IS	Iceland	53% (64%)
IT	Italy	79% (94%)	IL	Israel	50% (61%)
CY	Cyprus	78% (94%)	MK	Macedonia, FYR	56% (67%)
LV	Latvia	80% (96%)	NO	Norway	78% (93%)
LT	Lithuania	80% (96%)	RS	Serbia	47% (57%)
LU	Luxembourg	72% (87%)	CH	Switzerland	61% (73%)
HU	Hungary	81% (97%)	TR	Turkey	64% (77%)
MT	Malta	76% (91%)	UA	Ukraine	49% (58%)

Data availability taking into account shorter time series for several indicators is shown between brackets.

3.2 Methodology for calculating the Summary Innovation Index

The methodology for calculating the Summary Innovation Index distinguishes between eight different steps.

Step 1: Identifying and replacing outliers

Positive outliers are identified as those country scores which are higher than the mean across all countries plus twice the standard deviation. Negative outliers are identified as those country scores which are lower than the mean across all countries minus twice the standard deviation. These outliers are replaced by the respective maximum and minimum values observed over all the years and all countries. Table 4 summarises the outliers per indicator and year (negative outliers are shown in italics).

Table 4: Overview of positive and negative outliers

	Positive / *Negative* outlier
Human resources	
1.1.1 New doctorate graduates	SI: 2013-2015; CH: 2009-2016
1.1.2 Percentage population aged 25-34 having completed tertiary education	CY: 2017
1.1.3 Population aged 25-64 participating in lifelong learning	SE: 2014-2017; CH: 2010-2017
Attractive research systems	
1.2.1 International scientific co-publications per million population	DK: 2015-2017; IS: 2012-2017; CH: 2011-2017
1.2.2 Top 10% most cited publications	CH: 2011
1.2.3 Foreign doctorate students	LU: 2011-2016

	Positive / *Negative* outlier
Innovation-friendly environment	
1.3.1 Broadband penetration	DK: 2017; SE: 2017
1.3.2 Opportunity-driven entrepreneurship *(years shown refer to three-yearly averages)*	DK: 2014-2016; LU: 2013; IS: 2010-2012; NO: 2011-2016
Finance and support	
2.1.1 R&D expenditure in the public sector	DK: 2013; FI: 2010
2.1.2 Venture capital investment *(years shown refer to three-yearly averages)*	IE: 2010-2011; GR: 2016-2017; LV: 2017; LU: 2010-2011, 2016-2017
Firm investments	
2.2.1 R&D expenditure in the business sector	FI: 2009; IL: 2009-2016
2.2.2 Non-R&D innovation expenditures *(years shown refer to reference year of CIS survey)*	LT: 2014; TR: 2012, 2014; CH: 2010; RS: 2012
2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel	FI: 2012, 2014; NO: 2012, 2014-2017; *RO: 2017*
Innovators	
3.1.1 SMEs introducing product or process innovations *(years shown refer to reference year of CIS survey)*	CH: 2008 *RO: 2012, 2014; UA: 2010, 2012*
3.1.2 SMEs introducing marketing or organisational innovations *(years shown refer to reference year of CIS survey)*	DE: 2008; CH: 2014; IL: 2008; *RO: 2014*
3.1.3 SMEs innovating in-house *(years shown refer to reference year of CIS survey)*	*RO: 2014*
Linkages	
3.2.1 Innovative SMEs collaborating with others *(years shown refer to reference year of CIS survey)*	BE: 2014; UK: 2008, 2010, 2014
3.2.2 Public-private co-publications	DK: 2016; IS: 2010-2017; CH: 10-2017
3.2.3 Private co-funding of public R&D expenditures	IL: 2008-2015
Intellectual assets	
3.3.1 PCT patent applications	FI: 2009-2013; SE: 2008-2015; IL: 2008-2015
3.3.2 Trademark applications *(years shown refer to two-yearly averages)*	CY: 2013-2017; LU: 2010-2017; MT: 2013-2017
3.3.3 Design applications *(years shown refer to two-yearly averages)*	BG: 2014; LU: 2012-2016; MT: 2013-2017
Employment impacts	
4.1.1 Employment in knowledge-intensive activities	IL: 2012-2015
4.1.2 Employment in fast-growing enterprises in innovative sectors	IE: 2014; HU: 2015; SK: 2012, 2013; *CY: 2013, 2015*
Sales impacts	
4.2.1 Medium and high technology product exports	*EL: 2012, 2013; IS: 2010-2017;* *NO: 2010-2017*
4.2.2 Knowledge-intensive services exports	IE: 2010 – 2016; LU: 2016
4.2.3 Sales of new-to-market and new-to-firm innovations *(years shown refer to reference year of CIS survey)*	SK: 2010; TR: 2012; CH: 2008

Step 2: Setting reference years

For each indicator, a reference year is identified for all countries based on data availability for all those countries for which data availability is at least 75%. For most indicators, this reference year lags one or two years behind the year to which the EIS refers.

Step 3: Imputing for missing values

Reference year data are then used for "2017", etc. If data for a year-in-between are not available, missing values are replaced with the value for the previous year. If data are not available at the beginning of the time series, missing values are replaced with the next available year. The following examples clarify this step and show how 'missing' data are imputed. If data are missing for all years, no data will be imputed (the indicator will not contribute to the Summary Innovation Index).

Latest year missing	"2017"	"2016"	"2015"	"2014"	"2013"
Available data	N/A	45	40	35	30
Use most recent year	45	45	40	35	30
Year-in-between missing	"2017"	"2016"	"2015"	"2014"	"2013"
Available data	50	N/A	40	35	30
Substitute with previous year	50	40	40	35	30
Beginning-of-period missing	"2017"	"2016"	"2015"	"2014"	"2013"
Available data	50	45	40	35	N/A
Substitute with next available year	50	45	40	35	35

Step 4: Determining Maximum and Minimum scores

The Maximum score is the highest score found for the eight-year period within all countries excluding positive outliers. Similarly, the Minimum score is the lowest score found for the eight-year period within all countries excluding negative outliers.

Step 5: Transforming data that have highly skewed distributions across countries

Most of the indicators are fractional indicators with values between 0% and 100%. Some indicators are unbound indicators, where values are not limited to an upper threshold. These indicators can be highly volatile and can have skewed data distributions (where most countries show low performance levels, and a few countries show exceptionally high levels of performance). For these indicators where the degree of skewness across the full eight-year period is above one, data have been transformed using a square root transformation, i.e. using the square root of the indicator value instead of the original value. For the following indicators, data have been transformed: Opportunity-driven entrepreneurship, Public-private co-publications, Private co-funding of public R&D expenditures, and Trademark applications (Table 5). A square root transformation means using the square root of the indicator value instead of the original value.

Table 5: Degree of skewness and data transformations

Innovation dimension / Indicator	Skewness	Skewness after transformation
Human resources		
1.1.1 New doctorate graduates	0.419 #	--
1.1.2 Population aged 25-34 having completed tertiary education	-0.061 #	--
1.1.3 Population aged 25-64 participating in lifelong learning	0.741 #	--
Attractive research systems		
1.2.1 International scientific co-publications	0.737 #	--
1.2.2 Top 10% most cited publications	0.063 #	--
1.2.3 Foreign doctorate students	0.854 #	--
Innovation-friendly environment		
1.3.1 Broadband penetration	0.588 #	--
1.3.2 Opportunity-driven entrepreneurship	1.129	0.655
Finance and support		
2.1.1 R&D expenditure in the public sector	0.125 #	--
2.1.2 Venture capital investment	0.769 #	--
Firm investments		
2.2.1 R&D expenditure in the business sector	0.736 #	--
2.2.2 Non-R&D innovation expenditures	0.955 #	--
2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel	0.012 #	--
Innovators		
3.1.1 SMEs introducing product or process innovations	-0.128 #	--
3.1.2 SMEs introducing marketing or organisational innovations	-0.061 #	--
3.1.3 SMEs innovating in-house	-0.078 #	--
Linkages		
3.2.1 Innovative SMEs collaborating with others	0.354 #	
3.2.2 Public-private co-publications	1.243	0.489
3.2.3 Private co-funding of public R&D expenditures	1.966	0.838
Intellectual assets		
3.3.1 PCT patent applications	0.975 #	--
3.3.2 Trademark applications	1.683	0.910
3.3.3 Design applications	0.714 #	--
Employment impacts		
4.1.1 Employment in knowledge-intensive activities	0.217 #	--
4.1.2 Employment in fast-growing enterprises in innovative sectors	0.112 #	--
Sales impacts		
4.2.1 Medium and high technology product exports	-0.404 #	--
4.2.2 Knowledge-intensive services exports	0.170 #	--
4.2.3 Sales of new-to-market and new-to-firm innovations	0.296 #	--

No transformation as skewness is below 1.

Step 6: Calculating re-scaled scores

Re-scaled scores of the country scores (after correcting for outliers and a possible transformation of the data) for all years are calculated by first subtracting the Minimum score and then dividing by the difference between the Maximum and Minimum score. The maximum re-scaled score is thus equal to 1, and the minimum re-scaled score is equal to 0. For positive and negative outliers, the re-scaled score is equal to 1 or 0, respectively.

Step 7: Calculating composite innovation indexes

For each year, a composite Summary Innovation Index is calculated as the unweighted average of the re-scaled scores for all indicators where all indicators receive the same weight (1/27 if data are available for all 27 indicators).

Step 8: Calculating relative-to-EU performance scores

Performance scores relative to the EU are then calculated as the SII of the respective country divided by the SII of the EU multiplied by 100. Relative performance scores are calculated for the full eight-year period compared to the performance of the EU in 2010 and for the latest year also compared to that of the EU in 2017. For the definition of the performance groups, only the performance scores relative to the EU in 2017 have been used.

3.3 International benchmarking

The methodology for calculating average innovation performance for the EU and its major global competitors is the same as that used for calculating average innovation performance for the EU Member States but using a smaller set of countries and a smaller set of indicators.

3.4 Performance group membership

For determining performance group membership, the EIS uses the following classification scheme:

- Innovation Leaders are all countries with a relative performance in 2017 more than 20% above the EU average in 2017;
- Strong Innovators are all countries with a relative performance in 2017 between 90% and 120% of the EU average in 2017;
- Moderate Innovators are all countries with a relative performance in 2017 between 50% and 90% of the EU average in 2017;
- Modest Innovators are all countries with a relative performance in 2017 below 50% of the EU average in 2017.

4. Why results cannot be compared between different EIS reports

The EIS 2017 measured average performance of countries' innovation systems for the year 2016. The EIS 2018 measures average performance of countries' innovation systems for the year 2017. In theory, as the EIS 2018 uses the same indicators as used in the EIS 2017, one would expect that the results for 2016 in the EIS 2018 should be the same as the results for 2016 in the EIS 2017. However, results cannot and should not be compared between different EIS reports for, among others, the following reasons:

1. For several indicators, data have been revised in the external sources from which data have been extracted;
2. The time period covered in both reports is different, with the oldest data used in the EIS 2017 no longer being used in the EIS 2018;
3. For some indicators, data have been updated by more than one year;
4. Data transformations have been applied to a different set of indicators.

These changes not only have an impact on the indicator values and thus the normalised scores, but they can also impact the Maximum and Minimum values in the normalisation process, resulting in slightly different normalised scores compared to last year.

Data revisions

The EIS covers data for an eight-year period. Instead of 'simply' removing for each indicator the first data point from the time series used for the EIS 2017 and adding one more recent year to the time series, data for all years covered in the analysis are extracted (again) for each EIS report from the data sources listed in Table 1. For several indicators, data for older years have been revised by these external data sources, leading to, mostly small, differences in indicator and thus normalised values for the same year between different EIS reports. Table 6 summarises for each indicator how many data values have been revised for each indicator, after imputing missing values and after normalising the indicator values, comparing the data used for the most recent seven years in the EIS 2017 and the seven oldest years in the EIS 2018. For several indicators, the number of revised data values is substantial, in particular for Percentage population aged 25-34 having completed tertiary education, International scientific co-publications per million population, Top 10% most cited publications, Venture capital expenditures[2], Public-private co-publications, PCT patent applications, Trademark applications, Design applications, Employment in knowledge-intensive activities, Employment in fast-growing enterprises in innovative sectors, and Knowledge-intensive services exports. Many of these data revisions, lead to only (very) small changes. Due to the large number of different indicator values, results in the EIS 2017 and EIS 2018 are not directly comparable.

Multi-year updates

For several indicators, data have been updated by more than one year. These indicators are highlighted with a * in the third column of Table 6: Venture capital expenditures, Public-private co-publications, and Medium and high technology product exports. For these indicators, the data used for '2016' in the EIS 2018 are comparable to the '2015' data in the EIS 2017.

[2] For Venture capital expenditures 2015 data have been revised by Invest Europe for nine Member States, most notably for Hungary (an upward revision of about 24%) and the United Kingdom (an upward revision of almost 52%). As a result, also the EU average was revised upward with 9.5%. In the EIS 2017, performance for the EU for Venture capital expenditures, using 2015 data as the most recent data. was only at 65% of its 2010 performance level (cf. Figure 10 in the EIS 2017). In the EIS 2018, performance for the EU for Venture capital expenditures, using 2017 data as the most recent data, is at 122% of its 2010 performance level (cf. Figure 9 in the EIS 2018). This large difference can be explained by the revised data for 2015. Using the revised Venture capital expenditures for the EU in 2015 shows a relative to EU 2010 performance of 94%, which is much higher than the 65% for 2015 reported in the EIS 2017.

Table 6: Summary of data revisions between the EIS 2017 and EIS 2018

	Years covered in EIS 2017	Years covered in EIS 2018	Number of data revisions (for # Member States)	Number of data revisions (for # other and neighbouring countries)
Human resources				
1.1.1 New doctorate graduates	2008-2015	2009-2016	11 (10)	1 (1)
1.1.2 Percentage population aged 25-34 having completed tertiary education	2009-2016	2010-2017	123 (28)	44 (8)
1.1.3 Percentage population aged 25-64 participating in lifelong learning	2009-2016	2010-2017	21 (3)	28 (4)
Attractive research systems				
1.2.1 International scientific co-publications per million population	2009-2016	2010-2017	182 (28)	44 (7)
1.2.2 Top 10% most cited publications	2007-2014	2008-2015	196 (28)	49 (7)
1.2.3 Foreign doctorate students	2008-2015	2009-2016	5 (5)	3 (2)
Innovation-friendly environment				
1.3.1 Broadband penetration	2009-2016	2010-2017	0 (0)	5 (1)
1.3.2 Opportunity-driven entrepreneurship	2009-2016	2010-2017	33 (17)	17 (7)
Finance and support				
2.1.1 R&D expenditure in the public sector	2008-2015	2009-2016	44 (21)	41 (8)
2.1.2 Venture capital expenditures	2008-2015	2010-2017 *	164 (28)	25 (6)
Firm investments				
2.2.1 R&D expenditure in the business sector	2008-2015	2009-2016	61 (18)	44 (8)
2.2.2 Non-R&D innovation expenditures	2007-2014	2009-2015 #	0 (0)	0 (0)
2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel	2009-2016	2010-2017	0 (0)	0 (0)
Innovators				
3.1.1 SMEs introducing product or process innovations	2007-2014	2009-2015 #	3 (1)	2 (2)
3.1.2 SMEs introducing marketing or organisational innovations	2007-2014	2009-2015 #	0 (0)	2 (2)
3.1.3 SMEs innovating in-house	2007-2014	2009-2015 #	20 (5)	10 (3)
Linkages				
3.2.1 Innovative SMEs collaborating with others	2007-2014	2009-2015 #	0 (0)	5 (3)
3.2.2 Public-private co-publications	2008-2015	2010-2017 *	178 (28)	50 (8)
3.2.3 Private co-funding of public R&D expenditures	2008-2015	2008-2015	90 (26)	35 (6)
Intellectual assets				
3.3.1 PCT patent applications	2007-2014	2008-2015	196 (28)	48 (7)
3.3.2 Trademark applications	2009-2016	2010-2017	196 (28)	56 (8)
3.3.3 Design applications	2009-2016	2010-2017	196 (28)	52 (8)
Employment impacts				
4.1.1 Employment in knowledge-intensive activities	2009-2016	2010-2017	159 (28)	33 (7)
4.1.2 Employment in fast-growing enterprises in innovative sectors	2007-2014	2008-2015	189 (27)	14 (2)

	Years covered in EIS 2017	Years covered in EIS 2018	Number of data revisions (for # Member States)	Number of data revisions (for # other and neighbouring countries)
Sales impacts				
4.2.1 Medium and high technology product exports	2008-2015	2010-2017 *	55 (28)	56 (8)
4.2.2 Knowledge-intensive services exports	2008-2015	2009-2016	121 (27)	49 (8)
4.2.3 Sales of new-to-market and new-to-firm innovations	2007-2014	2009-2015 #	0 (0)	8 (2)

For the indicators using CIS data, the results from the CIS 2014 have also been used for 2015.

* Indicators for which data have been updated with more than one year.

Data transformations

For indicators with highly skewed data distributions, data is adjusted using a square-root transformation if the degree of skewness of the data is above one[3]. In the EIS 2017, this affected the following indicators: Opportunity-driven entrepreneurship; Public-private co-publications; PCT patent applications; and Trademark applications.

In the EIS 2018, this affected the following indicators: Opportunity-driven entrepreneurship; Public-private co-publications; Private co-funding of public R&D expenditures; and Trademark applications.

For PCT patent applications and Private co-funding of public R&D expenditures, differences in the degrees of skewness in the EIS 2017 and EIS 2018 have resulted in different decisions whether or not to transform the data. As transformed data differ significantly from non-transformed data, for all years and countries normalised data for these two indicators are also different. As a result, their contribution to the Summary Innovation Index is different as consequently also the SII itself.

Impact on Maximum and Minimum scores

The data revisions and the change in the years covered in the eight-year period of analysis also have an impact on the Maximum and Minimum scores used in the normalisation process. For example, if for a particular indicator a higher value is included in the most recent data, then this new highest value will change the value of the Maximum score and thereby the normalised scores for all years.

Table 7 shows for each indicator if the Minimum and Maximum scores have changed compared to the EIS 2017. For 22 indicators, at least one of these scores have changed: for 13 indicators, both the Minimum and Maximum scores have changed; for 8 indicators, only the Maximum score has changed; and for 1 indicator, only the Minimum score has changed.

Conclusion

Due to changes in the data resulting from revised data extracted from external sources, and changes in the Maximum and Minimum scores used in the normalisation process, normalised data for the same year are in many cases different between the EIS 2017 and the EIS 2018. With different normalised scores, also the Summary Innovation Index for the same year will be different between the EIS 2017 and the EIS 2018.

Results between different EIS reports should not be compared. For comparisons over time, it is recommended to only use the time series results in each EIS report.

[3] This is explained in Step 5 in the methodology for calculating the Summary Innovation Index (cf. Section 3.2).

Table 7: Summary of changes in Maximum and Minimum scores in the EIS 2017 and EIS 2018

	Minimum score changed	Maximum score changed
Human resources		
1.1.1 New doctorate graduates	No	Yes. From 3.2 to 3.3
1.1.2 Percentage population aged 25-34 having completed tertiary education	Yes. From 18.1 to 23.8	Yes. From 54.9 to 56.2
1.1.3 Percentage population aged 25-64 participating in lifelong learning	Yes. From 1.2 to 1.1	Yes. From 28.1 to 28.4
Attractive research systems		
1.2.1 International scientific co-publications per million population	Yes. From 44 to 46	Yes. From 1939 to 2019
1.2.2 Top 10% most cited publications	Yes. From 1.7 to 1.8	Yes. From 15.4 to 15.7
1.2.3 Foreign doctorate students	No	Yes. From 54.3 to 54.9
Innovation-friendly environment		
1.3.1 Broadband penetration	No	Yes. From 25 to 32
1.3.2 Opportunity-driven entrepreneurship	Yes. From 0.52 to 0.63	Yes. From 3.15 to 2.97
Finance and support		
2.1.1 R&D expenditure in the public sector	Yes. From 0.16 to 0.16[4]	Yes. From 1.05 to 1.06
2.1.2 Venture capital expenditures	No	Yes. From 0.192 to 0.196
Firm investments		
2.2.1 R&D expenditure in the business sector	Yes. From 0.03 to 0.05	Yes. From 2.56 to 2.59
2.2.2 Non-R&D innovation expenditures	No	No
2.2.3 Enterprises providing training to develop or upgrade ICT skills of their personnel	No	Yes. From 37 to 38
Innovators		
3.1.1 SMEs introducing product or process innovations	No	No
3.1.2 SMEs introducing marketing or organisational innovations	Yes. From 11.2 to 10.5	Yes. From 62.0 to 60.5
3.1.3 SMEs innovating in-house	No	Yes. From 47.7 to 46.0
Linkages		
3.2.1 Innovative SMEs collaborating with others	No	No
3.2.2 Public-private co-publications	Yes. From 0.7 to 0.0	Yes. From 11.8 to 12.8
3.2.3 Private co-funding of public R&D expenditures	Yes. From 0.001 to 0.035	Yes. From 0.093 to 0.441
Intellectual assets		
3.3.1 PCT patent applications	No	Yes. From 3.02 to 8.25
3.3.2 Trademark applications	Yes. From 1.05 to 1.09	Yes. From 5.34 to 5.32
3.3.3 Design applications	No	Yes. From 9.73 to 9.65
Employment impacts		
4.1.1 Employment in knowledge-intensive activities	No	No
4.1.2 Employment in fast-growing enterprises in innovative sectors	Yes. From 0.570 to 0.771	Yes. From 7.720 to 7.720[5]
Sales impacts		
4.2.1 Medium and high technology product exports	Yes. From 18.8 to 19.5	No
4.2.2 Knowledge-intensive services exports	Yes. From 17.7 to 17.7[6]	Yes. From 91.2 to 91.3
4.2.3 Sales of new-to-market and new-to-firm innovations *	No	No

[4] This change is very small only with a minimum value of 0.157 in the EIS 2017 and 0.155 in the EIS 2018.
[5] This change is very small only with a maximum value of 7.72000 in the EIS 2017 and 7.71996 in the EIS 2018.
[6] This change is very small only with a minimum value of 17.71 in the EIS 2017 and 7.70 in the EIS 2018.

5. Impact of structural differences between countries

5.1 Contextual indicators used for European countries

In response to a need for contextual analyses to better understand performance differences on the innovation indicators used in the main measurement framework, a set of contextual indicators was introduced to the country profiles in the 2017 edition. For the EIS 2018 report, this list has been modified based on additional analyses and interactions with different stakeholders.[7]

This section discusses the relevance of these structural aspects to provide for a better understanding of differences between countries in the performance of particular indicators. The list of contextual indicators used in the European comparison, the years for which average performance has been calculated, and data sources used are shown in Table 8. Full definitions of all contextual indicators are also provided in this section.

Table 8: Contextual indicators in the European Innovation Scoreboard

	Period	Source
PERFORMANCE AND STRUCTURE OF THE ECONOMY		
GDP per capita (PPS)	Average 2014-2016	Eurostat
Average annual GDP growth (%)	2015-2017	Eurostat
Employment share Manufacturing (NACE C) (%)	Average 2014-2016	Eurostat
of which High and Medium high-tech (%)	Average 2014-2016	Eurostat
Employment share Services (NACE G-N) (%)	Average 2014-2016	Eurostat
of which Knowledge-intensive services (%)	Average 2014-2016	Eurostat
Turnover share SMEs (%)	Average 2013-2015	Eurostat
Turnover share large enterprises (%)	Average 2013-2015	Eurostat
Foreign-controlled enterprises – share of value added (%)	Average 2013-2015	Eurostat
BUSINESS AND ENTREPRENEURSHIP		
Enterprise births (10+ employees) (%)	Average 2013-2015	Eurostat
Total early-stage Entrepreneurial Activity (TEA) (%)	Average 2015-2017	Global Entrepreneurship Monitor
FDI net inflows (% GDP)	Average 2014-2016	World Bank: World Development Indicators
Top R&D spending enterprises per 10 million population	Average 2014-2016	EU Industrial R&D Investment Scoreboard
Buyer sophistication (1 to 7 best)	Average 2015-2017	World Economic Forum
GOVERNANCE AND POLICY FRAMEWORK		
Ease of starting a business (0 to 100 best)	Average 2015-2017	World Bank: Doing Business
Basic-school entrepreneurial education and training (1 to 5 best)	Average 2015-2017	Global Entrepreneurship Monitor
Government procurement of advanced technology products (1 to 7 best)	Average 2014-2016	World Economic Forum
Rule of law (-2.5 to 2.5 best)	Average 2014-2016	World Bank: Worldwide Governance Indicators
DEMOGRAPHY		
Population size	Average 2015-2017	Eurostat
Average annual population growth (%)	2015-2017	Eurostat
Population density	Average 2014-2016	Eurostat

[7] More details on the process of revising the contextual indicators are provided in the EIS Exploratory report "Supplementary analyses and contextualisation of innovation performance data", written by V. Cvijanović, S. Elci, A. Reid (EFIS Centre), and H. Hollanders (MERIT, Maastricht University). The report is available at https://ec.europa.eu/docsroom/documents/29306

Performance and structure of the economy

GDP per capita in purchasing power standards[8] is a measure for interpreting real income differences between countries. Higher income can increase the demand for new innovative goods and services. Economic growth is captured by the average annual growth rate of GDP for 2015-2017. In economies that grow faster, expanding markets may provide more favourable conditions for enterprises to sell their goods and services.

Important are differences in economic structures, with differences in the share of manufacturing in GDP and in so-called high-tech activities in manufacturing and services being important factors that explain why countries can perform better or worse on indicators like business R&D expenditures, PCT patents, and innovative enterprises. Medium-high and high-tech industries have higher technological intensities than other industries. These industries, on average, will have higher R&D expenditures, more patent applications, and higher shares of innovating enterprises. Countries with above-average shares of these industries are expected to perform better on several EIS indicators. For example, for the EU28 on average, 85% of R&D expenditures in manufacturing are accounted for by medium-high and high-technology manufacturing industries[9]. Also, the share of enterprises that introduced a product and/or process innovation is higher in medium-high and high-technology manufacturing industries compared to all core industries covered in the Community Innovation Survey[10].

[8] The purchasing power standard, abbreviated as PPS, is an artificial currency unit. Theoretically, one PPS can buy the same amount of goods and services in each country. However, price differences across borders mean that different amounts of national currency units are needed for the same goods and services depending on the country. PPS are derived by dividing any economic aggregate of a country in national currency by its respective purchasing power parities. PPS is the technical term used by Eurostat for the common currency in which national accounts aggregates are expressed when adjusted for price level differences using PPPs. PPPs can be interpreted as the exchange rate of the PPS against the Euro.

[9] Based on NACE Rev. 2 3-digit level, manufacturing industries can be classified as follows: High-technology (HT): Basic pharmaceutical products and pharmaceutical preparations (21); Computer, electronic and optical products (26); Air and spacecraft and related machinery (30.3*); Medium-high-technology (MHT): Chemicals and chemical products (20); Weapons and ammunition (25.4**); Electrical equipment (27); Machinery and equipment not elsewhere classified (28); Motor vehicles, trailers and semi-trailers (29); Other transport equipment (30) excluding Building of ships and boats (30.1) and excluding Air and spacecraft and related machinery (30.3); Medical and dental instruments and supplies (32.5***); Medium-low-technology (MLT): Reproduction of recorded media (18.2***); Coke and refined petroleum products (19); Rubber and plastic products (22); Other non-metallic mineral products (23); Basic metals (24); Fabricated metal products, except machinery and equipment (25) excluding Manufacture of weapons and ammunition (25.4); Building of ships and boats (30.1*); Repair and installation of machinery and equipment (33); Low-technology (LT): Food products (10); Beverages (11); Tobacco products (12); Textiles (13); Wearing apparel (14); Leather and related products (15); Wood and products of wood and cork, except furniture; articles of straw and plaiting materials (16); Paper and paper products (17); Printing and reproduction of recorded media (18) excluding Reproduction of recorded media (18.2); Furniture (31); Other manufacturing (32) excluding Medical and dental instruments and supplies (32.5). If data are only available at the NACE Rev. 2 2-digit level, industries identified with an * are classified as medium-high-technology, industries identified with an ** are classified as medium-low-technology, and industries identified with an *** are classified as low-technology (Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries).

[10] In accordance with Commission Regulation No 995/2012, the following industries and services are included in the Core target population to be covered in the CIS: Core Industry (excluding construction): Mining and quarrying (B), Manufacturing (C) (10-12: Manufacture of food products, beverages and tobacco; 13-15: Manufacture of textiles, wearing apparel, leather and related products; 16-18: Manufacture of wood, paper, printing and reproduction; 20: Manufacture of chemicals and chemical products; 21: Manufacture of basic pharmaceutical products and pharmaceutical preparations; 19-22 Manufacture of petroleum, chemical, pharmaceutical, rubber and plastic products; 23: Manufacture of other non-metallic mineral products; 24: Manufacture of basic metals; 25: Manufacture of fabricated metal products, except machinery and equipment; 26: Manufacture of computer, electronic and optical products; 25-30: Manufacture of fabricated metal products (except machinery and equipment), computer, electronic and optical products, electrical equipment, motor vehicles and other transport equipment; 31-33: Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment, Electricity, gas, steam and air conditioning supply (D), Water supply, sewerage, waste management and remediation activities (E) (36: Water collection, treatment and supply; 37-39: Sewerage, waste management, remediation activities). Core Services: Wholesale trade, except of motor vehicles and motorcycles (46), Transport and storage (H) (49-51: Land transport and transport via pipelines, water transport and air transport; 52-53: Warehousing and support activities for transportation and postal and courier activities); Information and communication (J) (58: Publishing activities; 61: Telecommunications; 62: Computer programming, consultancy and related activities; 63: Information service activities), Financial and insurance activities (K) (64: Financial service activities, except insurance and pension funding; 65: Insurance, reinsurance and pension funding, except compulsory social security; 66: Activities auxiliary to financial services and insurance activities), Professional, scientific and technical activities (M) (71-73: Architectural and engineering activities; technical testing and analysis; Scientific research and development; Advertising and market research).

Foreign ownership, including ownership from both other EU Member States and non-Member States, is important as on average about 40% of business R&D expenditures in EU Member States is made by foreign affiliates, which is significantly higher compared to major international competitors. The indicator measuring the share of foreign-controlled enterprises in value-added serves as a proxy for differences in the impact of foreign ownership on the economy.

Business and entrepreneurship

Opportunity-driven entrepreneurship provides a measure of opportunities for engaging in new business. The EIS indicator is complemented by two contextual indicators measuring the share of new enterprise births in the economy and Total early-stage Entrepreneurial activity (TEA), which measures the share of the adult population aged 18–64 years who are in the process of starting a business (a nascent entrepreneur) or who started a business which is not older than 42 months at the time of the respective survey (owner-manager of a new business).

Inflows of new technologies are important as they add to a country's economic and technological capacities. Inward Foreign direct investment (FDI) can have a positive impact on innovation performance, although there are differences depending on the complexity of the receiving industry, political and economic framework conditions as well as the quality of the institutions of the receiving countries. Inward FDI flows are measured over a three-year period, as average net inflows of investments to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor.

Enterprise characteristics are important for explaining differences in R&D spending and innovation activities. Large enterprises, defined as enterprises with 250 or more employees, account for almost four-fifths of EU business R&D expenditures, whereas SMEs, defined as enterprises with 10 to 249 employees, account for only one-fifth. The presence of large R&D spending enterprises is captured by the *EU Industrial R&D Investment Scoreboard*, which provides economic and financial data and analysis of the top corporate R&D investors from the EU and abroad[11].

Demand is an important driver of innovation. According to the Oslo Manual (2005)[12], demand factors shape innovation activity in two major ways: for the development of new products, as firms modify and differentiate products to increase sales and market share; and for the improvement of the production and supply processes to reduce costs and lower prices. A robust indicator measuring the demand for innovation is currently not available. The Executive Opinion Survey of the World Economic Forum includes an indicator that provides a measure of the preferences of individual consumers for innovative products. The degree of Buyer sophistication measures, on a scale from 1 (low) to 7 (high), whether buyers focus more on price or quality of products and services.

Governance and policy framework

Institutional and legal differences between countries may make it more difficult to engage in business activities. The World Bank's Doing Business report provides an index, Ease of starting a business, which measures the distance of each economy to the "frontier" economy providing the most lenient regulatory framework for doing business. Countries with more favourable regulatory environments will obtain scores closer to the maximum score of 100. This indicator complements the EIS indicators covering new business activities or perceived possibilities for new business activities: Employment of fast-growing firms in innovative sectors and Opportunity-driven entrepreneurship.

Entrepreneurial skills are important for successfully transforming ideas and inventions into innovations. These skills can be acquired on the job but also by formal schooling. Basic-school entrepreneurial education and training measures the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels.

Governments play an important role in enhancing the innovation capacities of an economy. Government procurement of advanced technology products measures the extent to which government procurement

[11] http://iri.jrc.ec.europa.eu/scoreboard.html

[12] The Oslo Manual is the foremost international source of guidelines for the collection and use of data on innovation activities in industry. OECD/Eurostat (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264013100-en

decisions foster technological innovation – from 1 (not at all) to 7 (extremely effectively). Trust is important for creating a business environment for undertaking risky innovative activities. Rule of law captures differences in the extent to which people have confidence in and abide by the rules of society. Rule of law measures differences in the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

Demography

Structural data also include population size and the average annual growth rate of population for 2015-2017. Increasing demand following an increasing population may provide more favourable conditions for enterprises to sell their goods and services. Densely populated areas are more likely to be more innovative for several reasons. Firstly, knowledge diffuses more easily when people and enterprises are located closer to each other. Secondly, in more densely populated areas there tends to be a concentration of government and educational services. Densely populated areas provide better training opportunities and employ above-average shares of highly educated people. Furthermore, the amount of natural assets per capita tends to decline with population density. This positively impacts on the share of MHT exports and the share of employment in knowledge intensive activities.

The remainder of this section presents the definitions of the structural indicators used in the EIS 2018 report for EU Member States and other European or neighbouring countries.

Performance and structure of the economy

GDP per capita (PPS)	
Indicator	Nominal Gross Domestic Product per capita
Unit	Purchasing power standard (PPS) per inhabitant
Calculated as	Average value for the years 2014 to 2016
Data source	Eurostat: Annual national accounts data
Average annual GDP growth (%)	
Indicator	Gross Domestic Product at market prices
Unit	Chain linked volumes, index 2010=100
Calculated as	Average annual growth rate between 2015 and 2017
Data source	Eurostat: Annual national accounts data
Employment share Manufacturing (NACE C) (%)	
Numerator	Employment in Manufacturing (NACE Rev. 2 C)
Denominator	Total employment
Calculated as	Average percentage share for the years 2014 to 2016
Data source	Eurostat: Employment in technology and knowledge-intensive sectors at the national level, by type of occupation
Of which High and Medium high-tech (%)	
Numerator	Total employment in the following industries: • High-technology: Basic pharmaceutical products and pharmaceutical preparations (NACE Rev. 2 21); Computer, electronic and optical products (NACE Rev. 2 26); Air and spacecraft and related machinery (NACE Rev. 2 30.3) • Medium-high-technology: Chemicals and chemical products (NACE Rev. 2 20); Weapons and ammunition (NACE Rev. 2 25.4); Electrical equipment (NACE Rev. 2 27) ; Machinery and equipment not elsewhere classified (NACE Rev. 2 28); Motor vehicles, trailers and semi-trailers (NACE Rev. 2 29); Other transport equipment (NACE Rev. 2 30) excluding Building of ships and boats (NACE Rev. 2 30.1) and excluding Air and spacecraft and

	related machinery (NACE Rev. 2 30.3); Medical and dental instruments and supplies (NACE Rev. 2 32.5)
Denominator	Employment in Manufacturing (NACE Rev. 2 C)
Calculated as	Average percentage share for the years 2014 to 2016
Data source	Eurostat: Employment in technology and knowledge-intensive sectors at the national level, by type of occupation
Employment share Services (NACE G-N) (%)	
Numerator	Employment in Services (NACE Rev. 2 G-N)
Calculated as	Average percentage share for the years 2014 to 2016
Denominator	Total employment
Data source	Eurostat: Employment in technology and knowledge-intensive sectors at the national level, by type of occupation
Of which Knowledge-intensive services (%)	
Numerator	Aggregate of employment in the following industries: Water transport; Air transport (NACE Rev. 2 50-51); Publishing activities; Motion picture, video and television programme production, sound recording and music publishing activities; Programming and broadcasting activities; Telecommunications; computer programming, consultancy and related activities; Information service activities (NACE Rev. 2 58-63); Financial and insurance activities (NACE Rev. 2 64-66); Legal and accounting activities; Activities of head offices, management consultancy activities; Architectural and engineering activities, technical testing and analysis; Scientific research and development; Advertising and market research; Other professional, scientific and technical activities; Veterinary activities (NACE Rev. 2 69-75); Employment activities (NACE Rev. 2 78); Security and investigation activities (NACE Rev. 2 80)
Denominator	Employment in Services (NACE Rev. 2 G-N)
Calculated as	Average percentage share for the years 2014 to 2016
Data source	Eurostat: Employment in technology and knowledge-intensive sectors at the national level, by type of occupation
Turnover share SMEs (%)	
Numerator	Turnover in enterprises with 10 to 249 persons employed
Denominator	Turnover in Total business economy; repair of computers, personal and household goods; except financial and insurance activities
Calculated as	Average percentage share for the years 2013 to 2015
Data source	Eurostat: Annual enterprise statistics by size class for special aggregates of activities
Turnover share large enterprises (%)	
Numerator	Turnover in enterprises with 250 persons employed or more
Denominator	Turnover in Total business economy; repair of computers, personal and household goods; except financial and insurance activities
Calculated as	Average percentage share for the years 2013 to 2015
Data source	Eurostat: Annual enterprise statistics by size class for special aggregates of activities

Share of foreign controlled enterprises (%)	
Numerator	Value added by foreign-controlled enterprises at factor cost in million euros for Non-financial business economy. A foreign-controlled enterprise shall mean that the controlling institutional unit is resident in a different country from the one where the institutional unit over which it has control is resident.[13]
Data source	Eurostat: Foreign control of enterprises by economic activity and a selection of controlling countries (from 2008 onwards) [fats_g1a_08]
Denominator	Value added, gross
Data source	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp]
Calculated as	Average percentage share for the years 2011 to 2014

Business and entrepreneurship

Enterprise births (10+ employees) (%)	
Numerator	Number of births of enterprises in year t
Size class	10 employees or more
Industries	Business economy except activities of holding companies
Denominator	Population of active enterprises in year t
Size class	10 employees or more
Industries	Business economy except activities of holding companies
Calculated as	Average percentage share for the years 2013 to 2015
Data source	Eurostat: Business demography data
Total early-stage Entrepreneurial Activity (TEA) (%)	
Indicator	Percentage of population aged 18-64 who are either a nascent entrepreneur or owner-manager of a new enterprise (less than 3.5 years old)[14]
Calculated as	Average for the years 2015 to 2017
Data source	Global Entrepreneurship Monitor
FDI net inflows (% GDP)	
Indicator	Foreign direct investment, net inflows (% of GDP)
Calculated as	Average percentage share for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: BX.KLT.DINV.WD.GD.ZS
Top R&D spending enterprises per 10 million population	
Numerator	Number of enterprises in the top 2500 enterprises investing the largest sums in R&D in the world
Data source	European Commission (IPTS) - The EU Industrial R&D Investment Scoreboard
Calculated as	Average number for the years 2015 to 2017
Denominator	Population
Data source	Eurostat

[13] A more detailed explanation is available at: http://ec.europa.eu/eurostat/cache/metadata/EN/fats_esms.htm
[14] Total Entrepreneurial Activity (TEA) is explained in detail at http://www.gemconsortium.org/wiki/1176

Buyer sophistication (1 to 7 best)	
Indicator	Average response to the following question: "In your country, on what basis do buyers make purchasing decisions? [1 = based solely on the lowest price; 7 = based on sophisticated performance attributes]"
Calculated as	Average number for the years 2015 to 2017
Data source	World Economic Forum, Global Competitiveness Report

Governance and policy framework

Ease of starting a business (0 to 100 best)	
Indicator	The "Starting a Business" indicator records all procedures, time, cost and paid-in minimum capital that are officially required for an entrepreneur to start up and formally operate an industrial or commercial business. These include obtaining all necessary licenses and permits and completing any required notifications, verifications or inscriptions for the company and employees with relevant authorities.
Calculated as	Average for the years 2015 to 2017
Data source	World Bank - Doing Business
Basic-school entrepreneurial education and training (1 to 5 best)	
Indicator	The indicator measures the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary school levels.
Calculated as	Average for the years 2015 to 2017
Data source	Global Entrepreneurship Monitor
Government procurement of advanced technology products (1 to 7 best)	
Indicator	The indicator measures the extent to which government procurement decisions in a country foster technological innovation by providing the average response to the following question: "Government purchase decisions for the procurement of advanced technology products are (1 = based solely on price, 7 = based on technical performance and innovativeness)"
Calculated as	Average for the years 2014 to 2016
Data source	World Economic Forum
Rule of law (-2.5 to 2.5 best)	
Indicator	Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
Calculated as	Average for the years 2014 to 2016
Data source	World Bank: Worldwide Governance Indicators

Demography

Population size	
Indicator	Population on 1 January
Calculated as	Average value for the years 2015 to 2017
Data source	Eurostat: Population data
Average annual population growth (%)	
Indicator	Population on 1 January
Calculated as	Average annual growth rate between 2015 and 2017

Data source	Eurostat: Population data
Population density	
Indicator	Inhabitants per km2
Calculated as	Average value for the years 2014 to 2016
Data source	Eurostat

5.2 Contextual indicators used for global economic competitors

For the international benchmarking, a comparable list of contextual indicators has been used, but for most indicators measuring Performance and structure of the economy and Demography, data have been retrieved from other data sources. For the international comparison, the number of so-called Unicorns is included. Unicorns are private start-ups with a value of US$1 billion or more. The list of contextual indicators used in the international comparison, the years for which average performance has been calculated, and data sources used are shown in Table 9.

Table 9: Contextual indicators in the international comparison

	Period	Source
PERFORMANCE AND STRUCTURE OF THE ECONOMY		
GDP per capita, PPP (international dollars)	Average 2014-2016	World Development Indicators*
Average annual GDP growth (%)	2014-2016	World Development Indicators*
Employment share in Agriculture (%)	Average 2014-2016	World Development Indicators*
Employment share in Industry (%)	Average 2014-2016	World Development Indicators*
Employment share in Services (%)	2016	World Development Indicators*
Manufacturing – share in total value added **	Average 2013-2015	World Development Indicators*
BUSINESS AND ENTREPRENEURSHIP		
Total early-stage Entrepreneurial Activity (TEA) (%)	Average 2015-2017	Global Entrepreneurship Monitor
FDI net inflows (% GDP)	Average 2014-2016	World Development Indicators*
Top R&D spending enterprises per 10 million population	Average 2015-2017	EU Industrial R&D Investment Scoreboard
Top R&D spending enterprises, average R&D spending, million Euros	Average 2015-2017	EU Industrial R&D Investment Scoreboard
Number of Unicorns	Total	CB Insights[15]
Buyer sophistication (1 to 7 best)	Average 2015-2017	World Economic Forum
GOVERNANCE AND POLICY FRAMEWORK		
Ease of starting a business (0 to 100 best)	Average 2015-2017	Doing Business*
Basic-school entrepreneurial education and training (1 to 5 best)	Average 2015-2017	Global Entrepreneurship Monitor
Government procurement of advanced technology products (1 to 7 best)	Average 2014-2016	World Economic Forum
Rule of law (-2.5 to 2.5 best)	Average 2014-2016	Worldwide Governance Indicators*
DEMOGRAPHY		
Population size (millions)	Average 2014-2016	World Development Indicators*
Average annual population growth (%)	2014-2016	World Development Indicators
Population density (inhabitants / km^2)	Average 2014-2016	World Development Indicators*

* Database from the World Bank ** Value added data are used in the international comparison as employment data are not available.

The following subsections present the definitions for each structural indicator used for EU Member States and other European or neighbouring countries.

[15] https://www.cbinsights.com/research-unicorn-companies

Performance and structure of the economy

GDP per capita (PPP)	
Indicator	GDP per capita, PPP (current international $)
Calculated as	Average value for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: NY.GDP.PCAP.PP.CD
Average annual GDP growth (%)	
Indicator	GDP per capita (constant 2010 US$)
Calculated as	Average annual growth rate between 2014 and 2016
Data source	World Bank (World Development Indicators) - Series name: NY.GDP.MKTP.KD
Employment share in Agriculture (%)	
Indicator	Employment in agriculture (% of total employment)
Calculated as	Average percentage share for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: SL.AGR.EMPL.ZS
Employment share in Industry (%)	
Indicator	Employment in industry (% of total employment)
Calculated as	Average percentage share for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: SL.IND.EMPL.ZS
Employment share in Services (%)	
Indicator	Employment in services (% of total employment)
Calculated as	Average percentage share for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: SL.SRV.EMPL.ZS
Manufacturing – share in total value added (%)	
Numerator	Value added in manufacturing, million US$
Denominator	Gross domestic product, million US$
Calculated as	Average percentage share for the years 2013 to 2015
Data source	United Nations Industrial Development Organization (UNIDO)

Business and entrepreneurship

Total early-stage Entrepreneurial Activity (TEA) (%)	
Indicator	Percentage of population aged 18-64 who are either a nascent entrepreneur or owner-manager of a new enterprise (less than 3.5 years old)[16]
Calculated as	Average for the years 2015 to 2017
Data source	Global Entrepreneurship Monitor
FDI net inflows (% GDP)	
Indicator	Foreign direct investment, net inflows (% of GDP)
Calculated as	Average percentage share for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: BX.KLT.DINV.WD.GD.ZS

[16] Total Entrepreneurial Activity (TEA) is explained in detail at http://www.gemconsortium.org/wiki/1176

Top R&D spending enterprises per 10 million population	
Numerator	Number of enterprises in the top 2500 enterprises investing the largest sums in R&D in the world
Data source	European Commission (IPTS) - The EU Industrial R&D Investment Scoreboard
Calculated as	Average number for the years 2015 to 2017
Denominator	Population
Data source	World Bank: World Development Indicators
Top R&D spending enterprises, average R&D spending, million Euros	
Numerator	Average R&D spending per enterprise listed in the top 2500 enterprises investing the largest sums in R&D in the world
Calculated as	Average number for the years 2015 to 2017
Data source	European Commission (IPTS) - The EU Industrial R&D Investment Scoreboard
Number of Unicorns	
Indicator	A unicorn is a private start-up company which, over time, has been valued at $1 billion or more
Calculated as	Total number of Unicorns listed April 2018
Data source	CB Insights: https://www.cbinsights.com/research-unicorn-companies
Buyer sophistication (1 to 7 best)	
Indicator	Average response to the following question: "In your country, on what basis do buyers make purchasing decisions? [1 = based solely on the lowest price; 7 = based on sophisticated performance attributes]"
Calculated as	Average number for the years 2015 to 2017
Data source	World Economic Forum, Global Competitiveness Report

Governance and policy framework

Ease of starting a business (0 to 100 best)	
Indicator	The "Starting a Business" indicator records all procedures, time, cost and paid-in minimum capital that are officially required for an entrepreneur to start up and formally operate an industrial or commercial business. These include obtaining all necessary licenses and permits and completing any required notifications, verifications or inscriptions for the company and employees with relevant authorities.
Calculated as	Average for the years 2015 to 2017
Data source	World Bank - Doing Business
Basic-school entrepreneurial education and training (1 to 5 best)	
Indicator	The indicator measures the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary school levels.
Calculated as	Average for the years 2015 to 2017
Data source	Global Entrepreneurship Monitor
Government procurement of advanced technology products (1 to 7 best)	

Indicator	The indicator measures the extent to which government procurement decisions in a country foster technological innovation by providing the average response to the following question: "Government purchase decisions for the procurement of advanced technology products are (1 = based solely on price, 7 = based on technical performance and innovativeness)"
Calculated as	Average for the years 2014 to 2016
Data source	World Economic Forum
Rule of law (-2.5 to 2.5 best)	
Indicator	Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
Calculated as	Average for the years 2014 to 2016
Data source	World Bank: Worldwide Governance Indicators

Demography

Population size	
Indicator	Population on 1 January
Calculated as	Average value for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: SP.POP.TOTL
Average annual population growth (%)	
Indicator	Population on 1 January
Calculated as	Average annual growth rate between 2014 and 2016
Data source	World Bank (World Development Indicators) - Series name: SP.POP.TOTL
Population density	
Indicator	Population density (people per sq. km of land area)
Calculated as	Average value for the years 2014 to 2016
Data source	World Bank (World Development Indicators) - Series name: EN.POP.DNST


European
Commission