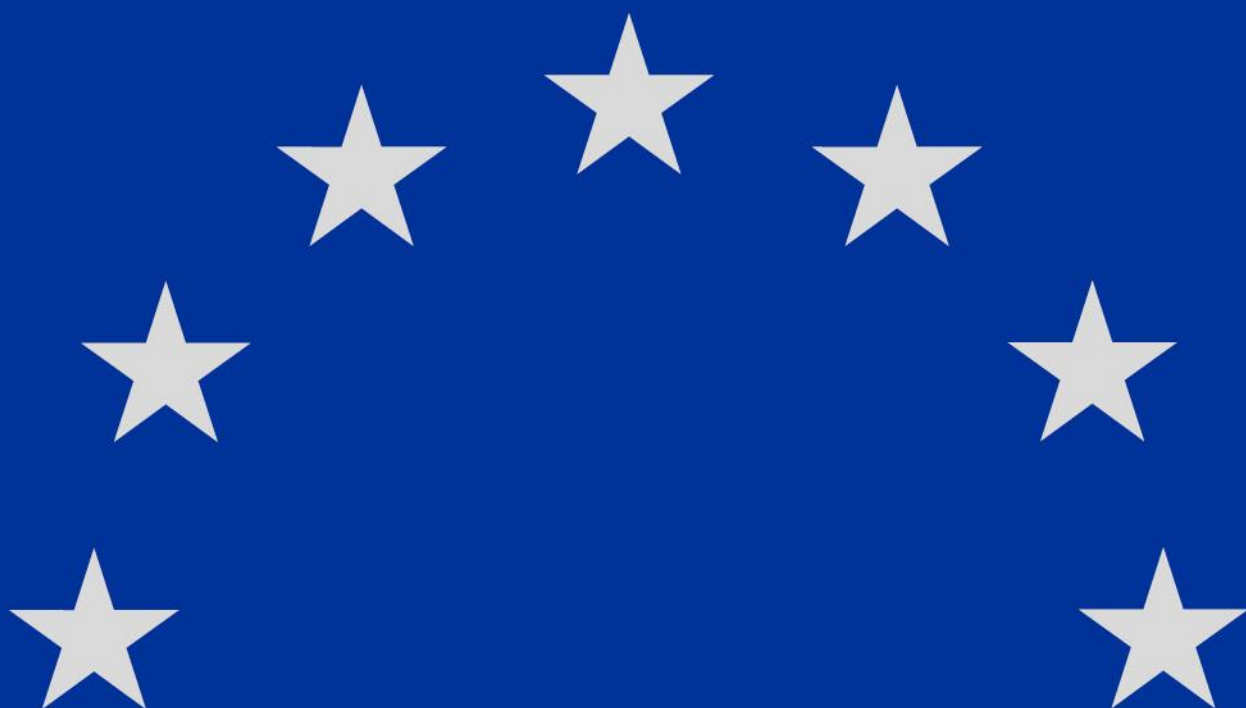


Regional Innovation Scoreboard 2025

Methodology Report

Independent Expert Report



Regional Innovation Scoreboard 2025 – Methodology Report

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Regional Innovation Scoreboard 2025

Methodology Report

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Contents

1.	Introduction	3
2.	Regional Innovation Scoreboard Indicators	3
2.1.	RIS Measurement Framework	3
2.2.	RIS indicators	7
2.3.	Regional coverage	14
2.4.	Regional data availability	17
3.	Methodology for calculating composite scores	28
3.1.	Step 1: Data collection and indicator calculation	29
3.2.	Step 2: Imputing data for regions impacted by revisions in NUTS	30
3.3.	Step 3: Setting reference years	31
3.4.	Step 4: Treating data breaks	33
3.5.	Step 5: Imputing for missing values	34
3.6.	Step 6: Identifying and replacing outliers	35
3.7.	Step 7: Transforming data if data are highly skewed.....	38
3.8.	Step 8: Determining Maximum and Minimum scores	39
3.9.	Step 9: Calculating re-scaled scores	39
3.10.	Step 10: Calculating composite innovation indexes	40
3.11.	Step 11: Calculating relative to EU performance scores	43
4.	Structural indicators	44
4.1.	Selected indicators to measure regional structural differences	44
4.2.	Definitions of structural indicators	45
	Annex A: A Manual for extracting and compiling RIS data	48
	Annex B: Report of a statistical audit of RIS done by JRC – COIN team.....	62

1. Introduction

The Regional Innovation Scoreboard (RIS) is the regional extension of the European Innovation Scoreboard (EIS), which provides insights at a national level. Regions are crucial engines of economic development, and measuring innovation performance at the regional level has become ever more important. The RIS uses the EIS indicators or their proxies for which regional level data is available and provides a comparative assessment of the performance of innovation systems across regions. The RIS 2025 follows the methodology of the EIS 2025 and uses data for 23 of the 32 indicators used in the EIS 2025. RIS 2025 covers 241 regions in 22 EU Member States, Norway, Serbia, Switzerland, and the United Kingdom (UK). Five countries (Cyprus, Estonia, Latvia, Luxembourg, and Malta) are included in the RIS only at the country level because their NUTS 1 and NUTS 2 regions are identical to their national territory.

Chapter 2 of the RIS Methodology Report presents the RIS measurement framework and how it differs from the EIS, describes the indicators included in RIS 2025, and provides information on regional coverage and data availability. Chapter 3 presents the methodology used to calculate the composite indicator (regional innovation index) in detail, including information on imputation techniques, treatment of data breaks, treatment of outliers, and the approach to calculating the regional innovation index and relative to EU performance. Chapter 4 presents the rationale and definitions for the structural indicators used in regional profiles and the online tool. In addition, Annex A provides a detailed manual for extracting and compiling RIS indicators, while Annex B presents the report of a statistical audit of RIS done by the JRC – COIN team.

2. Regional Innovation Scoreboard Indicators

This chapter presents the RIS measurement framework, how it differs from the EIS, and the indicators used. In addition, regional coverage of RIS and data availability is presented.

2.1. RIS Measurement Framework

Similarly to the EIS, the RIS measurement framework is divided into four main categories and 12 dimensions to assess regional innovation performance. The four main categories include:

Framework conditions: Innovation stems from knowledge-based activities, where information and expertise come together to drive progress. A solid scientific foundation is therefore essential for developing innovative solutions to address pressing challenges. Consequently, the RIS assesses the prevalence of tertiary education, the trend towards international collaboration and dissemination of research results, and the extent of digitalisation, recognising that advanced digital skills are instrumental in accessing information and fostering innovation.

Investments: Financial resources play a vital role in developing new solutions and facilitating their adoption by the market or firms. The RIS, therefore, evaluates the investments directed towards R&D and innovation coming from diverse sources such as the public sector and businesses. In addition, the RIS assesses the use of cloud computing services and employed ICT specialists, acknowledging the expanding role of digitalisation in Europe and globally.

Innovation activities: To assess regional innovation activities, the RIS places an emphasis on small and medium enterprises (SMEs). In this way, excessive concentration of innovation data around company headquarters (typically located in capital cities), is avoided. In addition, when large enterprises are included in the analysis, confidentiality concerns may limit data availability for certain regions. This dimension measures the extent to which SMEs introduce

novel products or business processes and engage in collaboration or co-publication across different sectors. An invention must be successfully commercialised or exploited to be considered an innovation. Therefore, the RIS examines how often companies in a region translate inventions into marketed products or related assets, using the number of patents, trademarks, or designs.

Impacts: Lastly, the RIS evaluates the impact of innovation activities on employment, sales, environmental sustainability, and labour productivity. The RIS assesses the success of new product innovations in generating sales revenue. In addition, the RIS goes beyond economic metrics and evaluates environmental impacts and labour productivity, underlining the intricate relationship between innovation, economic development, and environmental sustainability.

As part of a small-scale revision of the indicator framework for the EIS and RIS in late 2024 and early 2025, four indicators were updated¹. The revision fine-tuned the measurement framework in light of newly available data and to better reflect evolving European R&I policy priorities. It introduced four new indicators designed to better capture the factors driving innovation, address gaps identified during the review, and respond to emerging priorities such as digitalisation, industrial resilience, and societal impact. These changes are implemented in the 2025 editions of the EIS and RIS. The changes to the RIS indicators are described in Box 1.

Box 1: Description of changes in the 2025 RIS framework

Broadband penetration (proxy for *High-speed internet access* in EIS, 1.3.1) replaces the previous indicator measuring broadband penetration in enterprises, which did not have regional data. The new RIS indicator measures share of households with broadband access. As a result, *Individuals with above basic overall digital skills* (1.3.2) is removed, as it was previously measured with a proxy indicator regionalising the EIS indicator based on the regional score for *Households with broadband access*².

Cloud computing in enterprises (2.3.1) assesses the share of businesses using advanced online services like data storage, accounting, or customer management tools. It reflects the extent to which enterprises are adopting more advanced digital technologies.

Sales of new-to-market and new-to-firm innovations is retained within the framework but now replaces *Employment in knowledge-intensive activities* (4.1.1).

Exports of medium and high technology products (4.2.1) was added to the *Trade impacts* dimension. It is a proxy calculated based on the FIGARO regional dataset³ and EIS indicator values. The indicator was selected after an analysis of five alternatives.

Labour productivity (4.3.3) reflects how much economic value is created for each hour worked. Higher scores reflect greater efficiency and innovation-driven growth.

Ideally, the RIS should use the same measurement framework as the EIS, i.e. using regional data for the same indicators applied to measure innovation performance at the country level.

¹ Reid, A., et al. (2025). *European Innovation Scoreboard 2025: Technical report on the revision of the scoreboard methodology*. Independent expert report prepared for the European Commission, Directorate-General for Research and Innovation.

² The indicator was calculated using the following formula: *Individuals with above basic overall digital skills* = Regional score for *Households with broadband access* / Country score for *Households with broadband access* * Country score for *Individuals with above basic overall digital skills*.

³ Lopez Alvarez, Jorge; Galiano Bastarrica, Luis Antonio; Rueda-Cantuche, José Manuel (2017): FIGARO-REG 2017 10 sectors. European Commission, Joint Research Centre (JRC) [Dataset] PID: <http://data.europa.eu/89h/dff29c8d-b85b-41fa-9cb7-7289c7324937>

However, for several indicators used in the EIS, regional data are not available, therefore, the RIS is limited to using data for 23 of the 32 EIS indicators. For seven indicators, slightly different definitions have been applied to reflect the underlying regional data (see also Table 1 for an overview):

- Regional data is not available for *High-speed internet access*. Therefore, *Households with broadband access* is used as a proxy, as both indicators refer to household-level connectivity. While the EIS indicator specifically measures household access to very high-capacity fixed networks (VHCN), the RIS indicator covers a broader range of broadband technologies and serves as the closest available proxy at the regional level.
- For the three indicators using expenditure data from the Community Innovation Survey (CIS) – *Non-R&D innovation expenditures*, *Innovation expenditures per person employed in innovation active enterprises*, and *Sales of new-to-market and new-to-enterprise innovations* – the data in the RIS refer only to SMEs and not to all enterprises⁴.
- Regional data are not available for *Employed ICT specialists*. The indicator correlates highly at the country level with Employment in information and communication (NACE J). Regional data for the latter are available from Eurostat and is used to calculate regional estimates for this indicator using the following formula:

Regional score for Employed ICT specialists = Regional score for Employment in information and communication (NACE J) / Country score for Employment in information and communication (NACE J) * Country score for employed ICT specialists.

- *Exports of medium and high technology products* is not available at the regional level. A proxy for this indicator is calculated using 2017 FIGARO regional dataset⁵ and the EIS indicator values. Regional shares derived from the 2017 data are applied to the latest country-level values to estimate regional scores. The indicator is calculated in the following steps:

- 1) Calculating ratio between exports at region and country level based on 2017 FIGARO data:

$$Ratio_{Total} = \frac{Total\ exports\ in\ EUR_{regional}}{Total\ exports\ in\ EUR_{country}}; \quad Ratio_{MHT} = \frac{MHT\ exports\ in\ EUR_{regional}}{MHT\ exports\ in\ EUR_{country}}$$

MHT stands for medium and high technology products:

- 2) Calculating regional score for Exports of medium and high technology products

$$Indicator = \frac{MHT\ exports_{EIS\ data} * Ratio_{MHT}}{Total\ exports_{EIS\ data} * Ratio_{Total}}$$

- *Production-based CO₂ productivity* is not available at the regional level. *Air emissions by fine particulates* serves as the proxy indicator for the RIS.

⁴ The CIS assigns the innovation activities of multi-establishment enterprises to the region where the head office is located. There is a risk that regions without head offices score lower on the CIS indicators, as some of the activities in these regions are assigned to other regions with head offices. To minimise this risk, the regional CIS data excludes large firms - which are more likely to have multiple establishments in different regions - and focuses on SMEs only.

⁵ Lopez Alvarez, Jorge; Galiano Bastarrica, Luis Antonio; Rueda-Cantuche, José Manuel (2017): FIGARO-REG 2017 10 sectors. European Commission, Joint Research Centre (JRC) [Dataset] PID: <http://data.europa.eu/89h/dff29c8d-b85b-41fa-9cb7-7289c7324937>

Table 1: A comparison of the indicators included in the European Innovation Scoreboard and the Regional Innovation Scoreboard

Categories and dimensions	Indicator in EIS	Indicator in RIS
Framework Conditions		
Human resources	1.1.1 New doctorate graduates	No regional data
	1.1.2 Population with tertiary education	Identical
	1.1.3 Population involved in lifelong learning	Identical
Attractive research systems	1.2.1 International scientific co-publications	Identical
	1.2.2 Scientific publications among the top 10% most cited	Identical
	1.2.3 Foreign doctorate students as a % of all doctorate students	No regional data
Digitalisation	1.3.1 High-speed internet access	Broadband penetration as a proxy
	1.3.2 Individuals with above basic overall digital skills	No regional data
Investments		
Finance and support	2.1.1 R&D expenditure in the public sector	Identical
	2.1.2 Venture capital expenditures	No regional data
	2.1.3 Direct and indirect government support of business R&D	No regional data
Firm investments	2.2.1 R&D expenditure in the business sector	Identical
	2.2.2 Non-R&D innovation expenditures	Same indicator but data only for enterprises with 10-249 employees, inclusive
	2.2.3 Innovation expenditures per person employed	Same indicator but data only for enterprises with 10-249 employees, inclusive
Investments in information technologies	2.3.1 Cloud computing in enterprises	Identical
	2.3.2 Employed ICT specialists	Proxy using country level data and share of employment in information and communication
Innovation activities		
Innovators	3.1.1 SMEs introducing product innovations	Identical
	3.1.2 SMEs introducing business process innovations	Identical
Linkages	3.2.1 Innovative SMEs collaborating with others	Identical

Categories and dimensions	Indicator in EIS	Indicator in RIS
	3.2.2 <i>Public-private co-publications</i>	Identical
	3.2.3 <i>Job-to-job mobility of HRST</i>	No regional data
	3.3.1 <i>PCT patent applications</i>	Identical
<i>Intellectual assets</i>	3.3.2 <i>Trademark applications</i>	Identical
	3.3.3 <i>Design applications</i>	Identical
	Impacts	
<i>Sales and employment impacts</i>	4.1.1 <i>Sales of new-to-market and new-to-firm innovations</i>	Same indicator but data only for enterprises with 10-249 employees, inclusive
	4.1.2 <i>Employment in innovative enterprises</i>	Identical
<i>Trade impacts</i>	4.2.1 <i>Exports of medium and high technology products</i>	Proxy using EIS indicator data and FIGARO regional dataset ⁶
	4.2.2 <i>Knowledge-intensive services exports</i>	No regional data
	4.2.3 <i>High tech imports from partners outside of the EU27</i>	No regional data
<i>Resource and labour productivity</i>	4.3.1 <i>Resource productivity</i>	No regional data
	4.3.2 <i>Production-based CO2 productivity</i>	Air emissions by fine particulates as a proxy
	4.3.3 <i>Labour productivity</i>	Identical

2.2. RIS indicators

This section provides the definition, rationale, data source, and data availability for each indicator. For data from Eurostat, the code used by Eurostat is also provided. For some indicators, more than one data source has been used, e.g. GDP data are taken from Eurostat, but for countries not covered by Eurostat, data from the OECD or national sources have been used. The numbering of the indicators follows that of the indicators in the RIS 2025, as shown in Table 1. Annex A provides a manual for extracting and compiling RIS data.

Human resources

1.1.2 Population with 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
Rationale	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, including the service sectors, depends on a wide range of skills. The

⁶ While FIGARO provides regional data only for 2017, the indicator is updated to 2024 using regional shares derived from 2017 and applied to the most recent country-level data from the EIS. In addition, NACE aggregation in FIGARO database is available only at a high level, thus the following is considered medium and high technology products: NACE B-E. As a result, the calculations include sectors that are not considered as medium and high technology sectors by Eurostat. See Annex A for a detailed description of indicator calculation. FIGARO regional dataset available at: Lopez Alvarez, Jorge; Galiano Bastarrica, Luis Antonio; Rueda-Cantucho, José Manuel (2017): FIGARO-REG 2017 10 sectors. European Commission, Joint Research Centre (JRC) [Dataset] PID: <http://data.europa.eu/89h/dff29c8d-b85b-41fa-9cb7-7289c7324937>

	indicator focuses on a narrow share of the population aged 25 to 34 and will relatively quickly reflect changes in educational policies leading to more tertiary graduates.
Data source	Eurostat [edat_lfse_04]
Data availability	NUTS 2: 2000-2024

1.1.3 Population involved in lifelong learning

Numerator	Number of persons in private households aged between 25 and 64 years who have participated in the four weeks preceding the interview, in any education or training, whether or not relevant to the respondent's current or possible future job
Denominator	Total population aged between 25 and 64 years
Rationale	Lifelong learning encompasses all purposeful learning activity, whether formal, nonformal 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 [trng_lfse_04]
Data availability	NUTS 2: 2000-2024

Attractive research systems

1.2.1 International scientific co-publications

Numerator	Number of scientific publications with at least one co-author based abroad
Denominator	Total population
Rationale	International scientific co-publications are a proxy for the quality of scientific research as collaboration increases scientific productivity
Data source	Numerator: Scopus. Data calculated by Science Metrix (Elsevier) as part of a contract to the EC Denominator: Eurostat [demo_r_d2jan] and the Office for National Statistics for the UK (used to calculate approximate regional values based on the national population growth rate)
Data availability	NUTS 2: 2000-2024

1.2.2 Scientific publications among the top 10% most cited

Numerator	Number of scientific publications among the top-10% most cited publications worldwide
Denominator	Total number of scientific publications
Rationale	The indicator is a measure for the quality 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	Scopus. Data calculated by Science Metrix (Elsevier) as part of a contract to the EC
Data availability	NUTS 2: 2000-2022

Digitalisation

1.3.1 Broadband penetration

Numerator	Households with broadband access
Denominator	Total number of households
Rationale	The indicator serves as a regional proxy for High-speed internet access in the EIS. It provides a measure of digitalisation at the household level.

Difference from EIS	Broadband penetration as a proxy for High-speed internet access
Data source	Eurostat [isoc_r_broad_h]
Data availability	NUTS 2: 2006-2021

Finance and support

2.1.1 R&D expenditure in the public sector	
Numerator	All R&D expenditures in the government sector (GOV) and the higher education sector (HES)
Denominator	Regional Gross Domestic Product
Rationale	R&D expenditure represents one of the major drivers of economic growth in a knowledge-based economy. Trends in the R&D expenditure indicator provide key indications of the future competitiveness and wealth of a region. R&D 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 [rd_e_gerdreg]
Data availability	NUTS 2: 2000-2023

Firm investments

2.2.1 R&D expenditure in the business sector	
Numerator	All R&D expenditures in the business sector (BERD)
Denominator	Regional Gross Domestic Product
Rationale	The indicator captures the formal creation of new knowledge within firms. It is particularly important in the science-based sector (pharmaceuticals, chemicals and some areas of electronics), where most new knowledge is created in or near R&D laboratories.
Data source	Eurostat [rd_e_gerdreg]
Data availability	NUTS 2: 2000-2023

2.2.2 Non-R&D innovation expenditures	
Numerator	Sum of total innovation expenditure for SMEs, excluding intramural and extramural R&D expenditures
Denominator	Total turnover for SMEs
Rationale	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.
Difference from EIS	EIS indicator also includes large enterprises
Data source	Numerator: Eurostat CIS 2022 [inn_cis13_exp_r] Denominator: Eurostat CIS 2022 [inn_cis13_bas_r] Regional data from CIS 2014-2020 have been collected from the National Statistical Offices (NSOs) in several data requests as part of preparation of the previous RIS editions
Data availability	NUTS 1 and 2 for different countries for CIS 2014, CIS 2016, CIS 2018, CIS 2020, CIS 2022

2.2.3 Innovation expenditures per person employed	
Numerator	Innovation expenditure by SMEs
Denominator	Total employment in innovative SMEs
Rationale	The indicator measures the monetary input directly related to innovation activities

Difference from EIS	EIS indicator also includes large enterprises
Data source	Numerator: Eurostat CIS 2022 [inn_cis13_exp_r] Denominator: Eurostat CIS 2022 [inn_cis13_bas_r] Regional data from CIS 2014-2020 have been collected from the National Statistical Offices (NSOs) in several data requests as part of preparation of the previous RIS editions
Data availability	NUTS 1 and 2 for different countries for CIS 2014, CIS 2016, CIS 2018, CIS 2020, CIS 2022

Investments in information technologies

2.3.1 Cloud computing in enterprises

Numerator	Number of enterprises that buy cloud computing services used over the internet
Denominator	Total number of enterprises
Rationale	The uptake of cloud computing services signals the extent to which businesses integrate digital tools, which can influence innovation
Data source	Eurostat [isoc_r_cicce_usen2]
Data availability	NUTS 2: 2023

2.3.2 Employed ICT specialists

Numerator	Rate between the share of employment in the information and communication sector (NACE J) in the region and the country
Denominator	Share of ICT specialists in total employment
Rationale	Regional proxy for measuring the “employment in the industries most implicated in the digital transformation” in proportion to the total employment allowing to estimate the size of the digital economy in a country. ICT skills are particularly important for innovation in an increasingly digital economy.
Difference from EIS	As there is no regional data for the exact indicator on Eurostat, this is a proxy using country level data and share of employment in information and communication
Data source	Regional and national employment by sector: Eurostat [fst_r_lfe2en2]. National ICT specialist employment: Eurostat [isoc_sks_itspt]. Own estimates combining EIS country level with regional data (Eurostat) on Employment in information and communication (NACE J)
Data availability	NUTS 1 and 2 for different countries for 2008-2024

Innovators

3.1.1 SMEs introducing product innovations

Numerator	Number of SMEs who introduced at least one product innovation
Denominator	Total number of SMEs
Rationale	Product innovation is a key ingredient to innovation as they can create new markets and improve competitiveness. Higher shares of product innovators reflect a higher level of innovation activities
Data source	Eurostat CIS 2022 [inn_cis13_bas_r] Regional data from CIS 2014-2020 have been collected from the National Statistical Offices (NSOs) in several data requests as part of preparation of the previous RIS editions
Data availability	NUTS 1 and 2 for different countries for CIS 2014, CIS 2016, CIS 2018, CIS 2020, CIS 2022

3.1.2 SMEs introducing business process innovations

Numerator	Number of SMEs who introduced at least one business process innovation
Denominator	Total number of SMEs
Rationale	Many firms innovate not by improving new products but by improving their business processes. Business process innovations include process, marketing and organisational innovations.
Data source	Eurostat CIS 2022 [inn_cis13_bas_r] Regional data from CIS 2014-2020 have been collected from the National Statistical Offices (NSOs) in several data requests as part of preparation of the previous RIS editions
Data availability	NUTS 1 and 2 for different countries for CIS 2014, CIS 2016, CIS 2018, CIS 2020, CIS 2022

Linkages

3.2.1 Innovative SMEs collaborating with others

Numerator	Number of SMEs with innovation co-operation activities (i.e. that have had any co-operation agreements on innovation activities with other enterprises or institutions)
Denominator	Total number of SMEs
Rationale	This indicator measures the degree to which SMEs are involved in innovation co-operation. Complex innovations often depend on enterprises' ability to draw on diverse sources of information and knowledge, or to collaborate on the development of an innovation. This indicator measures the flow of knowledge between public research institutions and enterprises, and between enterprises and other enterprises.
Data source	Numerator: Eurostat CIS 2022 [inn_cis13_co_r] Denominator: Eurostat CIS 2022 [inn_cis13_bas_r] Regional data from CIS 2014-2020 have been collected from the National Statistical Offices (NSOs) in several data requests as part of preparation of the previous RIS editions
Data availability	NUTS 1 and 2 for different countries for CIS 2014, CIS 2016, CIS 2018, CIS 2020, CIS 2022

3.2.2 Public-private co-publications

Numerator	Number of scientific publications with at least one co-author based abroad
Denominator	Total population
Rationale	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	Numerator: Scopus. Data calculated by Science Metrix (Elsevier) as part of a contract to the EC Denominator: Eurostat [demo_r_d2jan] and the Office for National Statistics for the UK (used to calculate approximate regional values based on the national population growth rate)
Data availability	NUTS 2: 2000-2024

Intellectual assets

3.3.1 PCT patent applications

Numerator	Number of patent applications filed under the Patent Co-operation Treaty, by year of filing
Denominator	Gross Domestic Product in Purchasing Power Standard

Rationale	The capacity of firms to develop new products determines their competitive advantage. One indicator of the rate of new product innovation is the number of patent applications
Data source	Numerator: OECD, REGPAT Denominator: Eurostat [nama_10r_2gd] and OECD (for CH and UK)
Data availability	NUTS 2: two-year averages for 2000-2022

3.3.2 Trademark applications

Numerator	Number of trademark applications applied for at EUIPO
Denominator	Gross Domestic Product in Purchasing Power Standard
Rationale	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 EU 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 is a form of communication, a basis for publicity and advertising.
Data source	Numerator: European Union Intellectual Property Office (EUIPO). Data provided by Fraunhofer-ISI. Denominator: Eurostat [nama_10r_2gd] and OECD (for CH and UK)
Data availability	NUTS 2: two-year averages for 2000-2023

3.3.3 Design applications

Numerator	Number of designs applied for at EUIPO
Denominator	Gross Domestic Product in Purchasing Power Standard
Rationale	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 programs. 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.
Data source	Numerator: European Union Intellectual Property Office (EUIPO). Data provided by Fraunhofer-ISI. Denominator: Eurostat [nama_10r_2gd] and OECD (for CH and UK)
Data availability	NUTS 2: two-year averages for 2001-2023

Sales and employment impacts

4.1.1 Sales of new-to-market and new-to-firm innovations

Numerator	Sum of total turnover of new or significantly improved products for SMEs
Denominator	Total turnover for SMEs
Rationale	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).
Difference from EIS	EIS indicator includes all enterprises
Data source	Numerator: Eurostat CIS 2022 [inn_cis13_prodt_r] Denominator: Eurostat CIS 2022 [inn_cis13_bas_r]

	Regional data from CIS 2014-2020 have been collected from the National Statistical Offices (NSOs) in several data requests as part of preparation of the previous RIS editions
Data availability	NUTS 1 and 2 for different countries for CIS 2014, CIS 2016, CIS 2018, CIS 2020, CIS 2022

4.1.2 Employment in innovative enterprises

Numerator	Number of employed persons in innovative SMEs
Denominator	Total employment in SMEs
Rationale	Innovation in enterprises has a profound impact on the employability of workers. Firm innovation proves to be specifically important during a time of economic recession. Although high-skilled employees are less affected by a recession than low-skilled employees, a notable positive effect is observed for low-skilled employees in innovative firms as well.
Data source	Eurostat CIS 2022 [inn_cis13_bas_r] Regional data from CIS 2014-2020 have been collected from the National Statistical Offices (NSOs) in several data requests as part of preparation of the previous RIS editions
Data availability	NUTS 1 and 2 for different countries for CIS 2014, CIS 2016, CIS 2018, CIS 2020, CIS 2022

Trade impacts

4.2.1 Exports of medium and high technology products

Numerator	Value of medium and high tech exports
Denominator	Value of total product exports
Rationale	The indicator measures the technological competitiveness of the region, i.e. the ability to commercialise the results of research and development (R&D) and innovation. It uses FIGARO 2017 regional data to calculate ratio between region export share in medium and high tech products. Approximate region values for upcoming years using this ratio and country level export data are calculated.
Difference from EIS	This indicator is a proxy using EIS indicator data and FIGARO regional dataset
Data source	Regional: FIGARO regional dataset ⁷ Country: Eurostat, UNComtrade
Data availability	Country: 2010-2024. NUTS 2: 2017

Resource and labour productivity

4.3.2 Air emissions by fine particulates

Numerator	Sum of air pollutant (PM2.5) concentration for each spatial unit
Denominator	Total population across all spatial units
Rationale	This indicator reflects the average concentration of fine particulate matter (PM2.5) that people are exposed to, providing a population-weighted measure of air pollution's potential impact on human health
Difference from EIS	Air emissions by fine particulates used as a proxy for Production-based CO2 productivity
Data source	European Environmental Agency
Data availability	NUTS 3: 2005-2022

⁷ Lopez Alvarez, Jorge; Galiano Bastarrica, Luis Antonio; Rueda-Cantuche, José Manuel (2017): FIGARO-REG 2017 10 sectors. European Commission, Joint Research Centre (JRC) [Dataset] PID: <http://data.europa.eu/89h/dff29c8d-b85b-41fa-9cb7-7289c7324937>

4.3.3 Labour productivity

Numerator	GDP in constant prices
Denominator	Hours worked
Rationale	Labour productivity per hour worked can serve as an impact indicator. By measuring the real economic output generated per hour of work, it captures the broader effects of technological advancements, digitalisation, and process improvements on productivity.
Data source	Annual Regional Database of the European Commission (ARDECO)
Data availability	NUTS 3: 1980-2026

2.3. Regional coverage

This edition of the Regional Innovation Scoreboard provides a comparative assessment of the research and innovation performance of 241 regions in 22 EU Member States, Norway, Serbia, Switzerland, and the United Kingdom (UK). In addition, in the EU Member States Cyprus, Estonia, Latvia, Luxembourg, and Malta, NUTS 1 and NUTS 2 levels are identical to the country territory. Hence, these five countries are not analysed in the RIS report, as they are already analysed in the EIS, but they are included in the EU-27 average. In addition, they are shown on maps presenting regional performance groups in RIS report to provide contextual information and are included while ranking regions in Chapter 2.6 of the RIS report and regional country profiles.

The regional classification system, NUTS (Nomenclature of territorial units for statistics), is used in this report. The system distinguishes between three levels: NUTS 1 captures major socio-economic regions, NUTS 2 captures basic regions for the application of regional policies, and NUTS 3 captures small regions for specific diagnoses. For this edition of the RIS, the NUTS 2024 classification is used for all countries, covering NUTS 1 and NUTS 2 levels, depending on differences in regional data availability.

The NUTS classification was revised in 2024⁸. The NUTS 2024 update introduced changes to the regional classification used in the RIS for two Member States. In the Netherlands, the boundaries of two regions were modified. In Portugal, the boundaries were changed in one region and two regions were split into four. Another important NUTS2024 update concerns the UK. After the 2024 update, the UK is no longer part of the NUTS system. Thus, this report uses the NUTS 2021 version for the UK, which corresponds to the International Territorial Levels (ITLs) currently used by the UK Office for National Statistics. Due to these reasons, the number of regions covered in RIS 2025 increased to 241 from 239 regions in RIS 2023.

Depending on differences in regional data availability, the RIS covers 46 NUTS 1 regions and 195 NUTS 2 regions (see Table 2). With some countries only being covered at the NUTS 1 level, there can be significant differences in the average size of regions. For instance, the average population of a NUTS 1 region in France (total population of around 68.5 million) is almost 4.9 million, whereas it is 2.8 million for an average NUTS 2 region in Italy (total population about 59 million). The average unit of regional innovation performance analysis is 1.75 times larger in France than in Italy. These differences in unit size have implications for the variation of performance scores within countries. In general, a higher number of regions will lead to larger differences between regions in the same country. Differences in size of regions also affect indicator volatility as smaller regions typically show greater year-on-year fluctuations, particularly in survey-based measures such as those derived from CIS data.

⁸ More information on the NUTS2024 revision can be found here: <https://ec.europa.eu/eurostat/web/nuts>

Table 2: NUTS 1 and NUTS 2 regions included in RIS 2025 by country

Country	Number of regions at NUTS level		Average population size (2024)	Regions (NUTS code)	
	1	2			
Austria	3	--	3,052,917	Ostösterreich (AT1) Südösterreich (AT2)	Westösterreich (AT3)
Belgium	3	--	3,939,032	Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest (BE1)	Vlaams Gewest (BE2) Région wallonne (BE3)
Bulgaria	--	6	1,074,247	Severozapaden (BG31) Severen tsentralen (BG32) Severoiztochen (BG33)	Yugoiztochen (BG34) Yugozapaden (BG41) Yuzhen tsentralen (BG42)
Croatia	--	4	965,492	Panonska Hrvatska (HR02) Jadranska Hrvatska (HR03)	Grad Zagreb (HR05) Sjeverna Hrvatska (HR06)
Czechia	--	8	1,362,569	Praha (CZ01) Střední Čechy (CZ02) Jihozápad (CZ03) Severozápad (CZ04)	Severovýchod (CZ05) Jihovýchod (CZ06) Střední Morava (CZ07) Moravskoslezsko (CZ08)
Denmark	--	5	1,192,250	Hovedstaden (DK01) Sjælland (DK02) Syddanmark (DK03)	Midtjylland (DK04) Nordjylland (DK05)
Finland	1	4	1,120,770	Länsi-Suomi (FI19) Helsinki-Uusimaa (FI1B) Etelä-Suomi (FI1C)	Pohjois- ja Itä-Suomi (FI1D) Åland (FI2)
France	14	--	4,890,526	Ile-de-France (FR1) Centre — Val de Loire (FRB) Bourgogne-Franche-Comté (FRC) Normandie (FRD) Hauts-de-France (FRE) Grand Est (FRF) Pays de la Loire (FRG) Bretagne (FRH) Nouvelle-Aquitaine (FRI)	Occitanie (FRJ) Auvergne-Rhône-Alpes (FRK) Provence-Alpes-Côte d'Azur (FRL) Corse (FRM) RUP FR — Régions Ultrapériphériques Françaises (FRY)
Germany	9	29	2,196,212	Stuttgart (DE11) Karlsruhe (DE12) Freiburg (DE13) Tübingen (DE14) Oberbayern (DE21) Niederbayern (DE22) Oberpfalz (DE23) Oberfranken (DE24) Mittelfranken (DE25) Unterfranken (DE26) Schwaben (DE27) Berlin (DE3) Brandenburg (DE4) Bremen (DE5) Hamburg (DE6) Darmstadt (DE71) Gießen (DE72) Kassel (DE73) Mecklenburg-Vorpommern (DE8)	Braunschweig (DE91) Hannover (DE92) Lüneburg (DE93) Weser-Ems (DE94) Düsseldorf (DEA1) Köln (DEA2) Münster (DEA3) Detmold (DEA4) Arnsberg (DEA5) Koblenz (DEB1) Trier (DEB2) Rheinhessen-Pfalz (DEB3) Saarland (DEC) Dresden (DED2) Chemnitz (DED4) Leipzig (DED5) Sachsen-Anhalt (DEE) Schleswig-Holstein (DEF) Thüringen (DEG)
Greece	--	13	800,055	Attiki (EL30) Voreio Aigaio (EL41) Notio Aigaio (EL42) Kriti (EL43)	Ipeiros (EL54) Thessalia (EL61) Ionia Nisia (EL62) Dytiki Elláda (EL63) Sterea Elláda (EL64)

Country	Number of regions at NUTS level		Average population size (2024)	Regions (NUTS code)					
	1	2							
Hungary	--	8	1,198,078	Anatoliki Makedonia Thraki (EL51)	Peloponnisos (EL65)				
				Kentriki Makedonia (EL52)					
				Dytiki Makedonia (EL53)					
				Budapest (HU11)	Dél-Dunántúl (HU23)				
				Pest (HU12)	Észak-Magyarország (HU31)				
Ireland	--	3	1,783,894	Közép-Dunántúl (HU21)	Észak-Alföld (HU32)				
				Nyugat-Dunántúl (HU22)	Dél-Alföld (HU33)				
Italy	--	21	2,808,154	Northern and Western (IE04)	Eastern and Midland (IE06)				
				Southern (IE05)					
Lithuania	--	2	1,442,946	Piemonte (ITC1)	Sicilia (ITG1)				
				Valle d'Aosta/Vallée d'Aoste (ITC2)	Sardegna (ITG2)				
				Liguria (ITC3)	Provincia Autonoma di Bolzano/Bozen (ITH1)				
				Lombardia (ITC4)	Provincia Autonoma di Trento (ITH2)				
				Abruzzo (ITF1)	Veneto (ITH3)				
				Molise (ITF2)	Friuli-Venezia Giulia (ITH4)				
				Campania (ITF3)	Emilia-Romagna (ITH5)				
				Puglia (ITF4)	Toscana (IT11)				
				Basilicata (ITF5)	Umbria (ITI2)				
				Calabria (ITF6)	Marche (ITI3)				
				Lazio (ITI4)					
Netherlands	--	12	1,495,245	Sostinės regionas (LT01)	Vidurio ir vakarų Lietuvos regionas (LT02)				
				Groningen (NL11)	Noord-Holland (NL32)				
				Friesland (NL) (NL12)	Zeeland (NL34)				
				Drenthe (NL13)	Utrecht (NL35)				
				Overijssel (NL21)	Zuid-Holland (NL36)				
				Gelderland (NL22)	Noord-Brabant (NL41)				
				Flevoland (NL23)	Limburg (NL) (NL42)				
				Poland	--	17	2,154,175	Małopolskie (PL21)	Pomorskie (PL63)
								Śląskie (PL22)	Łódzkie (PL71)
								Wielkopolskie (PL41)	Świętokrzyskie (PL72)
								Zachodniopomorskie (PL42)	Lubelskie (PL81)
								Lubuskie (PL43)	Podkarpackie (PL82)
Dolnośląskie (PL51)	Podlaskie (PL84)								
Opolskie (PL52)	Warszawski stołeczny (PL91)								
Kujawsko-pomorskie (PL61)	Mazowiecki regionalny (PL92)								
Warmińsko-mazurskie (PL62)	Alentejo (PT1C)								
Portugal	2	7	1,182,192					Norte (PT11)	Oeste e Vale do Tejo (PT1D)
				Algarve (PT15)	Região Autónoma dos Açores (PT2)				
				Centro (PT) (PT19)	Região Autónoma da Madeira (PT3)				
				Grande Lisboa (PT1A)					
				Península de Setúbal (PT1B)					
Romania	--	8	2,383,447	Nord-Vest (RO11)	Sud-Muntenia (RO31)				
				Centru (RO12)	București-Ilfov (RO32)				
				Nord-Est (RO21)	Sud-Vest Oltenia (RO41)				
				Sud-Est (RO22)	Vest (RO42)				
				Bratislavský kraj (SK01)	Stredné Slovensko (SK03)				
Slovakia	--	4	1,356,172	Západné Slovensko (SK02)					

Country	Number of regions at NUTS level		Average population size (2024)	Regions (NUTS code)	
	1	2			
Slovenia	--	2	1,061,975	Vzhodna Slovenija (SI03)	Východné Slovensko (SK04)
Spain	2	17	2,558,931	Galicia (ES11)	Zahodna Slovenija (SI04)
				Principado de Asturias (ES12)	Extremadura (ES43)
				Cantabria (ES13)	Catalunya/Cataluña (ES51)
				País Vasco (ES21)	Comunitat Valenciana (ES52)
				Comunidad Foral de Navarra (ES22)	Illes Balears (ES53)
				La Rioja (ES23)	Andalucía (ES61)
				Aragón (ES24)	Región de Murcia (ES62)
				Comunidad de Madrid (ES3)	Ciudad de Ceuta (ES63)
				Castilla y León (ES41)	Ciudad de Melilla (ES64)
				Castilla-La Mancha (ES42)	Canarias (ES7)
Sweden	--	8	1,318,963	Stockholm (SE11)	Västsverige (SE23)
				Östra Mellansverige (SE12)	Norra Mellansverige (SE31)
				Småland med öarna (SE21)	Mellersta Norrland (SE32)
				Sydsverige (SE22)	Övre Norrland (SE33)
Norway	--	6	925,036	Innlandet (NO02)	Oslo og Viken (NO08)
				Trøndelag/Tröndelage (NO06)	Agder og Sør-Østlandet (NO09)
				Nord-Norge (NO07)	Vestlandet (NO0A)
Switzerland	--	7	1,280,323	Région lémanique (CH01)	Zürich (CH04)
				Espace Mittelland (CH02)	Ostschweiz (CH05)
				Nordwestschweiz (CH03)	Zentralschweiz (CH06)
					Ticino (CH07)
Serbia	--	4	1,651,292	City of Belgrade (RS11)	Region Šumadije i Zapadne Srbije (RS21)
				Autonomous Province of Vojvodina (RS12)	Region Južne i Istočne Srbije (RS22)
United Kingdom	12	--	5,522,798 (2018)*	North East (England) (UKC)	London (UKI)
				North West (England) (UKD)	South East (England) (UKJ)
				Yorkshire and The Humber (UKE)	South West (England) (UKK)
				East Midlands (England) (UKF)	Wales (UKL)
				West Midlands (England) (UKG)	Scotland (UKM)
				East (England) (UKH)	Northern Ireland (UKN)

Note: 2018 is the latest year for which population data for all UK regions are available on Eurostat [demo_r_d2jan].

2.4. Regional data availability

RIS uses data from European and international statistical services, such as Eurostat and OECD. For several indicators regional data was calculated by Science Metrix (Elsevier) and Fraunhofer ISI using bibliometric data and raw data from the European Union Intellectual Property Offices (EUIPO). These are the ways that RIS indicators are calculated:

- Data for seven RIS indicators are taken directly from official statistics services (e.g. Eurostat, European Environment Agency, JRC ARDECO). No additional calculations need to be done with these indicators. This is the case for the following indicators: *Population with tertiary education*, *Population involved in lifelong learning*, *Broadband penetration*, *R&D expenditure in the business sector*, *Cloud computing in enterprises*, *Air emissions by fine particulates*, and *Labour productivity*.

- Data for 11 RIS indicators are taken from official statistics services, but separately for the numerator and denominator. In these cases, the indicator is calculated by the RIS project team. Data availability for the numerator and denominator can vary. This is the case for the following indicators: *R&D expenditure in the public sector, Non-R&D innovation expenditures, Innovation expenditures per person employed, Employed ICT specialists, SMEs introducing product innovations, SMEs introducing business process innovations, Innovative SMEs collaborating with others, PCT patent applications, Sales of new-to-market and new-to-firm innovations, Employment in innovative enterprises, and Exports of medium and high technology products.*
- Data for five RIS indicators are provided by Science Metrix (Elsevier) and Fraunhofer ISI as part of a contract with the European Commission. For four of them a denominator is added (*International scientific co-publications, Public-private co-publications, Trademark applications, Design applications*). Thus, these indicators are also calculated by the RIS team.

Table 3 provides the data availability for each RIS indicator for every year in the period 2014-2024. For indicators where additional calculations were made, availability is provided separately for the numerator and denominator. Data availability is provided before any data treatment (break removal, imputation, etc.). Table 4 provides information about the regions for which data are not available.

Table 3: Regional data availability by indicator

Indicator	Data availability (percentage of available regions out of 241)										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
<i>1.1.2 Population with tertiary education</i>	94.2	94.2	96.7	96.7	96.7	98.8	93.4	93.4	93.8	94.6	94.6
<i>1.1.3 Population involved in lifelong learning</i>	94.2	93.8	96.7	97.1	96.7	99.2	92.9	93.4	93.8	95	95
<i>1.2.1 International scientific co-publications</i>											
Numerator: Number of scientific publications with at least one co-author based abroad	100	100	100	100	100	100	100	100	100	100	100
Denominator: Total population	95.4	95.4	95.4	97.1	97.1	97.1	97.1	97.1	97.1	99.2	95
<i>1.2.2 Scientific publications among the top 10% most cited</i>	98.8	98.8	98.8	98.8	98.8	99.6	99.6	99.6	99.6	No data	No data
<i>1.3.1 Broadband penetration</i>	90.9	89.2	89.2	92.1	95	99.6	85.9	92.1	No data	No data	No data
<i>2.1.1 R&D expenditure in the public sector</i>											
R&D expenditure in: government sector	58.9	72.6	63.5	73.9	70.5	73.9	68	74.7	No data	No data	No data
R&D expenditure in: higher education sector	58.9	71.4	64.7	76.3	71	70.1	68	74.3	No data	No data	No data
<i>2.2.1 R&D expenditure in the business sector</i>	47.7	80.1	53.5	82.2	59.3	75.5	56	78.8	No data	No data	No data

Indicator	Data availability (percentage of available regions out of 241)										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
<i>2.2.2 Non-R&D innovation expenditures⁹</i>											
Numerator: Sum of total innovation expenditure for SMEs, excluding intramural and extramural R&D expenditures	--	No data	--	No data	--	No data	--	No data	53.9	No data	No data
Denominator: Total turnover for SMEs		No data		No data		No data		No data	49.4	No data	No data
<i>2.2.3 Innovation expenditures per person employed¹⁰</i>											
Numerator: Innovation expenditure by SMEs	--	No data	--	No data	--	No data	--	No data	53.9	No data	No data
Denominator: Total employment in innovative SMEs		No data		No data		No data		No data	58.5	No data	No data
<i>2.3.1 Cloud computing in enterprises</i>	No data	No data	No data	No data	No data	No data	No data	No data	No data	29	No data
<i>2.3.2 Employed ICT specialists</i>											
Region share in NACE J	85.5	85.5	86.7	88	88	89.6	75.1	80.9	82.6	83	84.2
Country share NACE J	100	100	100	100	100	100	95	95	95	95	95
Share of ICT specialists (country)	100	100	100	100	100	100	95	95	95	95	95

⁹ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

¹⁰ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

Indicator	Data availability (percentage of available regions out of 241)										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
3.1.1 SMEs introducing product innovations¹¹											
Numerator: Number of SMEs who introduced at least one product innovation	--	No data	--	No data	--	No data	--	No data	58.5	No data	No data
Denominator: Total number of SMEs		No data		No data		No data		No data	58.5	No data	No data
3.1.2 SMEs introducing business process innovations¹²											
Numerator: Number of SMEs who introduced at least one business process innovation	--	No data	--	No data	--	No data	--	No data	58.5	No data	No data
Denominator: Total number of SMEs		No data		No data		No data		No data	58.5	No data	No data
3.2.1 Innovative SMEs collaborating with others¹³											
Numerator: Number of SMEs with innovation co-operation activities	--	No data	--	No data	--	No data	--	No data	58.1	No data	No data
Denominator: Total number of SMEs		No data		No data		No data		No data	58.5	No data	No data
3.2.2 Public-private co-publications											

¹¹ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

¹² Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

¹³ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

Indicator	Data availability (percentage of available regions out of 241)											
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
Numerator: Number of public-private co-authored research publications	100	100	100	100	100	100	100	100	100	100	100	100
Denominator: Total population	95.4	95.4	95.4	97.1	97.1	97.1	97.1	97.1	97.1	99.2	95	
<i>3.3.1 PCT patent applications</i>												
Numerator: Number of patent applications filed under the Patent Co-operation Treaty, by year of filing	100	100	100	100	100	100	100	100	100	Data incomplete	Data incomplete	
Denominator: GDP in PPP	97.9	97.9	97.9	97.9	97.9	97.9	97.9	100	97.5	89.6	No data	
<i>3.3.2 Trademark applications</i>												
Numerator: Number of trademark applications applied for at EUIPO	100	100	100	100	100	100	100	100	100	100	100	
Denominator: GDP in PPP	97.9	97.9	97.9	97.9	97.9	97.9	97.9	100	97.5	89.6	No data	
<i>3.3.3 Design applications</i>												
Numerator: Number of designs applied for at EUIPO	100	100	100	100	100	100	100	100	100	100	100	
Denominator: GDP in PPP	97.9	97.9	97.9	97.9	97.9	97.9	97.9	100	97.5	89.6	No data	
<i>4.1.1 Sales of new-to-market and new-to-firm innovations¹⁴</i>												

¹⁴ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

Indicator	Data availability (percentage of available regions out of 241)										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Numerator: Sum of total turnover of new or significantly improved products for SMEs	--	No data	--	No data	--	No data	--	No data	60.2	No data	No data
Denominator: Total turnover for SMEs		No data		No data		No data		No data	49.4	No data	No data
<i>4.1.2 Employment in innovative enterprises¹⁵</i>											
Numerator: Number of employed persons in innovative SMEs	--	No data	--	No data	--	No data	--	No data	58.5	No data	No data
Denominator: Total employment in SMEs		No data		No data		No data		No data	58.5	No data	No data
<i>4.2.1 Exports of medium and high technology products</i>											
FIGARO 2017 regional data	No data	No data	No data	95.4	No data	No data	No data	No data	No data	No data	No data
Export data at country level	94.6	100	100	100	100	100	95	95	95	95	95
<i>4.3.2 Air emissions by fine particulates</i>	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4	No data	No data
<i>4.3.3 Labour productivity</i>	95	95	95	95	95	95	95	95	95	95	92.1

¹⁵ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

Table 4: Regions for which data are not available

Indicator	Data not available for
<i>1.1.2 Population with tertiary education</i>	1 year: 1 DE, 1 FR region 2 years: 3 HR, 3 NO regions 5 years: 5 PT, 12 UK regions 9 years: 2 NL regions 11 years: 1 FI region
<i>1.1.3 Population involved in lifelong learning</i>	1 year: 1 BG, 1 DE, 1 RO region 2 years: 2 EL, 3 HR, 3 NO regions 4 years: 1 BG region 5 years: 5 PT, 12 UK regions 9 years: 2 NL regions
<i>1.2.1 International scientific co-publications</i>	
Numerator: Number of scientific publications with at least one co-author based abroad	--
Denominator: Total population	1 year: 12 UK regions 3 years: 4 RS regions 9 years: 5 PT regions 10 years: 2 NL regions
<i>1.2.2 Scientific publications among the top 10% most cited</i>	5 years: 2 ES regions 9 years: 1 FI regions
<i>1.3.1 Broadband penetration</i>	1 year: 13 FR, 3 HR, 3 NO, 2 SI regions 2 years: 1 FR, 12 UK regions 4 years: 7 CH, 2 HU, 3 IE, 2 LT, 7 PL regions 5 years: 4 RS regions 8 years: 1 FI region
<i>2.1.1 R&D expenditure in the public sector</i>	
R&D expenditure in: government sector	1 year: 3 BG, 1 ES, 5 FI, 2 LT, 3 NO, 1 PL, 5 PT regions 2 years: 13 EL, 2 PL regions 3 years: 1 BG, 5 DK, 2 HU, 10 UK regions 4 years: 2 PL, 4 RS, 8 SE regions 5 years: 1 AT, 3 PL, 2 UK regions 6 years: 2 AT, 3 HR, 3 IE, 4 PL regions 7 years: 14 FR, 3 NO, 1 PL regions

Indicator	Data not available for
	8 years: 7 CH, 2 ES, 12 NL, 4 PL regions
R&D expenditure in: higher education sector	1 year: 2 ES, 5 FI, 3 IT, 2 LT, 3 NO, 3 PL, 5 PT regions 2 years: 13 EL, 2 ES, 5 PL regions 3 years: 5 DK, 3 ES, 2 HU, 1 PL, 2 SI, 8 UK regions 4 years: 4 PL, 4 RS, 8 SE regions 5 years: 1 AT, 1 BG, 2 UK regions 6 years: 2 AT, 1 BG, 1 ES, 3 HR, 3 IE, 1 PL, 2 UK regions 7 years: 14 FR, 3 NO regions 8 years: 1 BG, 7 CH, 3 ES, 12 NL regions
<i>2.2.1 R&D expenditure in the business sector</i>	1 year: 5 FI, 2 LT, 3 NO, 2 PL, 5 PT regions 2 years: 13 EL, 7 PL regions 3 years: 5 DK, 2 HU, 2 PL, 12 UK regions 4 years: 3 AT, 38 DE, 4 RS, 6 SE regions 6 years: 7 CH, 3 HR, 3 IE, 2 SE regions 7 years: 2 ES, 14 FR, 3 NO regions 8 years: 12 NL regions
<i>2.2.2 Non-R&D innovation expenditures¹⁶</i>	
Numerator: Sum of total innovation expenditure for SMEs, excluding intramural and extramural R&D expenditures	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PT, 38 DE, 4 SK, 5 DK, 6 NO, 7 CH, 9 PL regions
Denominator: Total turnover for SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PT, 21 IT, 3 PL, 38 DE, 5 DK, 6 NO, 7 CH regions
<i>2.2.3 Innovation expenditures per person employed¹⁷</i>	
Numerator: Innovation expenditure by SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PT, 38 DE, 4 SK, 5 DK, 6 NO, 7 CH, 9 PL regions

¹⁶ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

¹⁷ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

Indicator	Data not available for
Denominator: Total employment in innovative SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
2.3.1 Cloud computing in enterprises	1 year: 12 NL, 12 UK, 13 EL, 14 FR, 17 PL, 21 IT, 3 IE, 38 DE, 4 RS, 5 FI, 7 CH, 8 CZ, 8 SE, 9 PT regions
2.3.2 Employed ICT specialists	
Region share in NACE J	1 year: 1 EL, 13 DE regions 2 years: 1 BG, 1 DE, 1 HU, 3 HR, 3 NO regions 3 years: 3 DE regions 4 years: 1 BG, 1 DE, 1 PL, 2 EL regions 5 years: 1 DE, 1 EL, 1 RO, 12 UK, 3 PT regions 6 years: 1 PL, 1 PT, 1 RO regions 7 years: 1 FR, 1 IT regions 8 years: 1 EL, 1 PL, 1 PT, 2 NO regions 9 years: 1 EL, 2 NL regions 10 years: 1 DE, 1 PL, 1 PT region 11 years: 1 FI, 1 IT, 2 ES, 2 PL, 2 PT, 4 EL regions
Country share NACE J	5 years: 12 UK regions
Share of ICT specialists (country)	5 years: 12 UK regions
3.1.1 SMEs introducing product innovations ¹⁸	
Numerator: Number of SMEs who introduced at least one product innovation	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
Denominator: Total number of SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
3.1.2 SMEs introducing business process innovations ¹⁹	
Numerator: Number of SMEs who introduced at least one business process innovation	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions

¹⁸ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

¹⁹ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

Indicator	Data not available for
Denominator: Total number of SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
<i>3.2.1 Innovative SMEs collaborating with others²⁰</i>	
Numerator: Number of SMEs with innovation co-operation activities	1 year: 1 HR, 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
Denominator: Total number of SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
<i>3.2.2 Public-private co-publications</i>	
Numerator: Number of public-private co-authored research publications	--
Denominator: Total population	1 year: 12 UK regions 3 years: 4 RS regions 9 years: 5 PT regions 10 years: 2 NL regions
<i>3.3.1 PCT patent applications</i>	
Numerator: Number of patent applications filed under the Patent Co-operation Treaty, by year of filing	--
Denominator: GDP in PPP	1 year: 12 UK, 7 CH regions 2 years: 6 NO regions 7 years: 5 PT regions
<i>3.3.2 Trademark applications</i>	
Numerator: Number of trademark applications applied for at EUIPO	--
Denominator: GDP in PPP	1 year: 12 UK, 7 CH regions 2 years: 6 NO regions 7 years: 5 PT regions
<i>3.3.3 Design applications</i>	
Numerator: Number of designs applied for at EUIPO	--
Denominator: GDP in PPP	1 year: 12 UK, 7 CH regions 2 years: 6 NO regions 7 years: 5 PT regions

²⁰ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

Indicator	Data not available for
<i>4.1.1 Sales of new-to-market and new-to-firm innovations²¹</i>	
Numerator: Sum of total turnover of new or significantly improved products for SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
Denominator: Total turnover for SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PT, 21 IT, 3 PL, 38 DE, 5 DK, 6 NO, 7 CH regions
<i>4.1.2 Employment in innovative enterprises²²</i>	
Numerator: Number of employed persons in innovative SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
Denominator: Total employment in SMEs	1 year: 12 NL, 12 UK, 14 FR, 2 ES, 2 PL, 2 PT, 38 DE, 5 DK, 6 NO, 7 CH regions
<i>4.2.1 Exports of medium and high technology products</i>	
FIGARO 2017 regional data	1 year: 4 RS, 7 CH regions
Export data at country level	1 year: 6 NO, 7 CH regions 5 years: 12 UK regions
<i>4.3.2 Air emissions by fine particulates</i>	9 years: 1 ES, 1 FR, 12 UK, 2 PT regions
<i>4.3.3 Labour productivity</i>	1 year: 7 CH regions 11 years: 12 UK regions

3. Methodology for calculating composite scores

The overall performance of each regional innovation system is summarised by a composite indicator, the Regional Innovation Index (RII). The methodology used for calculating the RII is outlined below.

The data collection and calculation process for the RIS has been automated for the 2025 release following the approach used in EIS. The approach is summarised in Figure 1 below.

The construction of the index for 2025 has been performed using the COINr package²³, adapted and extended to the RIS. COINr is an open-source R package recently developed by the European Commission's Competence Centre for Composite Indicators and Scoreboards²⁴, and

²¹ Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

²² Data prior to CIS 2022 was obtained from National Statistics Office. The special request agreement with Eurostat and the NSOs providing regional data includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, data for previous CIS additions separately for numerator and denominator is not available.

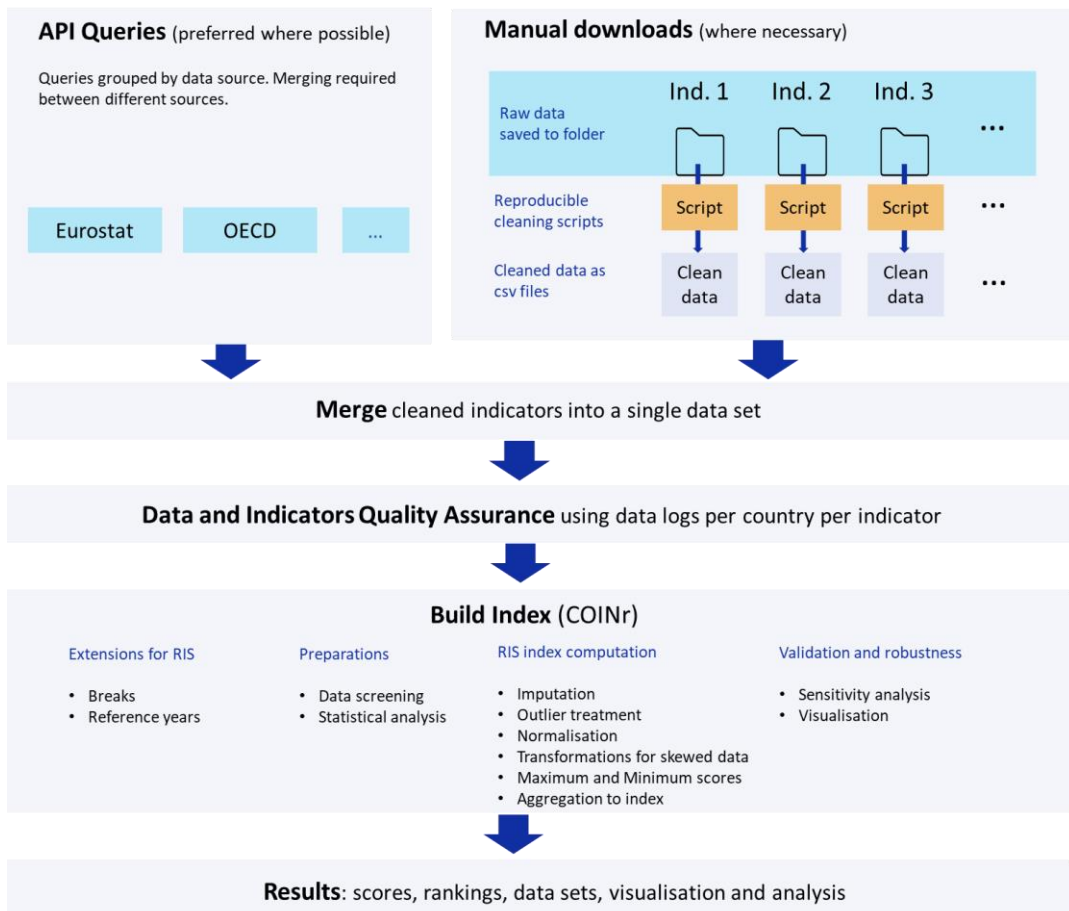
²³ See: <https://bluefoxr.github.io/COINr/>

²⁴ See: <https://composite-indicators.jrc.ec.europa.eu/>

it implements international guidelines and best practices in composite indicator construction²⁵. It allows highly detailed and flexible construction and analysis of composite indicators, including imputation, normalisation, outlier treatment and sensitivity analysis.

This approach provides a highly replicable and easy to follow data pipeline which feeds into the COINr package and automatically provides the main outputs of the RIS. Since the data collection, processing and outputs are largely based on code (using the R software), all code is packaged together and hosted on GitHub, which also facilitates the auditing process.

Figure 1: RIS automation process



3.1. Step 1: Data collection and indicator calculation

Where possible (for 12 indicators), the data was collected using API queries, more specifically, the Eurostat R package²⁶. This allowed for a highly replicable and easy to follow data pipeline and minimised the possibility of human errors. However, for the rest of the indicators, API query was not available and thus, the data was downloaded manually. For all indicators, data cleaning and indicator calculations were done using R.

²⁵ Nardo M, Saisana M, Saltelli A, Tarantola S, Hoffmann A, Giovannini E. Handbook on Constructing Composite Indicators: Methodology and User Guide. Paris (France): OECD publishing; 2008. JRC47008. <https://publications.jrc.ec.europa.eu/repository/handle/JRC47008>

²⁶ <https://cran.r-project.org/web/packages/eurostat/index.html>

For five indicators, data from an alternative to the main source was used to fill in the data gaps in certain countries. This was the case for the following indicators:

- Denominator for indicators *International scientific co-publications* and *Public-private co-publications*. The latest available UK population data on Eurostat is for 2019. Thus, from 2020 onward, the denominator for these two indicators was calculated using an alternative source. National level data for mid-year population estimates were taken from the Office for National Statistics of the UK²⁷. This data was used to calculate annual population growth rates, which were then applied to the 2019 Eurostat data to estimate national and regional populations for the subsequent years.
- *PCT patent applications*, *Trademark applications*, *Design applications*. These indicators used GDP in PPP data. This data is not available in Eurostat for the UK and for Switzerland and Norway for 2022-2023. This data was taken from OECD (Gross domestic product – Regions). As the OECD provides data in US dollars, it was necessary to convert these values into euros. This conversion was done using an average exchange rate, calculated by comparing the corresponding data in Eurostat and OECD for EU countries.

In addition, data for 7 CIS indicators are publicly available for 2022 in Eurostat. However, regional data for previous CIS editions was not publicly available. Regional data prior to CIS 2022 was obtained from the National Statistics Office (NSO) as part of the preparation of the previous RIS editions under the special request agreement with Eurostat and the NSOs. However, this special agreement includes a rule that the contractor must delete the confidential regional data once the RIS report is published. Thus, raw data for previous CIS editions separately for numerator and denominator are not available and only the final indicator values are.

3.2. Step 2: Imputing data for regions impacted by revisions in NUTS

For this edition of the RIS, the NUTS 2024 classification is used²⁸. However, for some indicators, data are only available according to earlier versions of the NUTS classification. As a result, certain indicators in this edition of the RIS still use NUTS 2021 or NUTS 2016 classifications. In such cases, values for NUTS 2024 regions were calculated using a special correspondence developed for RIS (see Table 5). This correspondence is relevant for three regions in Croatia, three regions in Norway, two regions in the Netherlands, and five regions in Portugal.

The correspondence was used in the following indicators:

- *Broadband penetration*: Croatia, the Netherlands, Portugal, Norway
- *R&D expenditure in the public sector*: the Netherlands, Portugal
- *R&D expenditure in the business sector*: Portugal
- *Employed ICT specialists*: Portugal
- *Exports of medium and high technology products*: Croatia, the Netherlands, Norway, Portugal

²⁷<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/timeseries/ukpop/pop>

²⁸ After 2024 update, the UK is no longer part of the NUTS system. Thus, this report uses the NUTS 2021 version for the UK, which corresponds to the International Territorial Levels (ITLs) currently used by the UK Office for National Statistics. More information on the NUTS2024 revision can be found here: <https://ec.europa.eu/eurostat/web/nuts> <https://ec.europa.eu/eurostat/web/nuts>

- *Air emissions by fine particulates*: the Netherlands, Portugal
- For seven CIS indicators (*Non-R&D innovation expenditures, Innovation expenditures per person employed, SMEs introducing product innovations, SMEs introducing business process innovations, Innovative SMEs collaborating with others, Sales of new-to-market and new-to-firm innovations, and Employment in innovative enterprises*): Portugal (only 2014-2020)

Table 5: Correspondence used to impute data for regions impacted by revisions in the NUTS classification

Impacted NUTS2024 regions	Correspondence	Rationale
HR02 Panonska Hrvatska	HR02 = HR04	One region was split into three new regions, thus the values of this one region are used for the newly created regions.
HR05 Grad Zagreb	HR05 = HR04	
HR06 Sjeverna Hrvatska	HR06 = HR04	
NO08 Oslo og Viken	NO08 = (NO01+NO03)/2	New region made of multiple previous regions, thus the average of the old regions to form new region is used.
NO09 Agder og Sør-Østlandet	NO09 = (NO03+NO04)/2	
NO0A Vestlandet	NO0A = (NO04+NO05)/2	
NL35 Utrecht	NL35 = (NL31+NL33)/2	Boundary changed forming a new region (NL35) of NL31 and part of NL33. The average of the old regions to form new region is used.
NL36 Zuid-Holland	NL36 = NL33	Boundary changed forming NL36 of large part of NL33. Thus, value of the old region used to form a new region.
PT19 Centro (PT)	PT19 = PT16	Boundary changed forming PT19 of large part of PT16. Thus, value of the old region used to form a new region.
PT1A Grande Lisboa	PT1A = PT17	Boundary changed forming PT1C of large part of PT18. Thus, value of the old region used to form a new region.
PT1B Península de Setúbal	PT1B = PT17	Boundary changed forming PT1D by taking parts of two regions (PT16 and PT18). The average of the old regions used to form new region.
PT1C Alentejo	PT1C = PT18	One region was split into two new regions, thus the value of this one region is used for the newly created regions.
PT1D Oeste e Vale do Tejo	PT1D = (PT16+PT18)/2	

3.3. Step 3: Setting reference years

For each indicator, a reference year is identified based on data availability for all regions for which data availability is at least 75%. For most indicators, this reference year will be lagging one or two years behind the year to which the EIS refers (see Table 6). However, exceptions were made to CIS indicators, since regional CIS2022 data did not pass the 75% threshold due to no regional data for Germany and France.²⁹ In addition, the exception was made to *Cloud*

²⁹ For Germany and France, the latest available regional data from CIS2020 were used.

computing in enterprises where data was not available at the regional level for Czechia, Germany, Ireland, Greece, France, Italy, Netherlands, Poland, Portugal, Finland, Sweden and thus data availability did not pass the 75% threshold. Data for the most recent years available (2023) was used for this indicator.

Table 6. The most recent year of indicators used in RIS

Indicator	Most recent year used in the RIS
<i>1.1.2 Population with tertiary education</i>	2024
<i>1.1.3 Population involved in lifelong learning</i>	2024
<i>1.2.1 International scientific co-publications</i>	2024
<i>1.2.2 Scientific publications among the top 10% most cited</i>	2022
<i>1.3.1 Broadband penetration</i>	2021
<i>2.1.1 R&D expenditure in the public sector</i>	2021
<i>2.2.1 R&D expenditure in the business sector</i>	2021
<i>2.2.2 Non-R&D innovation expenditures</i>	2022
<i>2.2.3 Innovation expenditures per person employed</i>	2022
<i>2.3.1 Cloud computing in enterprises</i>	2023
<i>2.3.2 Employed ICT specialists</i>	2024
<i>3.1.1 SMEs introducing product innovations</i>	2022
<i>3.1.2 SMEs introducing business process innovations</i>	2022
<i>3.2.1 Innovative SMEs collaborating with others</i>	2022
<i>3.2.2 Public-private co-publications</i>	2024
<i>3.3.1 PCT patent applications</i>	2022
<i>3.3.2 Trademark applications</i>	2023
<i>3.3.3 Design applications</i>	2023
<i>4.1.1 Sales of new-to-market and new-to-firm innovations</i>	2022
<i>4.1.2 Employment in innovative enterprises</i>	2022
<i>4.2.1 Exports of medium and high technology products</i>	2024 ³⁰
<i>4.3.2 Air emissions by fine particulates</i>	2022
<i>4.3.3 Labour productivity</i>	2024

³⁰ While FIGARO provides regional data only for 2017, the indicator is updated to 2024 using regional shares derived from 2017 and applied to the most recent country-level data from the EIS. See Annex A for a detailed description of indicator calculation.

3.4. Step 4: Treating data breaks

Breaks in the time series in at least one country's regions are reported for nine indicators (see Table 7 below). To ensure data comparability across years, all data prior to a break in the time series are removed. For example, if a break occurs for a region in 2023, all data for that region before 2023 are deleted. As a result, the time series for that region will contain only data from 2023 onwards. Table 7 briefly summarises the recorded breaks by indicator and year.

Table 7. Breaks in time series by indicator

Indicator	Breaks
<i>1.1.2 Population with tertiary education</i>	2021: All regions 2023: SI regions 2024: BG regions
<i>1.1.3 Population involved in lifelong learning</i>	2021: All regions 2022: SK regions 2023: SI regions 2024: BE, BG, DE, EL, IE regions
<i>1.3.1 Broadband penetration</i>	2014: RO regions 2016: SE regions 2017: CH regions 2019: SE regions 2020: CZ regions 2021: DE, IE regions
<i>2.1.1 R&D expenditure in the public sector</i>	
R&D expenditure in: government sector	2016: DE regions
R&D expenditure in: higher education sector	2018: HU regions
<i>2.2.1 R&D expenditure in the business sector</i>	2015: CH regions 2016: IT regions 2018: HU regions
<i>2.3.2 Employed ICT specialists</i>	
Region share in NACE J	2021: All regions 2023: DK regions 2024: BG regions
Country share NACE J	2021: All countries 2023: DK 2024: BG
Share of ICT specialists (country)	2021: All countries 2023: DK
<i>3.3.1 PCT patent applications</i>	

Indicator	Breaks
Numerator: Number of patent applications filed under the Patent Co-operation Treaty, by year of filing	--
Denominator: GDP in PPP	2019: DE regions 2020: BE, PL regions 2021: IT, PT regions
<i>3.3.2 Trademark applications</i>	
Numerator: Number of trademark applications applied for at EUIPO	--
Denominator: GDP in PPP	2019: DE regions 2020: BE, PL regions 2021: IT, PT regions
<i>3.3.3 Design applications</i>	
Numerator: Number of designs applied for at EUIPO	--
Denominator: GDP in PPP	2019: DE regions 2020: BE, PL regions 2021: IT, PT regions

There was also a break in the time series of CIS indicators in 2022 for Italy and Sweden, caused by a change in the statistical unit from the legal unit to the enterprise. The change is a result of Commission Implementing Regulation (EU) 2022/1092 of 30 June 2022, aiming to harmonise data collection methods. This change is considered an improvement, as it leads to more accurate data. While Italy and Sweden explicitly reported this break, similar changes were introduced in other countries as well, though not all of them flagged it as a break in the time series. Moreover, some countries had already implemented this shift in earlier CIS editions. Taking all of this into account, and following consultations with Eurostat, it was decided to disregard this break in the time series in the analysis.

3.5. Step 5: Imputing for missing values

Imputation for missing values is implemented following four rules in the order as shown below:

1. If data for a year in between the start and end of the time series are not available, missing values are replaced with the value from the previous year.
2. If data are not available at the end of the time series, missing values are replaced with the value from the previous year.
3. If data are not available at the beginning of the time series, missing values are replaced with the next available year.
4. If there are no regional data for any of the previous nor the following year, the missing values are replaced by the higher-level NUTS aggregate.

For most indicators where additional calculations were needed, the first three steps of imputation were done at the numerator and denominator level, and only after that, the indicator value was calculated. Imputation from higher-level NUTS aggregate (fourth imputation step) was implemented only for calculated indicators to avoid inconsistencies arising from

mismatched geographic levels, for example, imputing a denominator from a national level while the numerator is based on regional data would compromise the validity of the resulting indicator.

Specifically, imputation using the first three imputation steps was done for three indicators: *R&D expenditure in the public sector*, *Employed ICT specialists*, and *PCT patent applications*. It was not done for the remaining eight indicators, where additional calculations were required for the following reasons:

- Seven CIS indicators (2.2.2 *Non-R&D innovation expenditures*, 2.2.3 *Innovation expenditures per person employed*, 3.1.1 *SMEs introducing product innovations*, 3.1.2 *SMEs introducing business process innovations*, 3.2.1 *Innovative SMEs collaborating with others*, 4.1.1 *Sales of new-to-market and new-to-firm innovations*, 4.1.2 *Employment in innovative enterprises*): data at the numerator and denominator level was not available before 2022, thus to ensure consistency, imputation was done only at the indicator level.
- *Exports of medium and high technology products*: there was no missing data, thus imputation was not needed.

3.6. Step 6: Identifying and replacing outliers

Chauvenet's Criterion in statistical theory is used to determine outliers. Positive outliers are identified as those region scores which are higher than the mean across all regions plus twice the standard deviation. Negative outliers are identified as those region scores which are smaller than the mean across all regions minus twice the standard deviation. These outliers are replaced by the respective maximum and minimum values observed over all the years and all regions.

With replacing positive (or negative) outliers, more than one region can share the highest (lowest) normalised score of 1 (0). Table 8 summarises the outliers per indicator and year (negative outliers are shown in *italics*) for the full time series, including imputed values. Years refer to the reference years in the RIS 2025.

Table 8: Outliers by indicator

Indicator	Outliers (Positive / <i>Negative</i>)
1.1.2 <i>Population with tertiary education</i>	<p>Positive: CH04 2018-2025; ES13 2024; ES21 2018-2025; FR1 2018-2025; IE05 2025; IE06 2018-2025; LT01 2018-2025; NL32 2023; NL35 2018-2025; NO08 2023-2025; PL91 2018-2025; SE11 2024-2025; UKI 2018-2025</p> <p><i>Negative:</i> <i>HU31 2024; RO12 2018-2022; RO21 2024; RO22 2018-2025; RO31 2018-2025; RO41 2024-2025</i></p>
1.1.3 <i>Population involved in lifelong learning</i>	<p>Positive: CH04 2024; DK01 2023-2025; DK02 2025; DK04 2024-2025; F119 2018-2022; F11B 2018-2025; F11D 2018-2022; NL11 2018-2022; NL23 2025; NL35 2018-2025; SE11 2018-2025; SE12 2018-2025; SE21 2018-2025; SE22 2018-2025; SE23 2018-2025; SE31 2018-2025; SE32 2018-2025; SE33 2018-2025</p> <p><i>Negative:</i> --</p>
1.2.1 <i>International scientific co-publications</i>	<p>Positive: BE1 2019-2025; CH01 2018-2025; CH03 2018-2025; CH04 2018-2025; CZ01 2020-2025; DK01 2018-2025; DK04 2022-2025; DK05 2025; F11B 2021-2025; NL11 2018-2025; NL35 2020-2025; NO06 2018-2025; SE11 2019-2025; SE12 2022-2025; SE33 2019-2025; UKI 2022-2025</p> <p><i>Negative:</i> --</p>

Indicator	Outliers (Positive / Negative)
1.2.2 Scientific publications among the top 10% most cited	<p>Positive: CH04 2018-2022; DE93 2023; DK05 2019; ES63 2023-2025; NL12 2020; NL22 2020; NL23 2023-2025; NL32 2018-2022; NL34 2023-2025; NL35 2019; UKH 2018-2023</p> <p>Negative: BG31 2018-2025; BG32 2018-2019; BG33 2018-2019; BG34 2019-2025; CZ04 2019-2022; EL64 2019; ES63 2018-2022; HR02 2019-2020; HR06 2019-2021; PL72 2023; PL92 2018-2020; RO22 2020-2021; RO41 2019-2020; SK03 2019</p>
1.3.1 Broadband penetration	<p>Positive: --</p> <p>Negative: BG31 2018-2022; BG32 2018-2020; BG33 2018-2019; BG34 2018-2021; BG41 2018-2020; BG42 2018-2020; EL41 2019; EL42 2019; EL43 2019; EL51 2018-2021; EL52 2018-2021; EL53 2018-2021; EL54 2018-2021; EL61 2018-2021; EL62 2018-2021; EL63 2018-2021; EL64 2018-2021; EL65 2018-2021; ES43 2018; FRM 2019-2021; FRY 2018-2021; HU31 2018; ITF3 2018; ITF5 2018; ITF6 2018; ITG1 2018; PT11 2018-2019; PT15 2018; PT19 2018-2019; PT1C 2018-2020; PT1D 2018-2020; RO11 2018; RO12 2018; RO21 2018-2020; RO22 2018-2019; RO31 2018-2020; RO41 2018-2019; RO42 2018</p>
2.1.1 R&D expenditure in the public sector	<p>Positive: CZ01 2018-2019; DE12 2018-2025; DE3 2018-2025; DE5 2018-2025; DE91 2018-2025; DEA2 2018-2025; DEB2 2018-2020; DED2 2018-2025; DED5 2018-2025; DK01 2023-2025; DK05 2023-2025; EL43 2024-2025; EL54 2024; FRJ 2018-2025; NO06 2018-2025; SE12 2018-2024; SE33 2018-2025</p> <p>Negative: --</p>
2.2.1 R&D expenditure in the business sector	<p>Positive: AT2 2018-2025; BE3 2024-2025; CH03 2018-2025; DE11 2018-2025; DE12 2021-2025; DE14 2018-2025; DE21 2018-2025; DE91 2018-2025; DEB3 2023-2025; DK01 2018-2025; SE23 2021-2025</p> <p>Negative: --</p>
2.2.2 Non-R&D innovation expenditures	<p>Positive: FRY 2021-2025; RS11 2018-2020; RS12 2018-2022; RS21 2018-2022; RS22 2021-2022; UKL 2018-2025</p> <p>Negative: --</p>
2.2.3 Innovation expenditures per person employed	<p>Positive: BE1 2021-2025; BE2 2025; BE3 2021-2025; FR1 2023-2025; FRH 2023-2025; FRY 2018-2025; HR06 2025; IE05 2025; IE06 2025; RS21 2018-2022; RS22 2018-2022</p> <p>Negative: --</p>
2.3.1 Cloud computing in enterprises	<p>Positive: --</p> <p>Negative: BG31 2018-2025; ES64 2018-2025; RO22 2018-2025; RO31 2018-2025; RO41 2018-2025</p>
2.3.2 Employed ICT specialists	<p>Positive: BG41 2025; CH04 2018-2025; CZ01 2018-2025; DE3 2018-2025; FI1B 2018-2025; FR1 2024-2025; HR05 2024-2025; HU11 2018-2025; LT01 2024-2025; NL23 2023; NL32 2018-2025; NL35 2018-2025; PL91 2024-2025; PT1A 2018-2025; RO32 2018-2024; SE11 2018-2025; SK01 2018-2025; UKI 2018-2025</p> <p>Negative: --</p>

Indicator	Outliers (Positive / Negative)
3.1.1 SMEs introducing product innovations	<p>Positive: DEB2 2021-2022; EL41 2025; EL43 2023-2025; EL52 2023-2024; EL54 2023-2024; EL62 2025; EL63 2023-2024; EL64 2023-2024; EL65 2023-2025; FI2 2021-2022; NO06 2021-2022; NO08 2021-2025; RS11 2021-2022</p> <p>Negative: ES63 2018-2025; RO11 2018-2020; RO12 2018-2020; RO21 2018-2020; RO22 2023-2025; RO31 2018-2025; RO32 2018-2020; RO41 2018-2025; RO42 2018-2025</p>
3.1.2 SMEs introducing business process innovations	<p>Positive: BE2 2023-2025; DEB1 2023-2025; EL30 2023-2024; EL41 2025; EL43 2023-2025; EL52 2023-2024; EL54 2023-2024; EL61 2023-2024; EL62 2025; EL63 2023-2024; EL65 2023-2024</p> <p>Negative: ES63 2021-2025; PL62 2018-2020; RO11 2023-2025; RO12 2018-2025; RO21 2021-2025; RO22 2021-2025; RO31 2018-2025; RO32 2018-2025; RO41 2018-2025; RO42 2018-2025</p>
3.2.1 Innovative SMEs collaborating with others	<p>Positive: BE1 2023-2024; BE2 2021-2025; EL41 2021-2022; EL43 2018-2020; EL63 2021-2022; FI19 2021-2024; FI1B 2021-2024; FI1C 2021-2022; FI1D 2023-2024; FI2 2025; NO02 2021-2025; NO06 2018-2025; NO07 2021-2025; NO08 2023-2025; NO09 2023-2025; NO0A 2021-2025; SE11 2025; SE12 2025; SE22 2025; SE23 2025; SE31 2025; SE32 2025; UKC 2018-2020; UKD 2018-2020; UKE 2018-2020; UKF 2018-2020; UKG 2018-2022; UKH 2018-2020; UKJ 2018-2022; UKK 2018-2020; UKL 2018-2020; UKM 2018-2020</p> <p>Negative: --</p>
3.2.2 Public-private co-publications	<p>Positive: CH01 2018-2025; CH03 2018-2025; CH04 2018-2025; DK01 2018-2025; NL11 2021-2025; NL35 2021-2025; NO06 2018-2025</p> <p>Negative: --</p>
3.3.1 PCT patent applications	<p>Positive: CH01 2023-2024; CH03 2018-2025; DE11 2018-2025; DE12 2023-2024; DE13 2022-2023; DE14 2019-2024; DE21 2018-2025; DE23 2018-2022; DE25 2018-2024; DEB3 2018-2024; DK05 2023-2025; FI19 2020-2021; FI1B 2018-2025; NL41 2018-2025; NL42 2018-2019; SE11 2018-2025; SE12 2018-2024; SE22 2018-2025; SE23 2020-2023</p> <p>Negative: --</p>
3.3.2 Trademark applications	<p>Positive: AT1 2022-2024; AT3 2022-2023; CH03 2021-2023; CH06 2018-2025; CH07 2018-2024; DE3 2022-2024; DE6 2023; DK01 2019-2021; ES23 2018-2020; ES52 2018-2023; FI1B 2018-2024; FI2 2018-2024; LT01 2022-2025; SE11 2018-2025; SE22 2022-2023</p> <p>Negative: --</p>
3.3.3 Design applications	<p>Positive: AT3 2018-2023; BG33 2018-2025; CH05 2018-2025; CH06 2018-2022; CZ03 2019-2020; DE11 2019-2020; DE21 2019; DE24 2018-2020; DE25 2020-2022; DE27 2018; DEA4 2018-2022; DEA5 2018-2021; DK04 2018-2024; ES52 2018-2019; FI2 2022-2024; ITH3 2018-2023; ITH4 2018-2020; ITH5 2025; ITI2 2018-2024; ITI3 2018-2025; NL41 2021-2024; PL21 2022-2023; PL41 2024-2025; PL72 2022; SE21 2018-2021</p> <p>Negative: --</p>

Indicator	Outliers (Positive / Negative)
4.1.1 Sales of new-to-market and new-to-firm innovations	Positive: CH05 2018-2025; EL43 2018-2025; EL53 2018-2020; EL54 2023-2024; EL62 2021-2022; EL64 2023-2024; ES13 2018-2020; ES41 2025; HR02 2025; IE04 2025; IE05 2023-2024; IE06 2023-2024; PT1A 2025; PT2 2021-2022; UKC 2018-2020; UKD 2018-2020; UKF 2018-2020; UKG 2018-2020; UKJ 2018-2020; UKK 2018-2020; UKL 2018-2020; UKM 2018-2020 Negative: --
4.1.2 Employment in innovative enterprises	Positive: -- Negative: ES63 2018-2025; ES64 2018-2025; RO11 2018-2025; RO12 2018-2025; RO21 2018-2025; RO22 2018-2025; RO31 2018-2025; RO32 2018-2025; RO41 2018-2025; RO42 2018-2025
4.2.1 Exports of medium and high technology products	Positive: -- Negative: EL41 2018-2025; EL42 2018-2025; EL43 2018-2025; EL51 2018-2025; EL52 2018-2023; EL53 2018-2025; EL54 2018-2025; EL61 2018; EL62 2018-2025; EL63 2018-2025; NO02 2018-2025; NO06 2018-2025; NO07 2018-2025; NO08 2018-2025; NO09 2018-2025; NO0A 2018-2025; PT2 2018-2023
4.3.2 Air emissions by fine particulates	Positive: BG31 2018-2019; BG32 2018; BG34 2018; BG41 2018-2021; BG42 2018-2020; CZ08 2018-2021; EL30 2020; EL41 2020; EL51 2018-2020; EL52 2018-2021; EL53 2018-2020; EL61 2020; EL64 2020; HR02 2019; HR05 2019-2021; HU11 2018; ITC1 2020; ITC4 2018-2020; ITH3 2018-2020; PL21 2018-2021; PL22 2018-2024; PL52 2018-2021; PL71 2018-2021; PL91 2018-2021; RO32 2018; RS11 2018-2024; RS12 2019-2021; RS21 2018-2023; RS22 2018-2023 Negative: --
4.3.3 Labour productivity	Positive: CH01 2018-2025; CH03 2018-2025; CH04 2018-2025; CH06 2022-2025; CH07 2018-2025; DK01 2019-2025; IE05 2018-2025; IE06 2018-2025; NO08 2018-2021 Negative: --

3.7. Step 7: Transforming data if data are highly skewed

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 regions show low performance levels, and a few regions 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. A square root transformation uses the square root of the indicator value instead of the original value.

For the following indicators, data have been transformed: *R&D expenditure in the business sector*, *Non-R&D innovation expenditures*, *Innovation expenditures per person employed*, *Public-private co-publications*, *PCT patent applications*, and *Design applications* (see more details in Table 9, where the skewness of these indicators is highlighted in bold).

Table 9: Skewness of the indicators before and after a possible data transformation

Indicator	Skewness	Skewness after transformation
1.1.2 Population with tertiary education	0.189	--
1.1.3 Population involved in lifelong learning	0.753	--
1.2.1 International scientific co-publications	0.986	--
1.2.2 Scientific publications among the top 10% most cited	-0.132	--
1.3.1 Broadband penetration	-0.528	--
2.1.1 R&D expenditure in the public sector	0.691	--
2.2.1 R&D expenditure in the business sector	1.009	0.086
2.2.2 Non-R&D innovation expenditures	2.017	0.637
2.2.3 Innovation expenditures per person employed	1.404	0.097
2.3.1 Cloud computing in enterprises	-0.172	--
2.3.2 Employed ICT specialists	0.914	--
3.1.1 SMEs introducing product innovations	-0.222	--
3.1.2 SMEs introducing business process innovations	-0.255	--
3.2.1 Innovative SMEs collaborating with others	0.507	--
3.2.2 Public-private co-publications	1.010	0.324
3.3.1 PCT patent applications	1.096	0.439
3.3.2 Trademark applications	0.672	--
3.3.3 Design applications	1.165	0.316
4.1.1 Sales of new-to-market and new-to-firm innovations	0.616	--
4.1.2 Employment in innovative enterprises	-0.604	--
4.2.1 Exports of medium and high technology products	-0.552	--
4.3.2 Air emissions by fine particulates	0.446	--
4.3.3 Labour productivity	0.250	--

3.8. Step 8: Determining Maximum and Minimum scores

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

3.9. Step 9: Calculating re-scaled scores

Re-scaled scores of the region 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.

3.10. Step 10: Calculating composite innovation indexes

For each year, a composite RII is calculated as the unweighted average of the re-scaled scores for all indicators, where all indicators receive the same weight (1/23 if data are available for all 23 indicators).

However, the RIS uses data for fewer indicators than EIS, 23 compared to 32 in the EIS. Moreover, the definitions of several indicators differ between the two, and regional data for some indicators are less up to date than the national level data used in the EIS. Consequently, the country level values of the RII and the Summary Innovation Index (SII) vary. Such differences between the EIS and RIS would be difficult to explain. To align the country level results between SII and RII, EIS-RIS alignment scores are applied to the RII. In this way, RII scores are adjusted to match SII scores as follows:

1. Calculate the EIS-RIS alignment score by dividing EIS Summary Innovation Index at country level by RIS Regional Innovation Index at country level: $EIS_index_CTR / RIS_index_CTR$. EIS-RIS alignment scores are provided in (Table 10).
2. Adjust regional RII scores by multiplying them with the corresponding country's EIS-RIS alignment score. EIS-RIS alignment scores affect only the overall RII values. The values of individual indicators remain unchanged.

Table 10: EIS-RIS alignment scores

	2018	2019	2020	2021	2022	2023	2024	2025
EU27	0.955	0.951	0.968	0.962	0.999	1.003	1.008	1.015
Austria	0.933	0.926	0.924	0.919	0.957	0.970	0.970	0.983
Belgium	0.989	0.981	0.983	0.981	1.012	0.988	0.994	0.985
Bulgaria	0.904	0.876	0.890	0.893	0.895	0.844	0.826	0.878
Croatia	0.895	0.887	0.884	0.896	0.922	0.978	0.939	0.964
Czechia	0.831	0.839	0.887	0.889	0.907	0.932	0.930	0.951
Denmark	1.022	1.027	1.019	1.007	1.033	1.033	1.050	1.001
Finland	0.899	0.910	0.906	0.901	0.922	0.945	0.939	0.958
France	1.089	1.081	1.085	1.091	1.114	1.088	1.096	1.109
Germany	0.976	0.975	0.983	0.979	0.999	1.011	1.013	1.036
Greece	0.924	0.921	0.947	0.898	0.917	0.875	0.897	0.893
Hungary	0.928	0.868	0.878	0.890	0.887	0.933	0.963	0.976
Ireland	1.007	1.022	0.988	1.006	1.006	1.000	1.029	1.106
Italy	0.925	0.918	0.936	0.922	0.956	0.936	0.930	0.923
Lithuania	0.878	0.881	0.891	0.909	0.916	0.941	0.948	0.946
Netherlands	0.992	1.031	1.038	1.054	1.081	1.082	1.093	1.060
Poland	0.926	0.935	0.951	0.950	0.964	0.941	0.917	0.939
Portugal	0.948	0.939	0.939	0.969	1.006	1.023	1.010	1.016
Romania	1.018	0.970	0.963	0.945	0.935	0.888	0.896	0.881
Slovakia	0.881	0.850	0.869	0.860	0.880	0.940	0.943	0.906

	2018	2019	2020	2021	2022	2023	2024	2025
Slovenia	0.974	0.963	0.964	0.918	0.948	0.945	0.943	0.949
Spain	1.081	1.083	1.109	1.076	1.089	1.071	1.055	1.071
Sweden	0.980	0.978	0.975	0.970	0.986	0.979	0.982	0.980
Norway	0.950	0.951	0.938	0.940	0.989	0.982	0.986	0.987
Switzerland	1.026	1.020	1.023	1.020	1.016	0.988	0.985	0.983
Serbia	0.729	0.730	0.761	0.689	0.677	0.829	0.827	0.823
United Kingdom	1.020	1.029	1.052	1.172	1.194	1.175	1.201	1.219

Only adjusted values of RII are used and presented across all RIS deliverables.

Higher than one EIS-RIS alignment score increases the RII of the region, while lower than one EIS-RIS alignment score decreases the RII of the region. Thus, due to correction factors, the RII of regions slightly changed. A visual comparison of the results for the four main performance groups is shown in Figure 2 and Figure 3, with the RIS 2025 results on the left and the results not using correction scores on the right. It shows that the performance groups of the following regions changed after applying the correction factor:

- Moved up performance group after applying the correction factor: DE14, DEA2, FR1, FRH, FRY, FRL, IE06, NL11, NL12, NL22, NL36, NL41, NL42, ES22, ES42, ES43, ES52, ES53, ES7, UKC, UKD, UKE, UKH, UKI, UKJ, UKK, UKL, UKN.
- Moved down performance group after applying the correction factor: FI19, EL41, EL51, EL61, HU11, ITC1, ITC2, ITC4, ITH1, ITH3, ITI1, ITI4, LT01, LT02, PL82, SK01, SE32, SE33, RS11.

Figure 2: RIS results after using EIS-RIS alignment scores

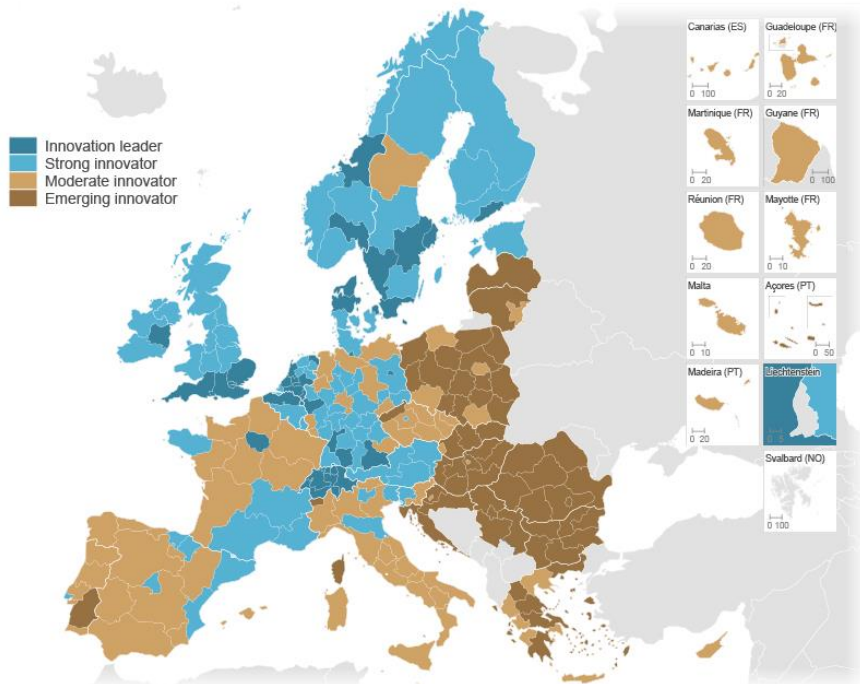
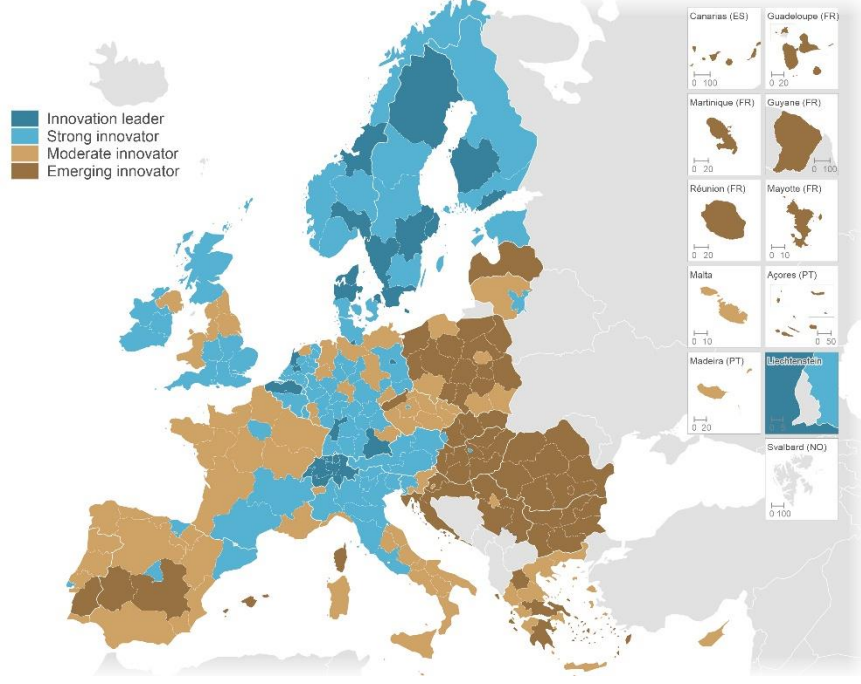


Figure 3: RIS without using EIS-RIS alignment scores



Notes: Administrative boundaries: © EuroGeographics © OpenStreetMapCartography. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the European Union.

This map uses the NUTS 2024 classification for all countries except the United Kingdom (UK). As the UK is no longer part of the NUTS system, the map applies the NUTS 2021 version for the UK, which corresponds to the International Territorial Levels (ITLs) currently used by the UK Office for National Statistics.

3.11. Step 11: Calculating relative to EU performance scores

Performance scores relative to the EU are calculated as the RII of the respective region divided by the RII of the EU, multiplied by 100. The same approach is used to calculate for the individual indicators re-scaled scores relative to the EU.

Relative performance scores are calculated for the full eight-year period compared to the performance of the EU in 2018 and for the latest year also to that of the EU in 2025. For the definition of the performance groups, only the performance scores relative to the EU in 2025 have been used.

Based on their RII scores relative to the EU in 2025, regions are categorised into four different groups, namely Innovation Leaders, Strong Innovators, Moderate Innovators, and Emerging Innovators. More specifically:

- **Innovation Leaders** where performance is above 125% of the EU average in 2025.
- **Strong Innovators** where performance is between 100% and 125% of the EU average in 2025.
- **Moderate Innovators** where performance falls within the range from 70% to 100% of the EU average in 2025, inclusive.
- **Emerging Innovators** where performance level is below 70% of the EU average in 2025.

To better show the diversity of regions, the four regional performance groups are broken down into 12 sub-groups. Three sub-groups are defined within each performance group by dividing the performance range in each group in three equal parts: the top one-third of regions (+), the middle one-third of regions, and the bottom one-third of regions (-). The thresholds for these groups are calculated by dividing the range in each performance group, i.e. the minimum possible value and the maximum possible value, into three equal parts. The maximum possible value in the Innovation Leader group is the value of the highest performing region³¹, while the lowest possible value in the Emerging Innovator group is the value of the lowest performing region³². The thresholds for the performance sub-groups in RIS 2025 are presented in Table 11.

Table 11: Defining performance sub-groups

Group	Top sub-group (+)	Middle sub-group	Bottom sub-group (-)
Innovation Leaders ³³	Innovation Leaders + Above 145.3% of EU average	Innovation Leaders Between 135.1% and 145.3% of EU average	Innovation Leaders - Between 125% and 135.1% of EU average
Strong Innovators	Strong Innovators + Between 116.7% and 125% of EU average	Strong Innovators Between 108.3% and 116.7% of EU average	Strong Innovators - Between 100% and 108.3% of EU average
Moderate Innovators	Moderate Innovators + Between 90% and 100% of EU average	Moderate Innovators Between 80% and 90% of EU average	Moderate Innovators - Between 70% and 80% of EU average

³¹ 155.40578

³² 22.67127

³³ The range for this group is 30.40578, calculated as 155.40578 – 125. Therefore, the groups are constructed using step sizes equal to one third of this range, which is 10.13526.

Group	Top sub-group (+)	Middle sub-group	Bottom sub-group (-)
Emerging Innovators ³⁴	Emerging Innovators + Between 54.2% and 70% of EU average	Emerging Innovators Between 38.4% and 54.2% of EU average	Emerging Innovators – Below 38.4% of EU average

4. Structural indicators

The RIS uses a set of contextual (structural) indicators to help users understand the structural differences between regions, which can explain variations in performance across the innovation indicators used in the main measurement framework. These structural indicators are provided in the regional profiles and online tool. The following sections present these indicators, explain their relevance for understanding regional differences, and provide detailed information about each structural indicator.

4.1. Selected indicators to measure regional structural differences

The list of structural indicators used in the RIS, the years for which average performance has been calculated, and the data sources used are shown in Table 12. The text below the table discusses the relevance and possible interpretation of these indicators.

Table 12: Structural indicators used in the RIS

Indicator	Years used in calculations	Source
Employment share in Agriculture & Mining (A-B)	2022-2024	Eurostat
Employment share in Manufacturing (C)	2022-2024	Eurostat
Employment share in Utilities & Construction (D-F)	2022-2024	Eurostat
Employment share in Services (G–N)	2022-2024	Eurostat
Employment share in Public administration (O-U)	2022-2024	Eurostat
Average number of employed persons per enterprise	2021-2022	Eurostat
GDP per capita (PPS)	2023	Eurostat
GDP per capita growth (PPS)	2019-2023	Eurostat
Population density	2023	Eurostat
Urbanisation	2024	Eurostat
Population size (000s)	2024	Eurostat

The employment share across different sectors reflects the structural characteristics of a region's economy, providing insight into its sectoral composition and development trajectory. For example, a higher share in manufacturing (C) may positively influence regional performance on innovation indicators such as *R&D expenditure in the business sector*, PCT patent

³⁴ The range for this group is 47.32873, calculated as 70 – 22.67127. Therefore, the groups are constructed using step sizes equal to one third of this range, which is 15.776243333333333.

applications, and the prevalence of innovative enterprises. Conversely, regions with a high concentration of public sector employment (O-U) often reflect structural tendencies such as a strong presence of government institutions or a reliance on public services. This can be associated with lower levels of private sector innovation activity, which in turn may impact outcomes on some indicators used in the RIS.

Average number of employed persons per enterprise provides insight into the structural composition of the business landscape, indicating whether a region is dominated by micro-enterprises, SMEs, or larger firms. Regions with larger average firm sizes may benefit from greater internal capacity for R&D and innovation activities, while those with smaller enterprises may demonstrate high entrepreneurial activity but face resource limitations that can impact innovation outcomes.

Nominal Gross Domestic Product per capita is a measure for interpreting real income differences between regions. Higher income can increase the demand for new innovative goods and services.

GDP per capita growth (PPS) measures economic growth. In economies that grow faster, increasing demand may provide more favourable conditions for enterprises to sell their goods and services.

Population density is measured by inhabitants per km². Densely populated areas are often more innovative due to easier knowledge diffusion, concentration of government and educational services, better training opportunities, and higher shares of highly educated workers.

Degree of urbanisation captures the spatial distribution of the population across different settlement types within a region. This indicator could help explain regional disparities in innovation performance. Urban and intermediate areas typically offer more favourable enabling conditions for innovation, such as better access to infrastructure, skilled labour, research institutions, and innovation networks. In contrast, rural regions may face structural limitations in these areas.

Population size is measured by the population in the region on 1 January of 2024. Larger population size can stimulate regional markets, creating greater demand for goods and services. This may enhance the business environment and support the scale-up of innovative activities, particularly in growing urban regions.

4.2. Definitions of structural indicators

This section provides the definition, data source, and data availability for each of the structural indicators used in regional profiles and the online tool complementing the RIS 2025. For data from Eurostat, the code used by Eurostat is also provided.

Employment share in Agriculture & Mining (A-B), 2022-2024 average

Numerator	Employment in Agriculture & Mining (NACE Rev. 2 A-B)
Denominator	Total employment
Calculated as	Average percentage share for the years 2022 to 2024, even in cases where data for some years is missing (NAs are ignored in the calculation)
Data source	Eurostat [htec_emp_reg2]
Data availability	NUTS 2: 2008-2024

Employment share in Manufacturing (C), 2022-2024 average

Numerator	Employment in Manufacturing (NACE Rev. 2 C)
Denominator	Total employment
Calculated as	Average percentage share for the years 2022 to 2024, even in cases where data for some years is missing (NAs are ignored in the calculation)

Data source	Eurostat [htec_emp_reg2]
Data availability	NUTS 2: 2008-2024

Employment share in Utilities and Construction (D-F), 2022-2024 average

Numerator	Employment in Utilities and Construction (NACE Rev. 2 D-F)
Denominator	Total employment
Calculated as	Average percentage share for the years 2022 to 2024, even in cases where data for some years is missing (NAs are ignored in the calculation)
Data source	Eurostat [htec_emp_reg2]
Data availability	NUTS 2: 2008-2024

Employment share in Services (G-N), 2022-2024 average

Numerator	Employment in Services (NACE Rev. 2 G-N)
Denominator	Total employment
Calculated as	Average percentage share for the years 2022 to 2024, even in cases where data for some years is missing (NAs are ignored in the calculation). Employment in Services (NACE Rev. 2 G-N) is calculated as the difference between the employment share in total services (NACE Rev. 2 G-U) and public administration; activities of extraterritorial organisations and bodies (NACE Rev. 2 O-U).
Data source	Eurostat [htec_emp_reg2]
Data availability	NUTS 2: 2008-2024

Employment share in Public administration (O-U), 2022-2024 average

Numerator	Employment in Public administration (NACE Rev. 2 O-U)
Denominator	Total employment
Calculated as	Average percentage share for the years 2022 to 2024, even in cases where data for some years is missing (NAs are ignored in the calculation).
Data source	Eurostat [htec_emp_reg2]
Data availability	NUTS 2: 2008-2024

Average number of employed persons per enterprise, 2021-2022 average

Numerator	Total number of persons employed
Denominator	Total number of enterprises
Calculated as	Average percentage share for the years 2021 and 2022. If data is missing for one year, the available year's value is used (NAs are ignored in the calculation).
Data source	For countries and regions: Eurostat [bd_size_r]. For EU27 average: Eurostat [bd_size]
Data availability	NUTS 3: 2021-2022

GDP per capita (PPS), 2023

Indicator	Nominal Gross Domestic Product per capita
Unit	Purchasing power standard (PPS, EU27 from 2020), per inhabitant
Data source	Eurostat [nama_10r_2gdp]
Data availability	NUTS 2: 2000-2023

GDP per capita growth (PPS), 2019-2023

Indicator	Nominal Gross Domestic Product per capita
Unit	Purchasing power standard (PPS, EU27 from 2020), per inhabitant
Calculated as	Compound annual growth rate (CAGR) between 2019 and 2023: $CAGR = (GDP \text{ per capita in } 2023 / GDP \text{ per capita in } 2019)^{(1/4)} - 1$

Data source	Eurostat [nama_10r_2gdp]
Data availability	NUTS 2: 2000-2023

Population density, 2023

Indicator	Population density (persons per square kilometre)
Data source	Eurostat [demo_r_d3dens]
Data availability	NUTS 3: 1990-2023

Degree of urbanisation (%), 2024

Numerator	Households living in densely populated areas and intermediate density areas
Denominator	Total population
Calculated as	Combined share of population living in cities (DEG1 – densely populated areas) and towns/suburbs (DEG2 – intermediate density areas) out of the total population (TOTAL) in 2024: $Urbanisation = (DEG1 + DEG2) / TOTAL \times 100$. If data is missing for any of the categories (DEG1, DEG2, TOTAL), the indicator is not calculated.
Data source	Eurostat [lfst_r_lfsd2hh]
Data availability	NUTS 2: 2006-2024

Population size (thousands), 2024

Indicator	Population on 1 January (divided by 1000)
Data source	Eurostat [demo_r_d2jan]
Data availability	NUTS 2: 1990-2024

Annex A: A Manual for extracting and compiling RIS data

This Annex describes how raw data have been collected for each indicator.

For data from Eurostat, the variable names are added between []. These can be used in the search box on Eurostat's website (<https://ec.europa.eu/eurostat/web/main/home>) to access the data.

Data from the OECD are available at: <https://data-explorer.oecd.org/>

1.1.2 Percentage population aged 25-34 having completed tertiary education

Data for all regions are extracted from Eurostat:

- Dataset: Population by educational attainment level, sex and NUTS 2 regions (%) [edat_lfse_04]
 - AGE: From 25 to 34 years
 - ISCED11: Tertiary education (levels 5-8)
 - SEX: Total
 - UNIT: Percentage
- Data are available for 2000-2024

1.1.3 Percentage population aged 25-64 participating in lifelong learning

Data for all regions are extracted from Eurostat:

- Dataset: Participation rate in education and training (last 4 weeks) by NUTS 2 regions [trng_lfse_04]
 - AGE: From 25 to 64 years
 - SEX: Total
 - UNIT: Percentage
- Data are available for 2000-2024

1.2.1 International scientific co-publications per million population

Numerator

Data on number of international scientific co-publications for all regions are calculated and made available by Science-Metrix for the years 2000-2024. Data have been calculated using full counting and have been extracted from Scopus. As there is no EU27 value provided in the regional dataset for the numerator, it has been calculated by summing the EU27 MS values.

Denominator

Population data for all regions are extracted from Eurostat:

- Dataset: Population on 1 January by age, sex and NUTS 2 region [demo_r_d2jan]
 - AGE: Total
 - SEX: Total
 - UNIT: Number
- Data are available for 1990-2024

Population data from 2020 onwards for the United Kingdom are extracted from the Office for National Statistics:

- Dataset: United Kingdom population mid-year estimate [UKPOP]
- This data was used to calculate population growth rate. The growth rate was used to impute data at the national level. For the regional level, share of the latest available year region population in the national population were used to calculate region population for data gaps.

Calculation of indicator

The indicator is calculated by dividing the number of international scientific co-publications by the population size in millions.

1.2.2 Scientific publications among the top-10% most cited publications worldwide

Data on the percentage share of publications among the top 10% most cited publications for all regions are calculated and made available by Science-Metrix for the years 2000-2022. Data have been calculated using fractional counting and have been extracted from Scopus.

As there is no EU27 value provided in the regional dataset for this indicator, it has been taken from the country-level dataset used in the EIS.

1.3.1 Broadband penetration

Data for all regions are extracted from Eurostat:

- Dataset: Households with broadband access [isoc_r_broad_h]
 - UNIT: Percentage of households
- Data are available for 2006-2021

As there is no EU27 value provided in the regional dataset, it has been extracted from country-level dataset:

- Dataset: Households - type of connection to the internet (2003-2021) [isoc_ci_it_h]
 - INDIC_IS: Household internet connection type: broadband
 - HHTYP: Total
 - UNIT: Percentage of households
- EU27 data are available for 2007-2021

2.1.1 R&D expenditures in the public sector as percentage of GDP

Data for all regions are extracted from Eurostat:

- Dataset: GERD by sector of performance and NUTS 2 regions [rd_e_gerdreg]
 - SECTPERF: Government sector; Higher education sector
 - UNIT: Percentage of gross domestic product (GDP)
- The indicator is calculated as the sum of the share of R&D expenditure by the government as a percentage of GDP and of the share of R&D expenditure by the higher education sector as a percentage of GDP.
- Data are available for 2000-2023

2.2.1 R&D expenditures in the business sector as percentage of GDP

Data for all regions are extracted from Eurostat:

- Dataset: GERD by sector of performance and NUTS 2 regions [rd_e_gerdreg]
 - SECTPERF: Business enterprise sector
 - UNIT: Percentage of gross domestic product (GDP)
- Data are available for 2000-2023

2.2.2 Non-R&D innovation expenditures in SMEs as percentage of turnover

Data for 2022 for all regions are extracted from Eurostat (Community Innovation Survey CIS 2022):

- **Numerator:** Innovation active enterprises' expenditure on R&D and innovation by type and NUTS region (CIS2022) [inn_cis13_exp_r]
 - EXPEND: Expenditure on innovation (excluding R&D)
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Thousand euro
- **Denominator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Total
 - INDIC_INN: Net turnover
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Thousand euro
- The indicator is **calculated** by dividing the data for the numerator by the data for the denominator and multiplying by 100.
- The EU27 aggregate is **calculated** using only data for those Member States for which both numerator and denominator data are available.

Regional CIS data for 2014, 2016, 2018, and 2020 are not directly available from Eurostat and have been collected from the National Statistical Offices (NSOs) in several data requests: a request for regional CIS 2014 data for the RIS 2017, a request for regional CIS 2016 data for the RIS 2019, a request for regional CIS 2018 data for the RIS 2021, and a request for regional CIS 2020 data for the RIS 2023. Regional CIS data are made available by NSOs on a

confidential basis and are only to be used for constructing the RIS reports. None of the data used for the RIS 2023 can therefore be shared.

2.2.3 Innovation expenditure per person employed

Data for 2022 for all regions are extracted from Eurostat (Community Innovation Survey CIS 2022):

- **Numerator:** Innovation active enterprises' expenditure on R&D and innovation by type and NUTS region (CIS2022) [inn_cis13_exp_r]
 - EXPEND: Expenditure on innovation (including R&D)
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Thousand euro
- **Denominator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Total
 - INDIC_INN: Employees
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number
- The indicator is **calculated** by dividing the data for the numerator by the data for the denominator and multiplying by 1000.
- The EU27 aggregate is calculated using only data for those Member States for which both numerator and denominator data are available.

Regional CIS data for 2014, 2016, 2018, and 2020 are not directly available from Eurostat and have been collected from the National Statistical Offices (NSOs) in several data requests: a request for regional CIS 2014 data for the RIS 2017, a request for regional CIS 2016 data for the RIS 2019, a request for regional CIS 2018 data for the RIS 2021, and a request for regional CIS 2020 data for the RIS 2023. Regional CIS data are made available by NSOs on a confidential basis and are only to be used for constructing the RIS reports. None of the data used for the RIS 2023 can therefore be shared.

2.3.1 Cloud computing in enterprises

Data for all regions are extracted from Eurostat:

- Dataset: Cloud computing services by NACE Rev. 2 activity and NUTS 2 region [isoc_r_cicce_usen2]
 - INDIC_IS: Buy cloud computing services used over the internet
 - SIZE_EMP: 10 persons employed or more
 - NACE_R2: All activities (except agriculture, forestry and fishing, and mining and quarrying), without financial sector
 - UNIT: Percentage of enterprises
- Data are available for 2023

2.3.2 ICT specialists (as a percentage of total employment)

Regional and country share of Employment in information and communication (NACE J)

Data for both regional and country share are extracted from Eurostat:

- Dataset: Employment by sex, age, economic activity and NUTS 2 regions (NACE Rev. 2) (1 000) [lfst_r_lfe2en2]
 - AGE: From 25 to 64 years
 - SEX: Total
 - NACE_R2: Total - all NACE activities; Information and communication
 - UNIT: Thousand persons
- Data are available for 2008-2024.

Both regional and country shares are calculated by dividing persons employed in Information and communication (J) by persons employed in total (Total - all NACE activities).

National share of ICT specialists in total employment

Data are extracted from Eurostat:

- Dataset: Employed ICT specialists - total [isoc_sks_itspt]:
 - UNIT: Percentage of total employment
- Data are available for 2004-2024.

Calculation of indicator

Employed ICT specialists at regional level is calculated by first determining the share of employment in the information and communication sector (NACE J) at both regional and national levels. The regional share is then divided by the national share to obtain a relative score. This relative score is multiplied by the national share of ICT specialists in total employment, resulting in an estimated share of employed ICT specialists at the regional level.

- $\text{Employed ICT specialists} = \text{Regional share of Employment in information and communication (NACE J)} / \text{Country share of Employment in information and communication (NACE J)} * \text{Country share of employed ICT specialists}$

3.1.1 SMEs introducing product innovations as percentage of SMEs

Data for 2022 for all regions are extracted from Eurostat (Community Innovation Survey CIS 2022):

- **Numerator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Enterprises with product innovation (regardless of business process innovation)
 - INDIC_INN: Enterprises
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number

- **Denominator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Total
 - INDIC_INN: Enterprises
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number
- The indicator is **calculated** by dividing the data for the numerator by the data for the denominator and multiplying by 100.
- The EU27 aggregate is calculated using only data for those Member States for which both numerator and denominator data are available.

Regional CIS data for 2014, 2016, 2018, and 2020 are not directly available from Eurostat and have been collected from the National Statistical Offices (NSOs) in several data requests: a request for regional CIS 2014 data for the RIS 2017, a request for regional CIS 2016 data for the RIS 2019, a request for regional CIS 2018 data for the RIS 2021, and a request for regional CIS 2020 data for the RIS 2023. Regional CIS data are made available by NSOs on a confidential basis and are only to be used for constructing the RIS reports. None of the data used for the RIS 2023 can therefore be shared.

3.1.2 SMEs introducing business process innovations as percentage of SMEs

Data for 2022 for all regions are extracted from Eurostat (Community Innovation Survey CIS 2022):

- **Numerator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Enterprises with business process innovation (regardless of product innovation)
 - INDIC_INN: Enterprises
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number
- **Denominator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Total
 - INDIC_INN: Enterprises
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number
- The indicator is **calculated** by dividing the data for the numerator by the data for the denominator and multiplying by 100.

- The EU27 aggregate is calculated using only data for those Member States for which both numerator and denominator data are available.

Regional CIS data for 2014, 2016, 2018, and 2020 are not directly available from Eurostat and have been collected from the National Statistical Offices (NSOs) in several data requests: a request for regional CIS 2014 data for the RIS 2017, a request for regional CIS 2016 data for the RIS 2019, a request for regional CIS 2018 data for the RIS 2021, and a request for regional CIS 2020 data for the RIS 2023. Regional CIS data are made available by NSOs on a confidential basis and are only to be used for constructing the RIS reports. None of the data used for the RIS 2023 can therefore be shared.

3.2.1 Innovative SMEs collaborating with others as percentage of SMEs

Data for 2022 for all regions are extracted from Eurostat (Community Innovation Survey CIS 2022):

- **Numerator:** Enterprises that co-operated on innovation activities with other entities by NUTS region (CIS2022) [inn_cis13_co_r]
 - ENTERPR: Innovation active enterprises
 - INN_ACT: Research and development (R&D) or other innovation activities
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number
- **Denominator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Total
 - INDIC_INN: Enterprises
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number
- The indicator is **calculated** by dividing the data for the numerator by the data for the denominator and multiplying by 100.
- The EU27 aggregate is calculated using only data for those Member States for which both numerator and denominator data are available.

Regional CIS data for 2014, 2016, 2018, and 2020 are not directly available from Eurostat and have been collected from the National Statistical Offices (NSOs) in several data requests: a request for regional CIS 2014 data for the RIS 2017, a request for regional CIS 2016 data for the RIS 2019, a request for regional CIS 2018 data for the RIS 2021, and a request for regional CIS 2020 data for the RIS 2023. Regional CIS data are made available by NSOs on a confidential basis and are only to be used for constructing the RIS reports. None of the data used for the RIS 2023 can therefore be shared.

3.2.2 Public-private co-publications per million population

Numerator

Data on number of public-private co-publications for all regions are calculated and made available by Science-Metrix for the years 2000-2024. Data have been calculated using full counting and have been extracted from Scopus. As there is no EU27 value provided in the regional dataset for the numerator, it has been calculated by summing the EU27 MS values.

Denominator

Population data for all regions are extracted from Eurostat:

- Dataset: Population on 1 January by age, sex and NUTS 2 region [demo_r_d2jan]
 - AGE: Total
 - SEX: Total
 - UNIT: Number
- Data are available for 1990-2024

Population data from 2020 onwards for the United Kingdom are extracted from the Office for National Statistics:

- Dataset: United Kingdom population mid-year estimate [UKPOP]
- This data was used to calculate population growth rate. The growth rate was used to impute data at the national level. For the regional level, share of the latest available year region population in the national population were used to calculate region population for data gaps.

Calculation of indicator

The indicator is calculated by dividing the number of international scientific co-publications by the population size in millions.

3.3.1 PCT patent applications per billion GDP (in PPS)

Numerator

Data on number of PCT patent applications filed under the Patent Co-operation Treaty (by year of filing) are extracted from the OECD REGPAT database. Instructions how to access the data tend to change and can be found in the link provided in a footnote³⁵.

Once the data is accessed, two files should be downloaded:

- 202505_PCT_Inv_reg.txt – file containing list of PCT inventors
- 202505_PCT_IPC.txt – file containing list of IPC classes and selected dates

After downloading the datasets, the following steps should be followed:

- Information from these two datasets should be merged using the common key 'pct_nbr' (PCT Publication Number). Before merging the data, it should be noted that country codes differ between NUTS and these two datasets for two countries of interest: UK (GB in REGPAT) and EL (GR in REGPAT).

³⁵ More information and how to get access to this database is available at: <https://www.oecd.org/en/data/datasets/intellectual-property-statistics.html>

- Then regional patent share for each record should be calculated by multiplying 'reg_share' (multiple allocation to a region) by 'inv_share' (inventor's share). This approach accounts for both the geographical distribution and contribution of inventors, avoiding double-counting when patents span multiple regions.
- The count of patents per region is obtained by summing the regional patent share across all records grouped by 'Reg_code' (NUTS3/TL3 region code). This provides the total weighted patent count per region.
- As there is no EU27 value provided in the regional dataset for the numerator, it has been calculated by summing the EU27 MS values.
- Data are available for 1977-2022

Denominator

Data on Gross Domestic Product (GDP) are extracted from Eurostat:

- Dataset: Gross domestic product (GDP) at current market prices by NUTS 2 regions [nama_10r_2gd]
 - UNIT: Million purchasing power standards (PPS, EU27 from 2020)
- Data are available for 2000-2023

For Switzerland and the United Kingdom GDP missing data are imputed using data from the OECD. Data should be accessed from OECD Data Explorer.

- Indicator: Gross domestic product – Regions (DSD_REG_ECO@DF_GDP)
- Frequency of observation: Annual
- Combined measure: Gross domestic product
- Combined unit of measure: US dollars, PPP converted, Millions, Current prices

USD values are converted into EUR using a single average exchange rate. This rate is calculated by first deriving country-specific rates: dividing the Eurostat EUR value by the OECD USD value for each country where both are available. Then averaging these derived rates across all such countries to get a single average exchange rate. This rate is then used to convert values from USD to EUR in Switzerland and the United Kingdom.

Calculation of indicator

The indicator is calculated by dividing the number of PCT patent applications by GDP in PPPs and multiplying by 1000. The indicator is calculated for each region as a 2-year rolling average. Prior to calculation of the rolling average, missing values are imputed (replacing with the last available value first, then the next available value).

3.3.2 Trademark applications per billion GDP (in PPS)

Numerator

Data on number of trademark applications for all regions are calculated and made available by Fraunhofer-ISI for the years 2000-2024. Data have been calculated using data from the European Union Intellectual Property Office (EUIPO). As there is no EU27 value provided in the regional dataset for the numerator, it has been calculated by summing the EU27 MS values.

Denominator

Data on Gross Domestic Product (GDP) are extracted from Eurostat:

- Dataset: Gross domestic product (GDP) at current market prices by NUTS 2 regions [nama_10r_2gd]
 - UNIT: Million purchasing power standards (PPS, EU27 from 2020)
- Data are available for 2000-2023

For Switzerland and the United Kingdom GDP missing data are imputed using data from the OECD. Data should be accessed from OECD Data Explorer.

- Indicator: Gross domestic product – Regions (DSD_REG_ECO@DF_GDP)
- Frequency of observation: Annual
- Combined measure: Gross domestic product
- Combined unit of measure: US dollars, PPP converted, Millions, Current prices

Data in USD are converted into EUR based on the conversion rate calculated using Eurostat and OECD data in other countries.

Calculation of indicator

The indicator is calculated by dividing the number of trademark applications by GDP in PPPs and multiplying by 1000. The indicator is calculated for each region as a 2-year rolling average. Prior to calculation of the rolling average, missing values are imputed (replacing with the last available value first, then the next available value).

3.3.3 Design applications per billion GDP (in PPS)

Numerator

Data on number of design applications for all regions are calculated and made available by Fraunhofer-ISI for the years 2000-2024. Data have been calculated using data from the European Union Intellectual Property Office (EUIPO). As there is no EU27 value provided in the regional dataset for the numerator, it has been calculated by summing the EU27 MS values.

Denominator

Data on Gross Domestic Product (GDP) are extracted from Eurostat:

- Dataset: Gross domestic product (GDP) at current market prices by NUTS 2 regions [nama_10r_2gd]
 - UNIT: Million purchasing power standards (PPS, EU27 from 2020)
- Data are available for 2000-2023

For Switzerland and the United Kingdom GDP missing data are imputed using data from the OECD. Data should be accessed from OECD Data Explorer.

- Indicator: Gross domestic product – Regions (DSD_REG_ECO@DF_GDP)
- Frequency of observation: Annual
- Combined measure: Gross domestic product
- Combined unit of measure: US dollars, PPP converted, Millions, Current prices

Data in USD are converted into EUR based on the conversion rate calculated using Eurostat and OECD data in other countries.

Calculation of indicator

The indicator is calculated by dividing the number of design applications by GDP in PPPs and multiplying by 1000. The indicator is calculated for each region as a 2-year rolling average. Prior to calculation of the rolling average, missing values are imputed (replacing with the last available value first, then the next available value).

4.1.1 Sales of new-to-market and new-to-firm innovations in SMEs as percentage of turnover

Data for 2022 for all regions are extracted from Eurostat (Community Innovation Survey CIS 2022):

- **Numerator:** Turnover from new or significantly improved products by NUTS region (CIS2022) [inn_cis13_prodt_r]
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - INNOVAT: Variable is a sum of
 - New or significantly improved products that were new to the firm
 - New or significantly improved products that were new to the market
 - UNIT: Thousand euro
- **Denominator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Total
 - INDIC_INN: Net turnover
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Thousand euro
- The indicator is **calculated** by dividing the data for the numerator by the data for the denominator and multiplying by 100.
- The EU27 aggregate is calculated using only data for those Member States for which both numerator and denominator data are available.

Regional CIS data for 2014, 2016, 2018, and 2020 are not directly available from Eurostat and have been collected from the National Statistical Offices (NSOs) in several data requests: a request for regional CIS 2014 data for the RIS 2017, a request for regional CIS 2016 data for the RIS 2019, a request for regional CIS 2018 data for the RIS 2021, and a request for regional CIS 2020 data for the RIS 2023. Regional CIS data are made available by NSOs on a confidential basis and are only to be used for constructing the RIS reports. None of the data used for the RIS 2023 can therefore be shared.

4.1.2 Employment in innovative enterprises

Data for 2022 for all regions are extracted from Eurostat (Community Innovation Survey CIS 2022):

- **Numerator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]

- ENTERPR: Innovation active enterprises
- INDIC_INN: Employees
- SIZECLAS: From 10 to 249 employees
- NACE_R2: Economic activities covered by CIS regulation
- UNIT: Number
- **Denominator:** Enterprises, employed persons and turnover by innovation status and NUTS region (CIS2022) [inn_cis13_bas_r]
 - ENTERPR: Total
 - INDIC_INN: Employees
 - SIZECLAS: From 10 to 249 employees
 - NACE_R2: Economic activities covered by CIS regulation
 - UNIT: Number
- The indicator is **calculated** by dividing the data for the numerator by the data for the denominator and multiplying by 100.
- The EU27 aggregate is calculated using only data for those Member States for which both numerator and denominator data are available.

Regional CIS data for 2014, 2016, 2018, and 2020 are not directly available from Eurostat and have been collected from the National Statistical Offices (NSOs) in several data requests: a request for regional CIS 2014 data for the RIS 2017, a request for regional CIS 2016 data for the RIS 2019, a request for regional CIS 2018 data for the RIS 2021, and a request for regional CIS 2020 data for the RIS 2023. Regional CIS data are made available by NSOs on a confidential basis and are only to be used for constructing the RIS reports. None of the data used for the RIS 2023 can therefore be shared.

4.2.1 Exports of medium and high technology products

Data on medium and high-tech exports and total product exports for all regions are extracted from FIGARO regional dataset³⁶. Data in this database are available for 2017 only.

For the country level data, dataset from European Innovation Scoreboard is used with data on exports of medium and high technology products and total exports. Data in this database are available for 2010-2024.

The regional value for this indicator is calculated using the following steps:

1. Removing intra-country exports: exclude rows where the first two letters of COUNTERPARTREG match those of 'REFREG' (e.g., both start with "AT").
2. Calculating exports for each region and country for medium and high technology products and in total. This is calculated by aggregating variable 'OBSVALUE' by 'REFREG' of regions and countries of interest.

NACE sectors are filtered for column 'ROWII'. Given that NACE aggregation is only available at a high level, the following is considered medium and high technology products: NACE B-E. Thus, the calculations include the following sectors that are not

³⁶ Dataset: Lopez Alvarez, Jorge; Galiano Bastarrica, Luis Antonio; Rueda-Cantuche, José Manuel (2017): FIGARO-REG 2017 10 sectors. European Commission, Joint Research Centre (JRC) [Dataset] PID: <http://data.europa.eu/89h/dff29c8d-b85b-41fa-9cb7-7289c7324937>

considered as medium and high technology sector by Eurostat³⁷: B Mining and quarrying, C10 Manufacture of food products, C11 Manufacture of beverages, C12 Manufacture of tobacco products, C13 Manufacture of textiles, C14 Manufacture of wearing apparel, C15 Manufacture of leather and related products, C16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, C17 Manufacture of paper and paper products, C18 Printing and reproduction of recorded media, C19 Manufacture of coke and refined petroleum products, C22 Manufacture of rubber and plastic products, C23 Manufacture of other non-metallic mineral products, C24 Manufacture of basic metals, C25 Manufacture of fabricated metal products, except machinery and equipment, C31 Manufacture of furniture, C32 Other manufacturing, C33 Repair and installation of machinery and equipment, D Electricity, gas, steam and air conditioning supply, E Water supply; sewerage, waste management and remediation activities.

3. Calculate ratio between exports at region and country level for each region separately for:

- Total export
- Export in Medium and high technology sector (MHT)

$$Ratio = \frac{Exports\ in\ EUR_{regional}}{Exports\ in\ EUR_{country}}$$

4. Use the ratios calculated in the Step 3 to approximate exports at regional level based on country level data from EIS at a given year:

- Total export at the regional level = total export at the country level * ratio_{total}
- Medium and high technology sector export at the regional level = Medium and high technology sector export at the country level * ratio_{MHT}

5. Calculate regional value for *Exports of medium and high technology products* using regional level export data calculated at the Step 4 above:

$$Indicator = \frac{Medium\ and\ high\ technology\ sector\ export_{regional}}{Total\ export_{regional}}$$

4.3.2 Air emissions by fine particulate matter (PM2.5) in the manufacturing sector

Data for the indicator is extracted from European Environment Agency dataset Burden of disease of air pollution (Countries, NUTS regions and cities), tabular data (2005-2022)³⁸. Dataset 'Burden of disease of air pollution (Countries & NUTS)' should be selected. While downloading the data, the following filters should be applied:

- Scenario: WHO 2021 AQG (336804)
- Spatial Unit Detail: All
- NUTS Name: All
- Degree Of Urbanisation: All Areas (incl. unclassified)
- Year: 2005-2022
- Air Pollutant: PM2.5

³⁷ https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:High-tech_classification_of_manufacturing_industries

³⁸ <https://www.eea.europa.eu/en/datahub/datahubitem-view/49930245-dc33-4c47-93b8-9512f0622ebc?activeAccordion=>

- Data Aggregation id: All
- Category: All
- Health Indicator: All
- Sex: Total

After the data is downloaded, the values for relevant regions of the column 'Air Pollution Population Weighted Average [ug/m3]' should be taken. This column already has a final value for the indicator. No additional calculations are needed.

4.3.3 Labour productivity

Data for all regions are extracted from ARDECO (Annual Regional Database of the European Commission):

- Dataset: Real labour productivity per hour worked [SOVGDH]
 - AGE: From 25 to 34 years
 - ISCED11: Tertiary education (levels 5-8)
 - UNIT: EUR2020
- Data are available for 1980-2026

Annex B: Report of a statistical audit of RIS done by JRC – COIN team

Statistical audits by JRC - COIN

The European Commission's Competence Centre on Composite Indicators and Scoreboards (COIN) at the Joint Research Centre (JRC) in Ispra has been invited to audit the Regional Innovation Scoreboard (RIS). The JRC audit focuses on the statistical soundness of the structure of the RIS as well as the impact of key modelling assumptions on the results. The independent statistical assessment of the RIS provided by the JRC-COIN guarantees the transparency and reliability of the index for both policymakers and other stakeholders, thus facilitating more accurate priority setting and policy formulation in the field of competitiveness and attractiveness.

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Data quality and treatment

The audit confirmed that the quality, outlier treatment, and normalisation of RIS data align with COIN recommendations or are supported by well-reasoned and robust alternative approaches. The COIN team investigated the potential impact of the presence of outliers on the index, as the RIS criteria differ from those recommended by COIN.

The JRC guidelines are governed by the principle of least intervention, aiming to make the fullest possible use of the available data while remaining flexible enough to accommodate a wide range of scenarios. The JRC recommends an approach for outlier identification based on skewness and kurtosis values, i.e., an absolute skewness higher than 2.0 and kurtosis higher than 3.5.

The current RIS criteria for flagging variables for outlier treatment differ from those put forward by the JRC. Specifically, the current RIS framework flags variables with a skewness value greater than or equal to one, applying a strict criterion that may result in smoothing the distribution and reducing the information available. This criterion also ignores the possibility of highly negatively skewed distributions, although such distributions are not present in the current RIS dataset. Furthermore, not considering kurtosis under the current RIS outlier identification can potentially ignore highly leptokurtic distributions. These distributions contain many outlying observations that skewness alone may fail to detect.

The COIN team investigated whether any indicators would still be flagged as outliers using the JRC criteria after applying the RIS outlier treatment process. Of the five variables treated with a square root transformation, only one - *2.2.2 Non-R&D innovation expenditures*- would require further treatment if the JRC criterion were used. Nevertheless, the JRC recommends adopting a combined threshold of 2.0 for absolute skewness and 3.5 for kurtosis as treatment criteria, as these criteria are more comprehensive and will serve any future iterations of the RIS framework, in which new variables may present new challenges.

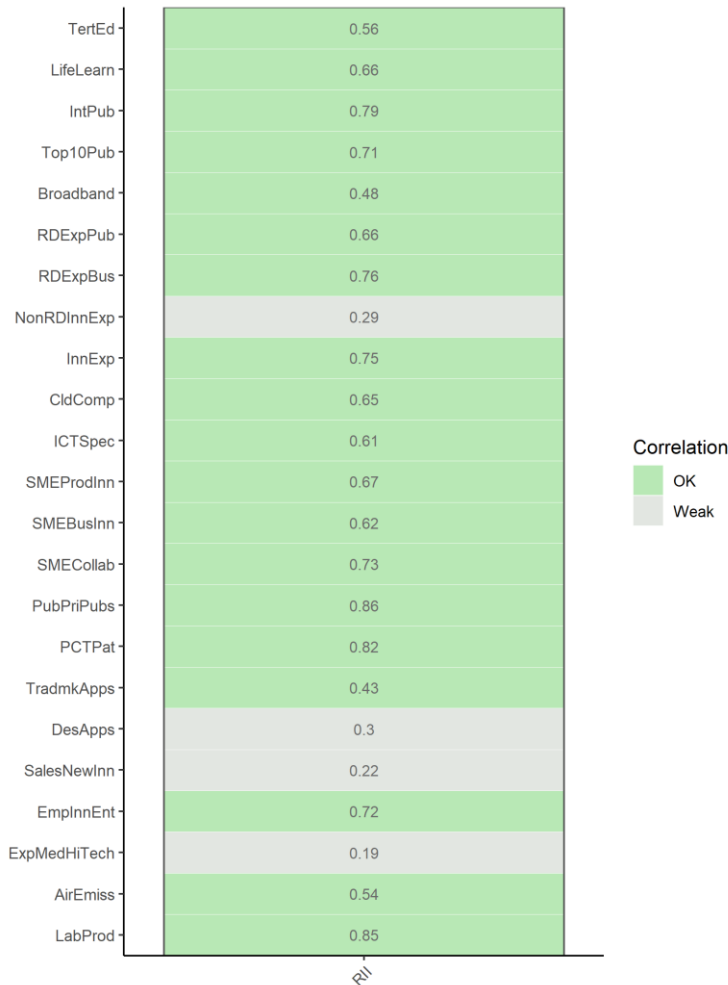
Correlation analysis of indicators

This section reviews the statistical coherence of the RIS indicators by examining the correlations between indicators and the correlations between indicators and the index. The RIS comprises 23 indicators, which are aggregated using the arithmetic mean to create the index. According to the COIN guidelines, all indicators that are aggregated should have a correlation of at least 0.30. A sufficient correlation between indicators facilitates the flow of information from indicators to aggregates by ensuring they point in the same direction and provide non-conflicting information.

Of the 253 indicator pairs, 151 (60%) correlations meet the guideline of at least 0.30, which is a good result given the large number of correlations. Moreover, there are no correlations below zero, which would signal conflicting information being aggregated. On the other hand, 102 (40%) correlations do not meet the guidelines. Almost half of these (48) are near zero, meaning below 0.10. Correlations between these indicators may not allow information to be transmitted efficiently to be reflected at the top level. To investigate the information transfer, we turn to the correlation between indicators and the index.

The good correlation structure between indicators is reflected in the correlations between indicators and the RIS as seen in Figure 4, of which 83% meet the guidelines of at least 0.30. In fact, almost all indicator-index correlations exceed 0.50, demonstrating that the information from the indicators is well reflected in the index. There are four indicator correlations with the index that do not meet the guideline of 0.30. Two of them (NonRDInnExp and DesApps) are very close to the guideline and do not pose any issues. The other two (SalesNewInn and ExpMedHiTech) are slightly lower, around 0.20, indicating that the information in these indicators is less well reflected in the overall index scores, but are still close to the acceptable threshold.

Figure 4: Correlations between indicators and RIS index scores



Source: European Commission, Joint Research Centre, 2025

Overall, **the statistical coherence of the RIS indicator framework appears excellent**, with a large number of positive indicator pair correlations and predominantly strong correlations between indicators and the index.

Impact of modelling assumptions

Assessing the effect of varying modelling assumptions on index ranking is an important part of any statistical audit. The rationale for the choices made by the RIS development team is multifaceted. Despite the well-substantiated rationales, there is an unavoidable subjectivity (or uncertainty) that is accounted for in the robustness assessment carried out by the JRC. More precisely, the uncertainty analysis is conducted to assess the impact of joint changes in modelling choices, producing a range of rankings and confidence intervals for the 242 regions included.

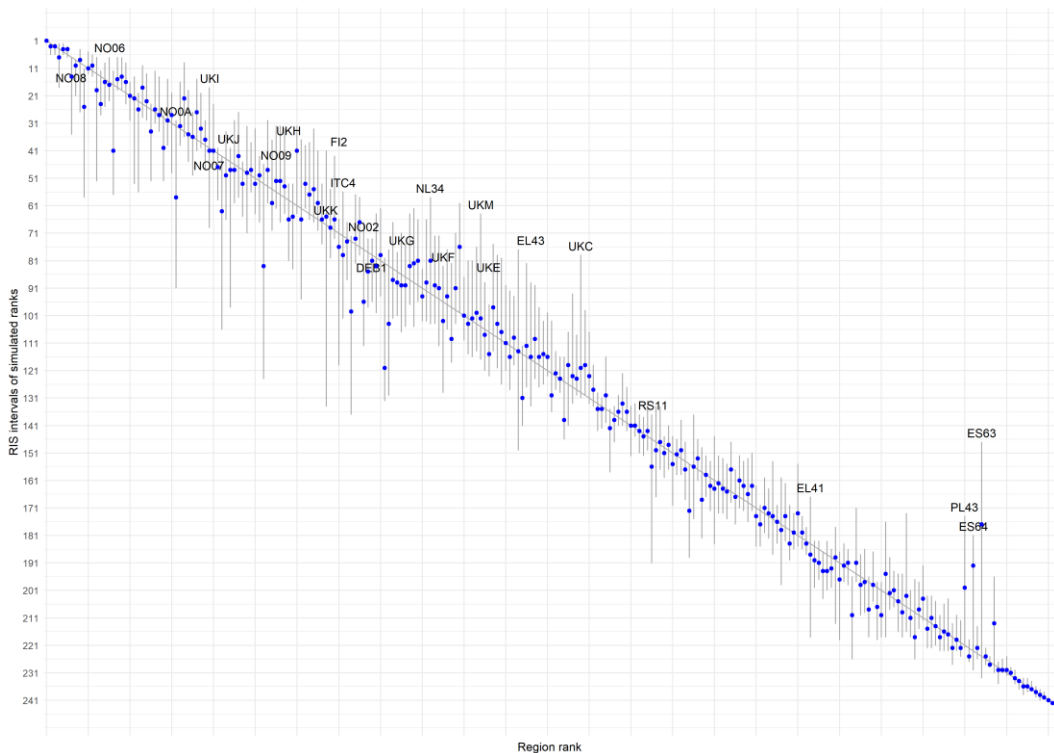
The alternative modelling assumptions in the uncertainty analysis cover imputation, outlier treatment, weights, normalisation, and aggregation, as summarised in Table 13. The weights are a set of randomly generated weights that vary by +/- 25% from their nominal values. The

uncertainty analysis takes a random set of weights and a random combination of the modelling choices in Table 13 to calculate the index. By repeating this procedure thousands of times, confidence intervals are obtained, indicating how much these choices can impact the rankings and thereby providing an estimate of uncertainty in the RIS.

The uncertainty analysis shows the extent to which the rankings produced by the current methodology could change if other valid alternatives are chosen. The COIN team considers a 15% change in ranking as acceptable uncertainty, while a 10% change in ranking is expected. Figure 2 shows the results of the uncertainty analysis. The median ranking is the blue point, and the bars represent 95% confidence intervals across iterations. The regions are sorted on the x-axis using their nominal RIS ranking.

In the RIS, 82% of regions have an acceptable level of uncertainty associated with their ranking, with their rankings changing by up to 36 ranks depending on the modelling choices made. This group includes 55% of all regions that meet the 10% criterion, with their rankings changing by less than 25 ranks for any combination of modelling choices. Furthermore, 13% of regions have an extremely small confidence interval of only 5% of the total range, corresponding to a change of only 12 ranks.

Figure 5: Uncertainty analysis of the RIS rankings across 8000 iterations



Source: European Commission, Joint Research Centre, 2025

However, there are also some regions that are more sensitive to alternative modelling choices. 18% of regions change by more than 36 ranks or more than 15% of the total range. Most of these, change by more than 45 ranks or 20% of the total range. These regions are concentrated in specific countries, namely the United Kingdom (seven regions) and Norway (four regions), while Italy, Netherlands, Germany, Finland, Poland, Serbia, Greece, and Spain have only one or two regions whose rank is uncertain. These regions are labelled in Figure 5. According to the Sobel sensitivity index, the uncertainty in ranking is almost entirely (92%) due to the choice of imputation and its interaction with other choices.

Overall, **the extensive uncertainty analysis shows that the RIS is quite robust to alternative modelling choices.** The modelling choices specified as alternatives by the COIN team included specifications that changed the underlying distributions, imputation, and aggregation – ranging from arithmetic to nearly geometric. The results of the uncertainty analysis are therefore promising, as the rankings of 82% of regions in the RIS are robust to many combinations of plausible but substantively different modelling choices.

Table 13: Model choice of the RIS framework and alternatives

Model choice	Nominal	Alternative
Treatment	1. Winsorise all observations +/- 2 S.D. from the mean, 2. If skewness > 1, use square root transformation	1. If absolute skewness > 2 and kurtosis > 3.5: Winsorise (max = 5 obs.), 2. If still absolute skewness > 2 and kurtosis > 3.5, use log transformation
Imputation	Interpolation	Median, k-Nearest Neighbours
Normalisation	Min-max (0,1)	Z-score (mean = 0.5, SD= 0.15)
Weights	Equal	+/- 25%
Aggregation	Arithmetic average (equivalent to generalised power mean with $p = 1$)	Generalised power mean with $p \in \{0.75, 0.50, 0.25\}$

Source: European Commission, Joint Research Centre, 2025

Conclusion

In conclusion, the JRC-COIN audit of the RIS has provided a comprehensive assessment of the index's statistical soundness and robustness. **The findings of the audit indicate that the RIS framework is well-structured and that the modelling assumptions underlying the index are generally well-founded.** While some areas for improvement have been identified, such as the treatment of outliers and the potential impact of the imputation method, **the audit suggests that the RIS is a reliable and transparent tool for policymakers and stakeholders.** Overall, the audit confirms that the RIS is a valuable resource for assessing regional innovation, and that its results can be used with confidence to inform policy priorities and initiatives.

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Within the context of the Regional Innovation Scoreboard (RIS), the RIS Methodology Report provides more detail on the methodology used for the RIS and the construction of the Regional Innovation Index (RII). The Methodology Report also provides detailed methodological information on the indicators used for both the RII and the Structural indicators that aim to provide a better understanding of the impact of structural differences on innovation performance scores.

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