MetricsEKT
Regional Indicators

The regional dimension of knowledge-intensive activities in Greece

Overview 2021

EKT NATIONAL DOCUMENTATION CENTRE

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Introduction

Production of new knowledge -through research activity- and its exploitation in real economy -through promotion and application of innovation- is vital both for addressing socio-economic challenges of our time, and for strengthening competitiveness of national production. Based on these basic assumptions, the European Union has promoted innovation in policy agenda. A typical example of that is Smart Specialization Strategy (RIS3), as a key framework for cohesion policy and relevant funding, already from the programming period 2014-2020.

The need for such an initiative is empirically stressed by the fact that the prolonged existence of performance gaps between regions in the specific knowledge and/or technology-inensive sectors widens economic and development disparities, increasing also the risk of "poverty trap" for the less favored regions. A final, negative consequence of this sequence is the continued divergence of these regions from those that respond to contemporary challenges, following patterns of economic policy and development that place particular emphasis on knowledge-intensive and highly technologically specialized investments and activities. In fact, persistent existence and widening of inequalities is a major challenge for contemporary cohesion policy and countries that have experienced mostly negative effects of economic crises.

Beyond this framework, but also in absolute relation to it, the well-known cycle of exercising public policy includes planning, implementation, monitoring, assessment and redesign of policy interventions, according to the results of the monitoring and assessment process. For this purpose, the creation and operation of an effective monitoring system of public interventions is of critical importance, both for regions and more broadly, at national and supra-national level. This necessity has been consolidated by the EU; thus, relevant legal obligations have been introduced in the operation of the European Structural and Investment Funds (ESIF), and more specifically for the purposes of Smart Specialization Strategy. The ultimate goal is related to the improvement of public interventions' and policy measures' efficiency, as well as to the ability to address the development needs of regions.

In the Greek case, the implementation of the Smart Specialization Strategy has contributed to upgrading research and innovation in policy agenda, trying to modernize he country's growth model. The National Documentation Center (EKT) is the public organisation that produces the official national statistics for Research, Development and Innovation, operating as the National Authority of the Hellenic Statistical System. In this context, EKT is the source of data related to research – innovation RIS3 implementation in Greece, publishing the relevant result indicators.

This edition is part of EKT's relevant activities, providing in a concrete and comprehensive way indicators that contribute to mapping of regional innovation systems. More specifically, factual analysis on research and innovation in Greek regions is presented through indicators that refer to four thematic axes: a) Research & Development activities, as reflected through the R&D expenditures carried out by the institutions of each Region, b) R&D personnel that is employed and participates in R&D activities, c) the performance of each Regions' bodies and entities in competitive EU R&D projects, scientific publications and doctoral theses, from which international presence, excellence and areas of scientific

and technological specialization of the Regions emerge, d) the innovative performance of each Regions' enterprises.

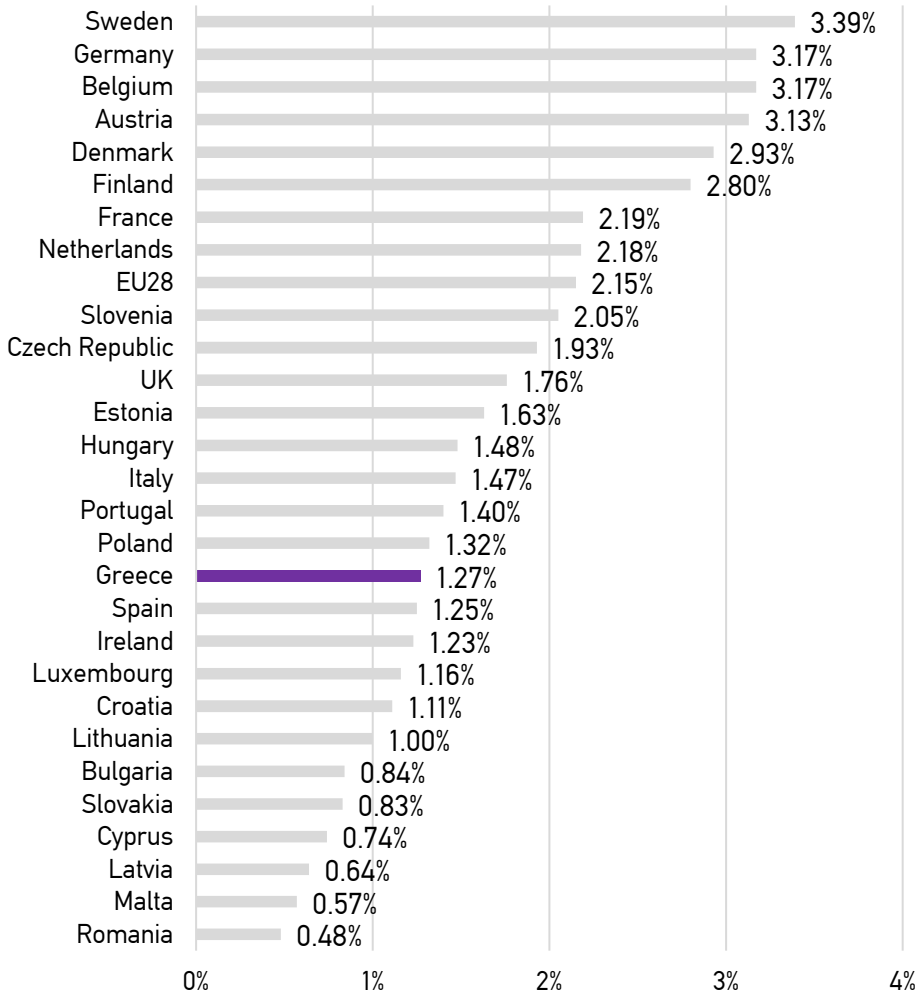
At the end of the day, this publication provides data and documented information to the scientific community, policy makers and the broader society on issues related to research, development and innovation performance of Greek regions. This publication and data available on EKT's website (https://metrics.ekt.gr/regions, https://metrics.ekt.gr/ris) provide valuable insights on regional innovation sstems to public debate, contributing further to the relevant discussion that is takeing place for the need for an alternative, knowledge-intensive growth paradigm at national and regional level.

1. R&D Expenditure in Greek Regions

The position of Greece, compared to EU Member States in 2019 (including the United Kingdom[1]), in terms of R&D intensity (R&D expenditure as a percentage of GDP), is shown in Figure 1.1. The country was ranked 17th (1.27%), lower than the EU average (2.15%).

FIGURE 1.1: R&D intensity per EU member state, 2019

(R&D expenditure of each EU Member State as a percentage of its GDP)



[1] In this publication, the references in the average of the European Union (EU average) refers to 28 member-states, since during the reference years, United Kingdom was a member of the EU. UK's withdrawal from the EU took place in 2020.

The expenditure for Research & Development (R&D) that is carried out in the thirteen Greek Regions in 2019 are shown in Table 1.1. The highest R&D expenditure is recorded in the Attiki Region (€ 1,428.42 million), followed -with a significant difference- by the Region of Kentriki Makedonia (€ 282.56 million) and the Region of Kriti (€ 140.63 million).

TABLE 1.1: R&D Expenditure (mil. Euro) in Greek Regions

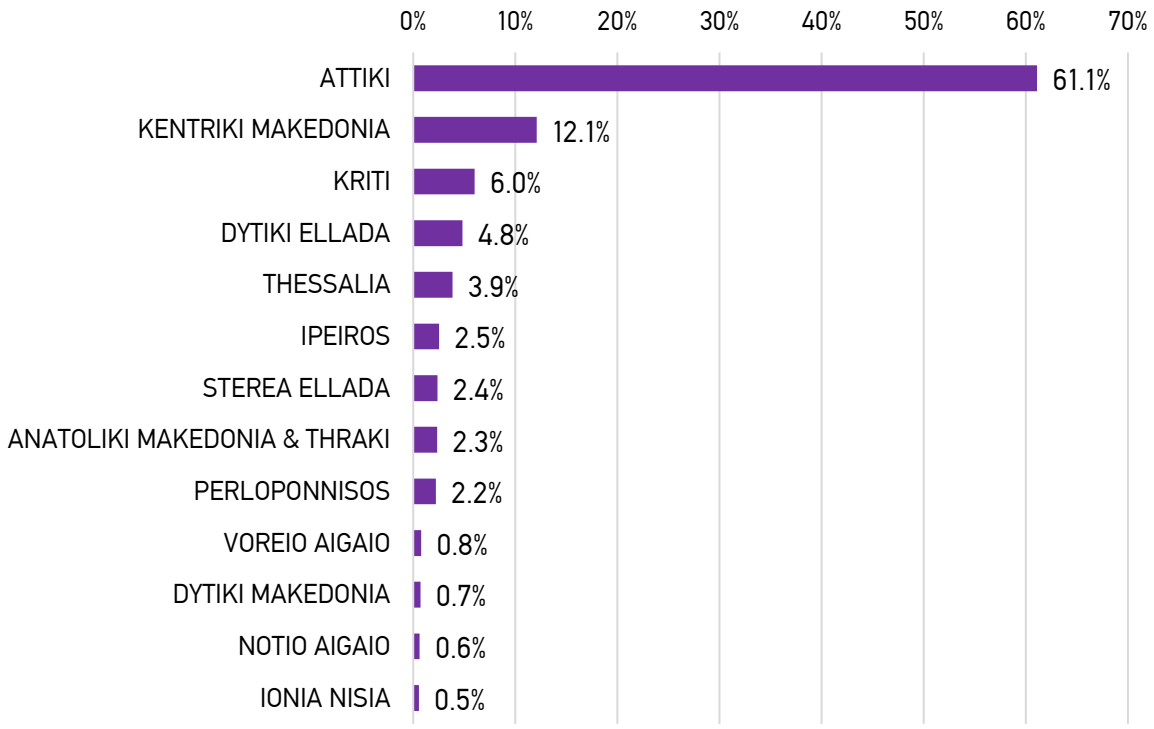
Region (NUTS2)	Total expenditure (mil. €)	R&D Sector of Activity			
		BES	GOV	HES	PNP
ATTIKI	1,428.42	828.95	292.42	292.46	14.59
KENTRIKI MAKEDONIA	282.56	89.72	81.52	109.41	1.91
KRITI	140.63	12.43	66.19	60.70	1.31
DYTIKI ELLADA	112.97	25.36	14.04	73.57	0.00
THESSALIA	90.00	23.48	8.84	57.58	0.10
IPEIROS	59.04	7.22	7.16	44.46	0.20
STEREA ELLADA	55.49	44.73	5.92	4.84	0.00
ANATOLIKI MAKEDONIA & THRAKI	54.52	11.78	7.50	35.20	0.04
PELOPONNISOS	51.91	25.59	17.45	8.15	0.72
VOREIO AIGAIO	18.25	1.37	5.91	10.64	0.33
DYTIKI MAKEDONIA	16.34	3.50	4.63	8.06	0.15
NOTIO AIGAIO	14.74	0.59	9.66	4.09	0.40
IONIA NISIA	12.79	3.18	2.70	6.91	0.00
Total[2]	**2,337.66**	**1,077.90**	**523.94**	**716.07**	**19.75**

[2] Any differences between the sum of the individual values and the total values of the table are due to rounding.

The share of national R&D expenditure among the Greek Regions is depicted in Figure 1.2. Most of the R&D expenditure - and with a significant difference compared to the rest - is located in the Attiki Region (61.1%). It is followed by the Region of Kentriki Makedonia, which corresponds to 12.1% of the national expenditure, the Region of Kriti with 6.0%, and the Region of Dytiki Ellada with 4.8%.The other Regions have shares of less than 4%.

FIGURE 1.2: Distribution of R&D expenditure in the Greek Regions, 2019

(Shares of the Greek Regions in the total national R&D expenditure)



More thoroughly, internationally, R&D statistics are analysed in 4 sectors, according to categoreies of institutions that perform R&D activities. In the tables and figures of this publication these four R&D sectors of performance are listed in the order and with the abbreviations adopted by Eurostat as follows: BES - Business Enterprise Sector, GOV - Government Sector, HES - Higher Education Sector, PNP - Private Non Profit Organisations.

In this context, the R&D carried out in the four aforementioned R&D activities sectors of performance in the Greek Regions is recorded in absolute terms in Table 1.1 and on a percentage basis in Figure 1.3.

Based on the data, the business enterprise sector carries out most of the R&D in the Attiki Region, the Region of Sterea Ellada and the Peloponnisos Region. In the other Regions, the highest share is recorded in either the higher education sector (in the cases of the Regions of Kentriki Makedonia, Dytiki

Ellada, Thessalia, Ipeiros, Anatoliki Makedonia-Thraki, Voreio Aigaio, Dytiki Makedonia, Ionia Nisia), or the government sector (in the cases of the Regions of Kriti and Notio Aigaio).

The highest shares of the business enterprise sector in total R&D expenditure are recorded in the Regions of Sterea Ellada (81%) and Attiki (58%).The highest percentages of participation of the higher education sector in the total R&D expenditure are recorded in the Regions of Ipeirios (75%) and Dytiki Ellada (65%) while the government sector plays an important role in the Regions of the Notio Aigaio (66%) and Kriti (47%).

FIGURE 1.3: R&D expenditure in the Greek Regions per sector of performance, 2019

(% distribution of total R&D expenditure of each Region per sector of performance)

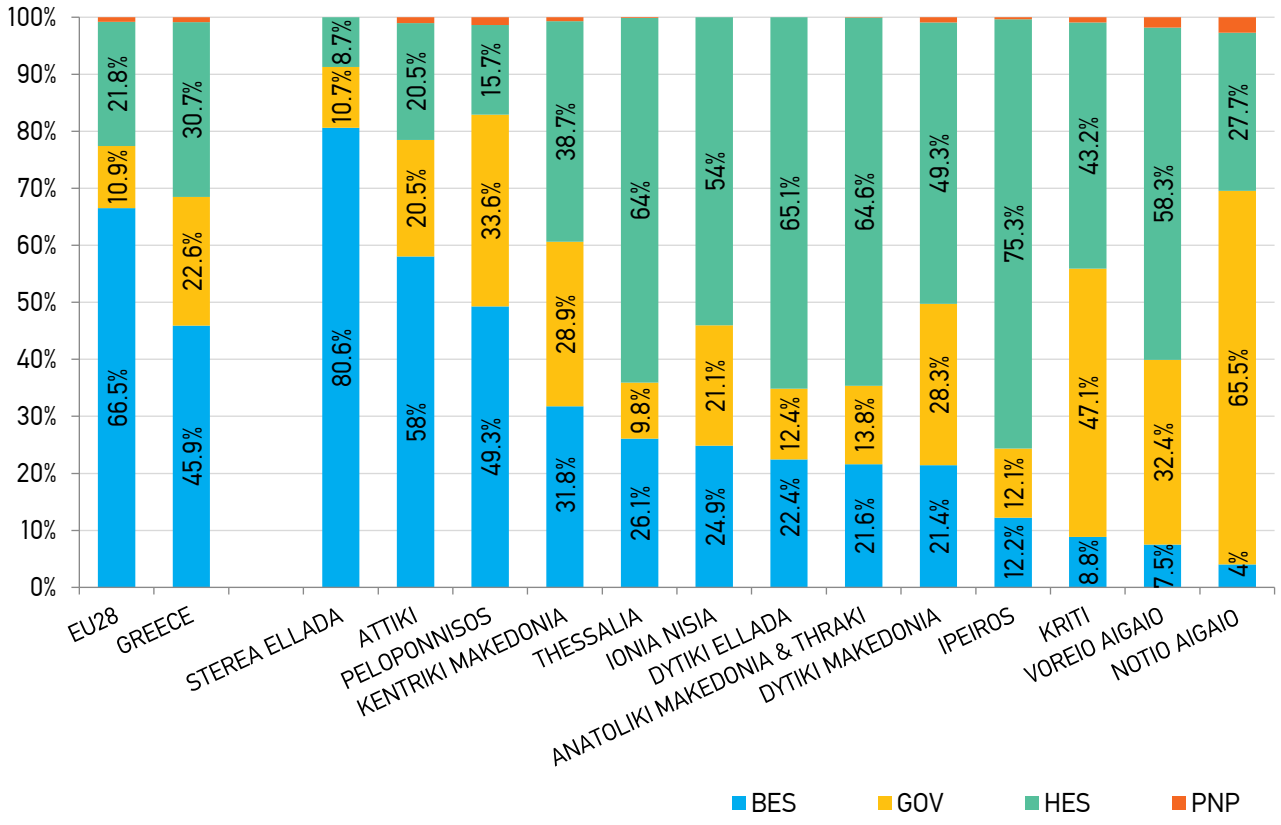


Figure 1.4 presents the structure of R&D expenditure, distinguishing the business enterprises sector from the government sector, the higher education sector and the private non-profit organizations sector. In each of the R&D sectors of performance, the Attiki Region has the highest percentage, with a significant difference from the Region of Kentriki Makedonia, which is consistently the second most important Region in carrying out R&D activity.

More specifically, the distribution between the Regions by sector of performance is the following:

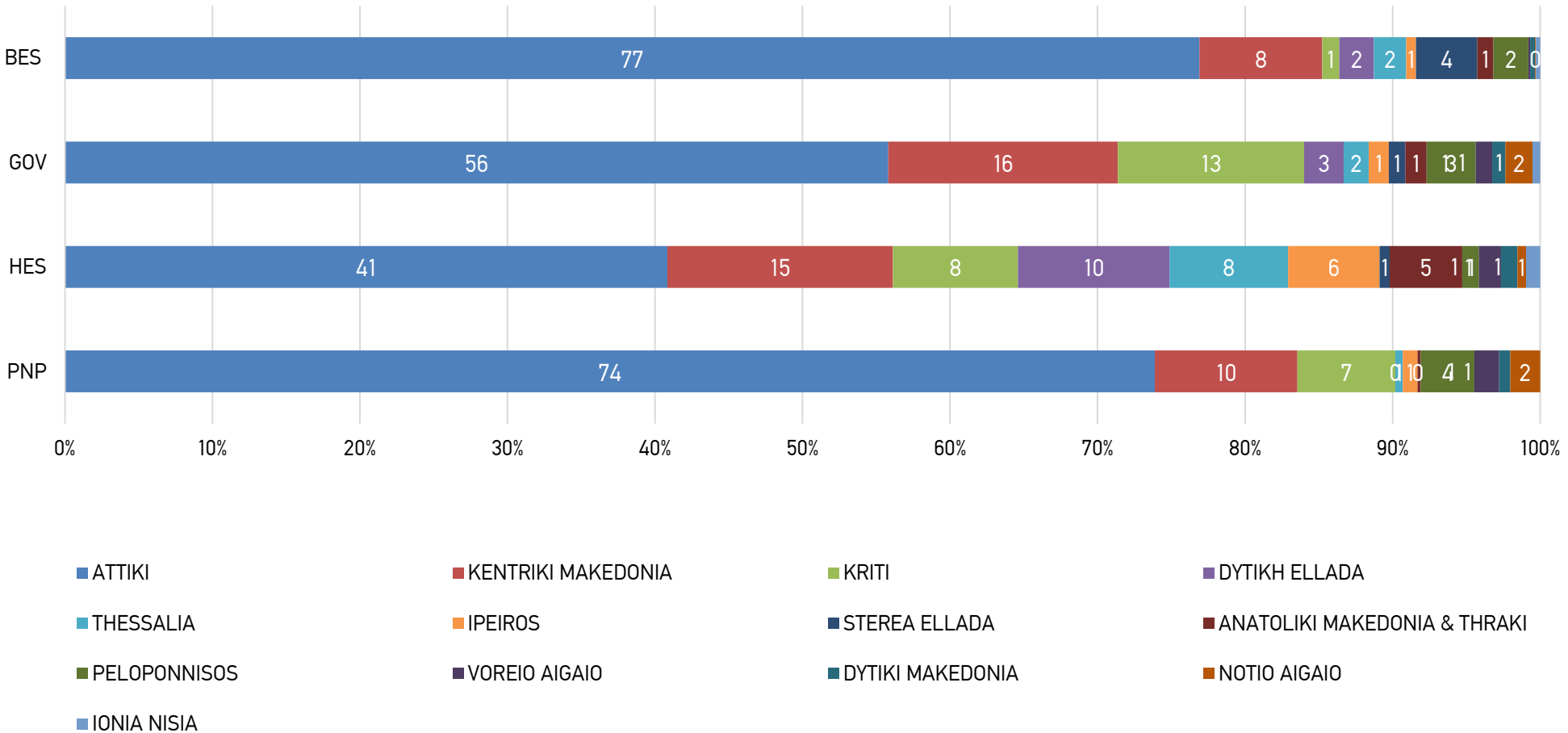
As far as the business enterprise sector is concerned, Attiki has the highest share, i.e. 76.9%, followed by Kentriki Makedonia (with a share of 8.3%), Sterea Ellada (4.1%), Dytiki Ellada and Peloponnisos (both with 2,4%), Thessalia (2.2%), Kriti (1.2%), Anatoliki Makedonia-Thraki (1.1%), Ipeiros (0.7%), Dytiki Makedonia and Ionia Nisia (both with 0.3%), and Voreio and Notio Aigaio (both with 0.1%).

When referrint to the government sector, Attiki leads with a percentage of 55.8%. The second highest concentration is in Kentriki Makedonia (15.6%), followed by Kriti (12.6%), Peloponnisos (3.3%), Dytiki Ellada (2.7%), Notio Aigaio (1,8%), Thessalia (1.7%), Anatoliki Makedonia-Thraki and Ipeiros (both with 1.4%), Voreio Aigaio and Sterea Ellada (both with 1.1%), Dytiki Makedonia (0.9%) and Ionia Nisia (0.5%).

In the sector of higher education, Attiki has the highest concentration of R&D expenditure (40.8%), followed by Kentriki Makedonia (15.3%), Dytiki Ellada (10.3%), Kriti (8.5%), Thessalia (8.0%), Ipeiros (6.2%), Anatoliki Makedonia-Thraki (4.9%), Voreio Aigaio (1.5%), Peloponnisos and Dytiki Makedonia (both with 1.1%), Ionia Nisia (1.0%), Sterea Ellada (0.7%) and Notio Aigaio (0,6%).

As far as the private non-profit organizations sectoris concerned, Attiki Region has the highest share (73.9%), followed by Kentriki Makedonia (9.7%), Kriti (6.6%), Peloponnisos (3.6%) , Notio Aigaio (2.0%), Voreio Aigaio (1.7%), Ipeiros (1.0%), Dytiki Makedonia (0.8%), Thessalia (0.5%) and Anatoliki Makedonia-Thraki (0.2%), while Dytiki Ellada, Sterea Ellada and Ionia Nisia have zero percentages.

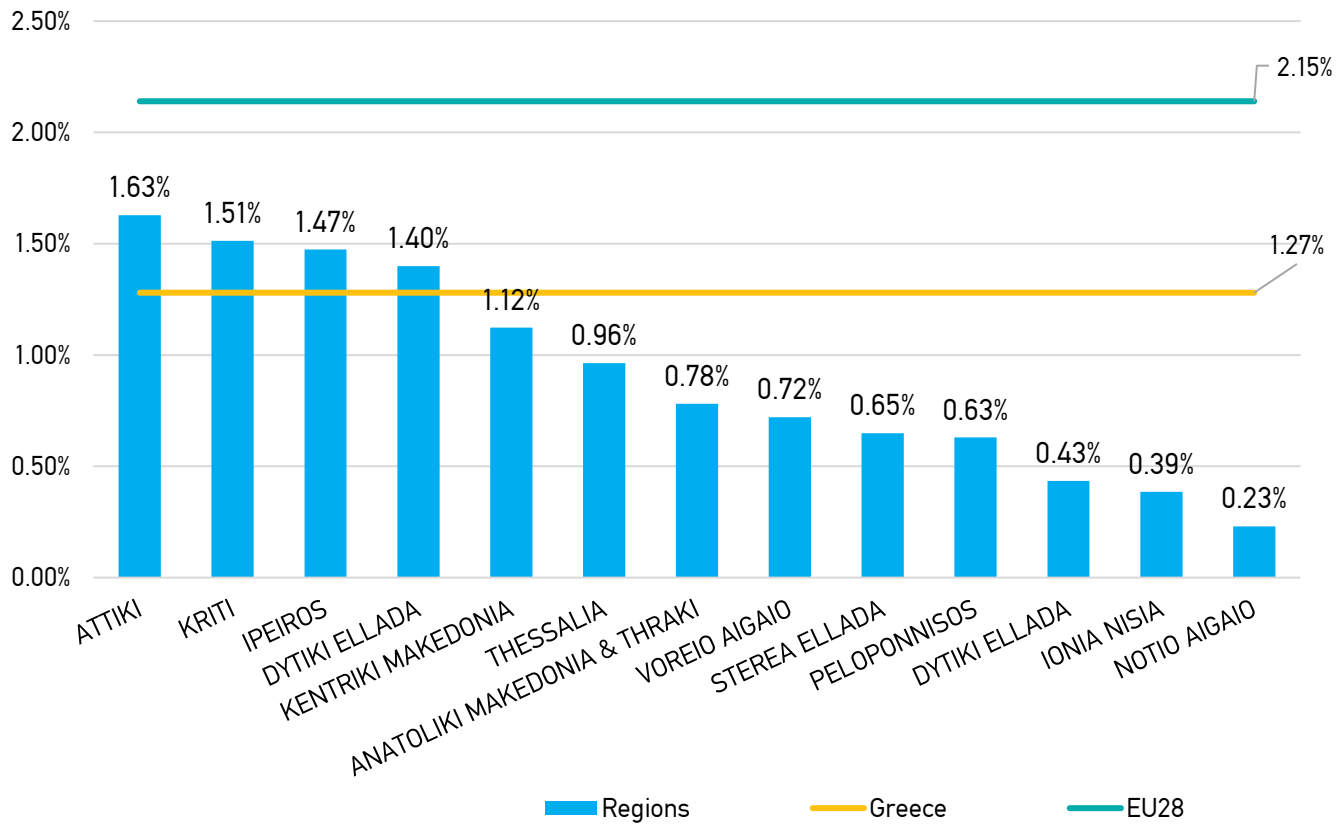
FIGURE 1.4: Distribution of R&D expenditure by R&D sector of performance across the Greek Regions,2019
(Shares of the Greek Regions in R&D expenditure per sector of performance)



R&D intensity, i.e. R&D expenditure as a percentage of GDP, is the most basic indicator of the importance that a country or region attaches to this activity. According to the detailed statistics for 2019, R&D intensity of Greece was 1.28% of GDP, and, as shown in Figure 1.5, the Regions of Attiki (1.63%), Kriti (1.51%), Ipeiros (1.47%) and Dytiki Ellada (1.40%) exceeded the national average, but remain lower than the corresponding EU average (2.15%).

FIGURE 1.5: R&D intensity per Region, 2019

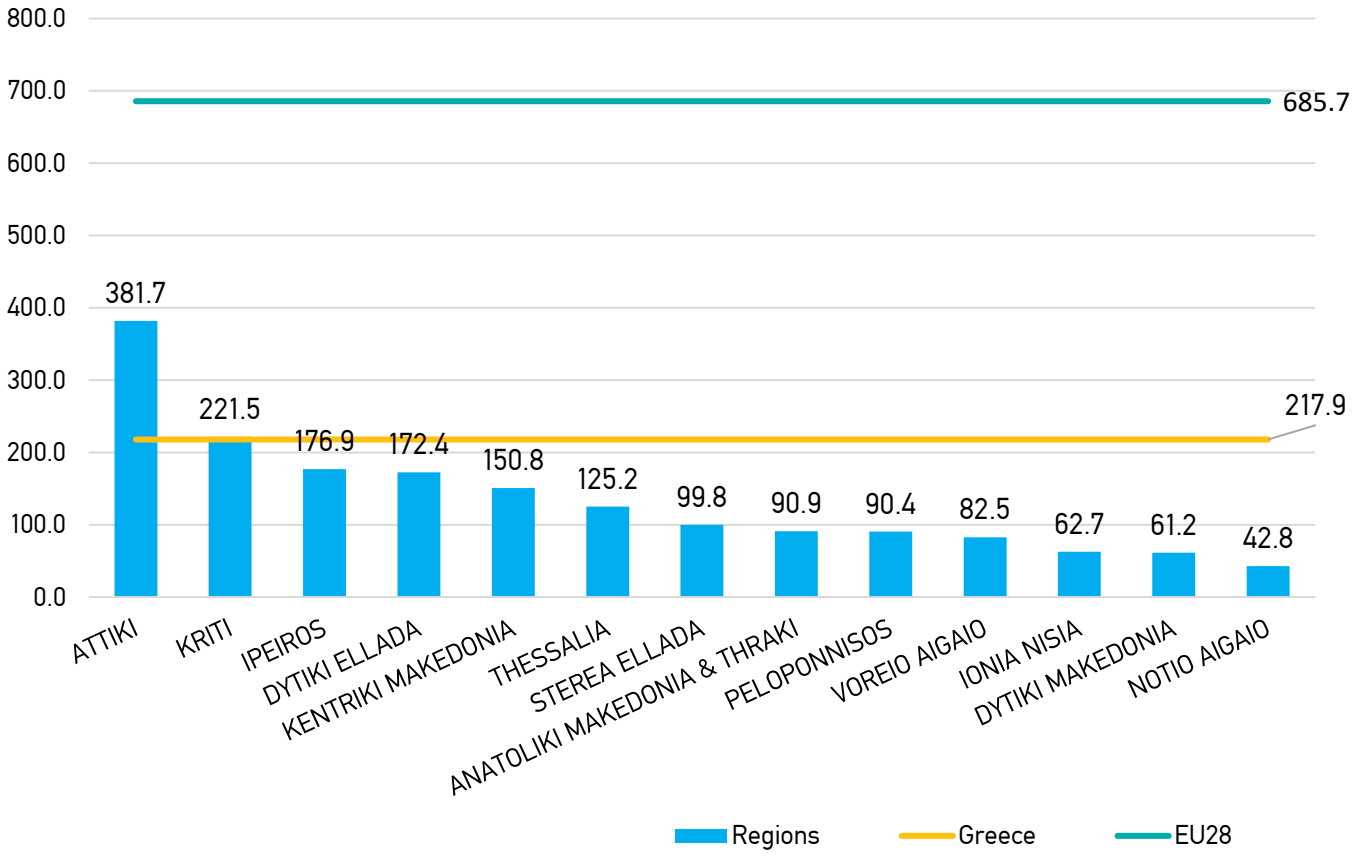
(R&D expenditure of each Region as a percentage of its GDP)



An alternative way of capturing the significance attributed to R&D emerges if R&D expenditure is expressed per capita (Figure 1.6). In terms of this indicator, the Region of Attiki (€ 381.7 per inhabitant) and the Region of Kriti (€ 221.5 per inhabitant) lead, surpassing the respective national performance (€ 217.9 per inhabitant). However, a significant difference is still recorded, when these data are compared to EU average (€ 685.7 per inhabitant).

FIGURE 1.6: R&D expenditure per inhabitant in the Greek Regions, 2019

(R&D expenditure, in Euros, per inhabitant in each Region)



2. R&D Personnel in Greek Regions

Table 2.1 presents not only the employment of the total R&D personnel by Region, but also the individual employment categories, i.e. researchers (scientists, engineers, PhD holders, etc.), and other personnel (such as technicians, programmers, administrators etc. without the participation of whom a research project cannot be completed). The data included are absolute values (Headcount and Full-time Equivalent). FTE - Full Time Equivalent is used to comparatively measure the personnel employed in R&D, and is calculated based on the time each person devotes to R&D activities. Therefore, a full-time R&D employee over a year is counted as one FTE, while a part-time employee is counted as a percentage of one FTE, in proportion to his/ her working hours on R&D.

The columns of the table show the number of persons (Headcount) and their equivalents on the basis of full-time employment (Full-Time Equivalent), per category, while the rows show the distribution of R&D personnel and the sub-categories of R&D employment in each R&D sector of performance, by Region[3]. The majority of R&D personnel and researchers are employed in the Attiki Region and differs significantly from, that of Kentriki Makedonia, which is in second place, followed by the Region of Kriti, both in Headcount and Full-Time Equivalent.

[3] In order to better present results, due to the relatively small contribution of Private non-Profit Organizations in the regional R&D expenditure data, this particular sector is presented cumulatively with the Business Enterprise Sector.

TABLE 2.1: R&D personnel in the Greek Regions by R&D sector of performance and type of employment, (in Headcount and Full-time equivalent), 2019

REGION	R&D Sector of Performance	R&D Personnel					
		Headcount			Full-time equivalent (FTE)		
		Total	Researchers	Other personnel	Total	Researchers	Other personnel
ATTIKI	BES & PNP	15,133	10,742	4,391	10,252	7,521	2,731
	GOV	18,189	11,892	6,297	7,457	5,040	2,416
	HES	20,797	11,576	9,221	9,461	7,004	2,456
	Σύνολο	54,119	34,210	19,909	27,170	19,566	7,604
VOREIO AIGAIO	BES & PNP	90	71	19	61	48	13
	GOV	350	131	219	208	85	123
	HES	1,031	774	257	395	339	55
	Total	1,471	976	495	664	472	191
NOTIO AIGAIO	BES & PNP	53	26	27	36	20	15
	GOV	357	149	208	237	97	141
	HES	428	332	96	149	131	18
	Total	838	507	331	422	248	174
KRITI	BES & PNP	628	307	321	383	206	177
	GOV	2,386	1,186	1,200	1,710	771	939
	HES	3,719	2,506	1,213	1,866	1,609	258
	Total	6,733	3,999	2,734	3,959	2,586	1,373
A. MAKEDONIA & THRAKI	BES & PNP	237	154	83	182	123	59
	GOV	399	181	218	281	116	165
	HES	2,749	1,854	895	1,251	1,051	200
	Total	3,385	2,189	1,196	1,714	1,290	424

REGION	R&D Sector of Performance	R&D Personnel					
		Headcount			Full-time equivalent (FTE)		
		Total	Researchers	Other personnel	Total	Researchers	Other personnel
KENTRIKI MAKEDONIA	BES & PNP	2.895	1.966	929	1.771	1.215	557
	GOV	4,266	2,685	1,581	1,962	1,232	731
	HES	8,340	6,676	1,664	4,379	4,052	328
	Total	15,501	11,327	4,174	8,113	6,500	1,613
DYTIKI MAKEDONIA	BES & PNP	98	66	32	74	47	28
	GOV	356	108	248	169	51	118
	HES	947	686	261	421	342	79
	Total	1,401	860	541	665	440	224
IPEIROS	BES & PNP	434	282	152	204	130	74
	GOV	362	200	162	237	113	125
	HES	2,880	1,654	1,226	1,226	1,015	211
	Total	3,676	2,136	1,540	1,667	1,258	409
THESSALIA	BES & PNP	808	469	339	405	278	127
	GOV	502	213	289	307	120	187
	HES	3,311	2,076	1,235	1,964	1,558	405
	Total	4,621	2,758	1,863	2,676	1,957	719
IONIA NISIA	BES & PNP	139	48	91	111	41	70
	GOV	177	83	94	97	45	52
	HES	816	675	141	556	524	32
	Total	1,132	806	326	763	610	153
DYTIKI ELLADA	BES & PNP	759	636	123	515	445	70
	GOV	808	392	416	434	194	239
	HES	4,681	3,223	1,458	2,921	2,226	695

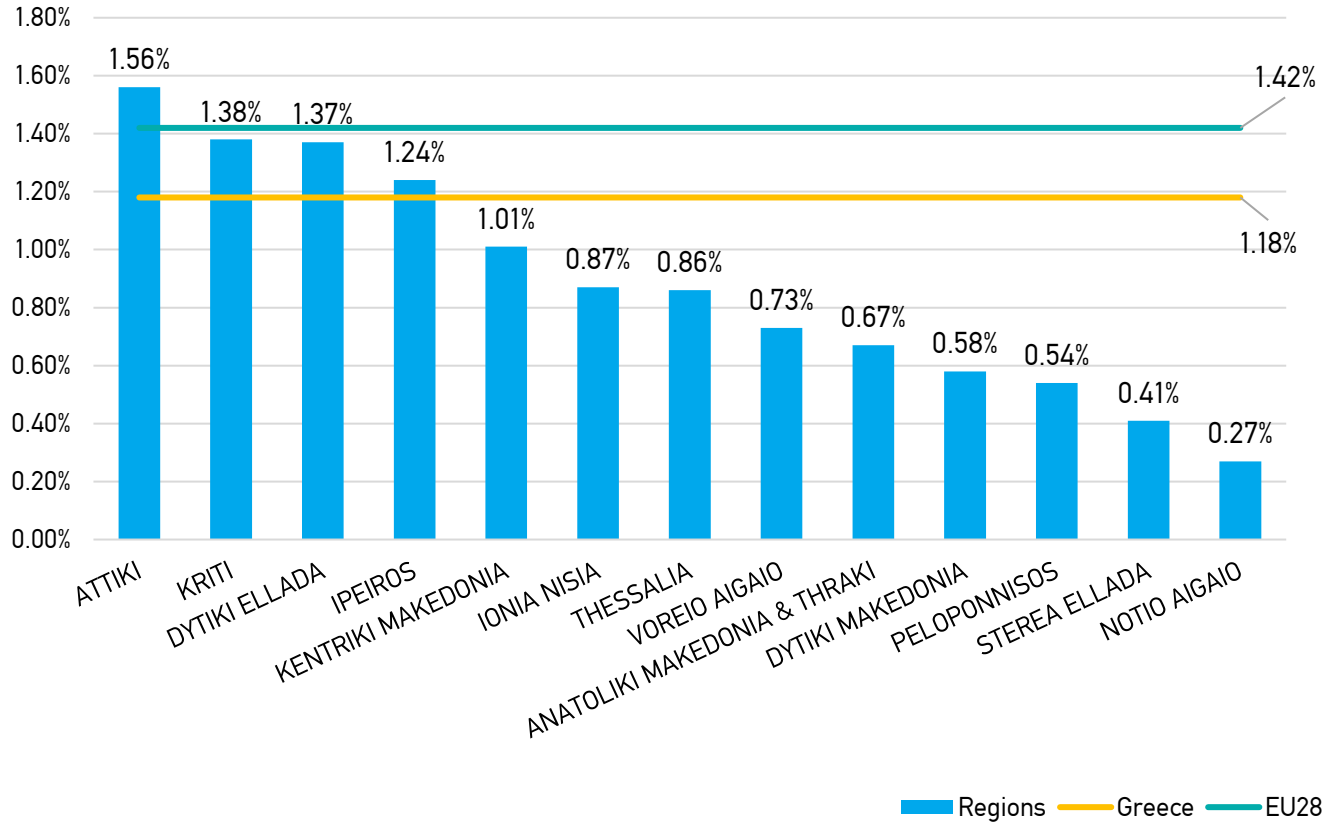
REGION	R&D Sector of Performance	R&D Personnel					
		Headcount			Full-time equivalent (FTE)		
		Total	Researchers	Other personnel	Total	Researchers	Other personnel
	Total	**6,248**	**4,251**	**1,997**	**3,869**	**2,865**	**1,005**
STEREA ELLADA	BES & PNP	**883**	529	354	**548**	357	191
	GOV	**381**	228	153	**184**	96	88
	HES	**538**	302	236	**226**	146	80
	Total	**1,802**	**1,059**	**743**	**958**	**599**	**359**
PELEPONNISOS	BES & PNP	**348**	207	141	**256**	149	106
	GOV	**1,168**	356	812	**612**	189	423
	HES	**1,082**	810	272	**425**	348	78
	Total	**2,598**	**1,373**	**1,225**	**1,293**	**686**	**607**

Note: Any differences between the sum of the individual values and the values listed as totals are due to rounding.

Employment in R&D activities in each Region varies, in terms of the percentage of the workforce, per Region. The highest performance rate is recorded in the Region of Attiki (1.56%), followed by the Region of Dytiki Ellada (1.38%), the Region of Kriti (1.37%) and the Region of Ipeiros (1.24%); percentages that are higher than the average national performance (1.18%).The corresponding average EU performance is 1.42% (Figure 2.1).

FIGURE 2.1: R&D personnel in the economically active population of the Greek Regions, 2019

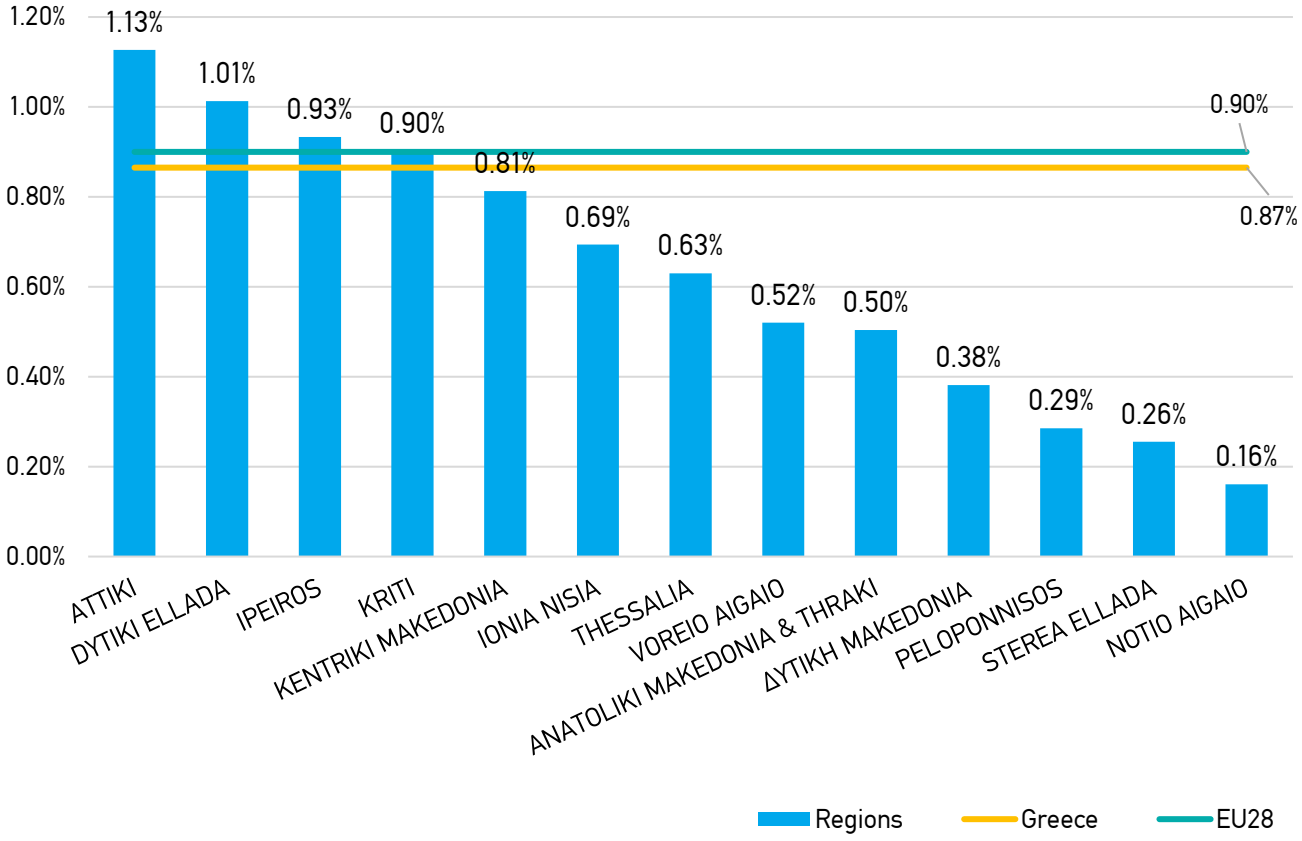
(R&D personnel in full-time equivalent, per Region, as % of the workforce in each Region)



If the above is considered in terms of the employment of researchers (as opposed to total R&D personnel), then their share of the workforce by Region is as follows: the Attiki Region shows the highest percentage (1.13%), followed by the Region of Dytiki Ellada (1.01%), the Region of Ipeiros (0.93%) and the Region of Kriti (0.90%), all of which exceed the average national performance (0.87%), but correspond to the EU28 average (0.90%) (Figure 2.2).

FIGURE 2.2: Researchers in the economically active population in the Greek Regions, 2019

(Researchers in full-time equivalent, per Region, as % of the workforce in each Region)



Figures 2.3 and 2.4 illustrate the employment of R&D personnel and researchers across the four sectors that carry out R&D activities (business enterprise sector, government sector, higher education sector and private non-profit sector).

More specifically, Figure 2.3 shows that the higher education sector employs the majority of the R&D personnel in most Greek Regions (in several of which the share exceeds 50%), except for the Regions of Sterea Ellada and Attiki, where the majority of R&D personnel are employed in the business enterprise sector, and the Peloponnisos and Notio Aigaio Regions, where the main R&D employer is the government sector. The specific weight of the higher education sector also applies to the country as a whole, while in the EU28 the majority of R&D personnel are employed in the business enterprise sector.

FIGURE 2.3: R&D personnel in the Greek Regions by R&D sector of performance, 2019

(% distribution by R&D sector of performance, calculation based on full-time equivalent)

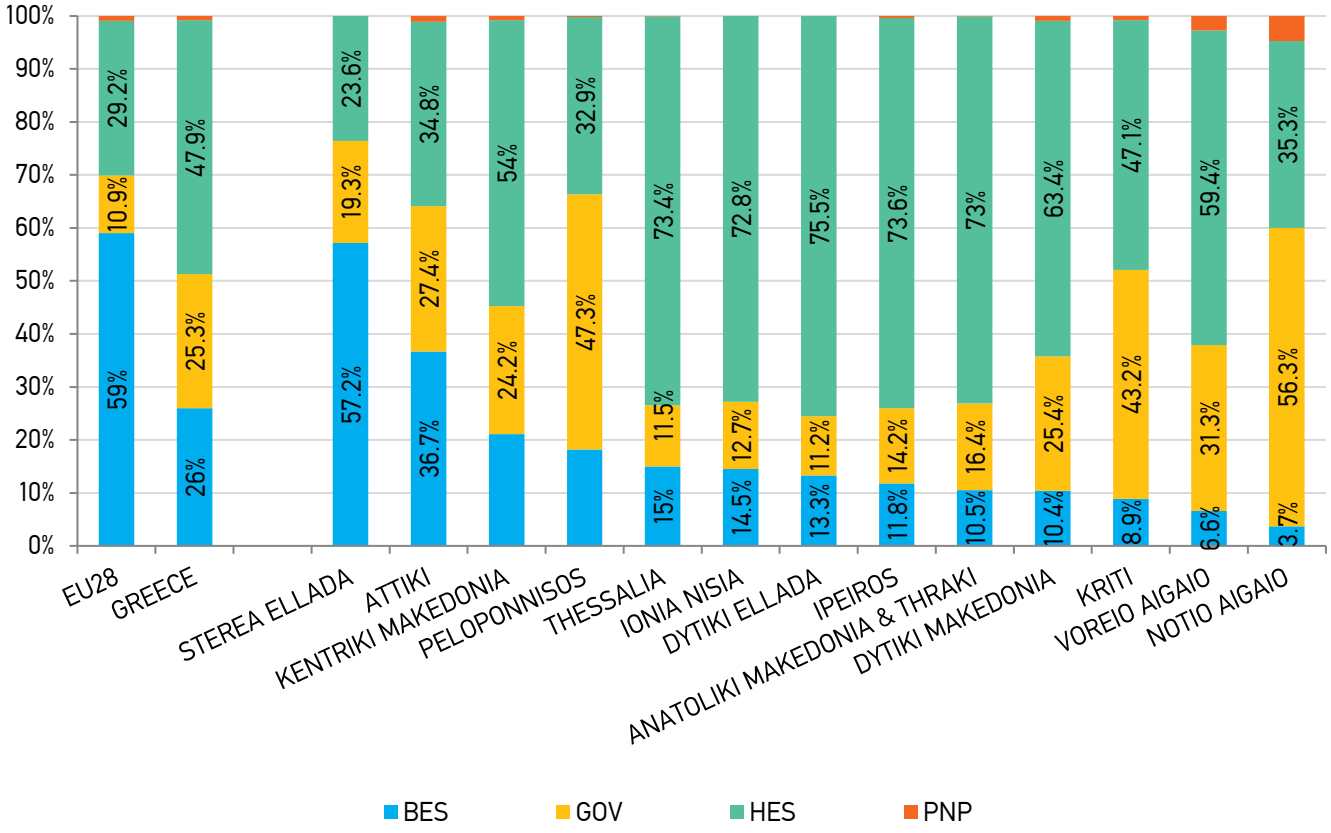
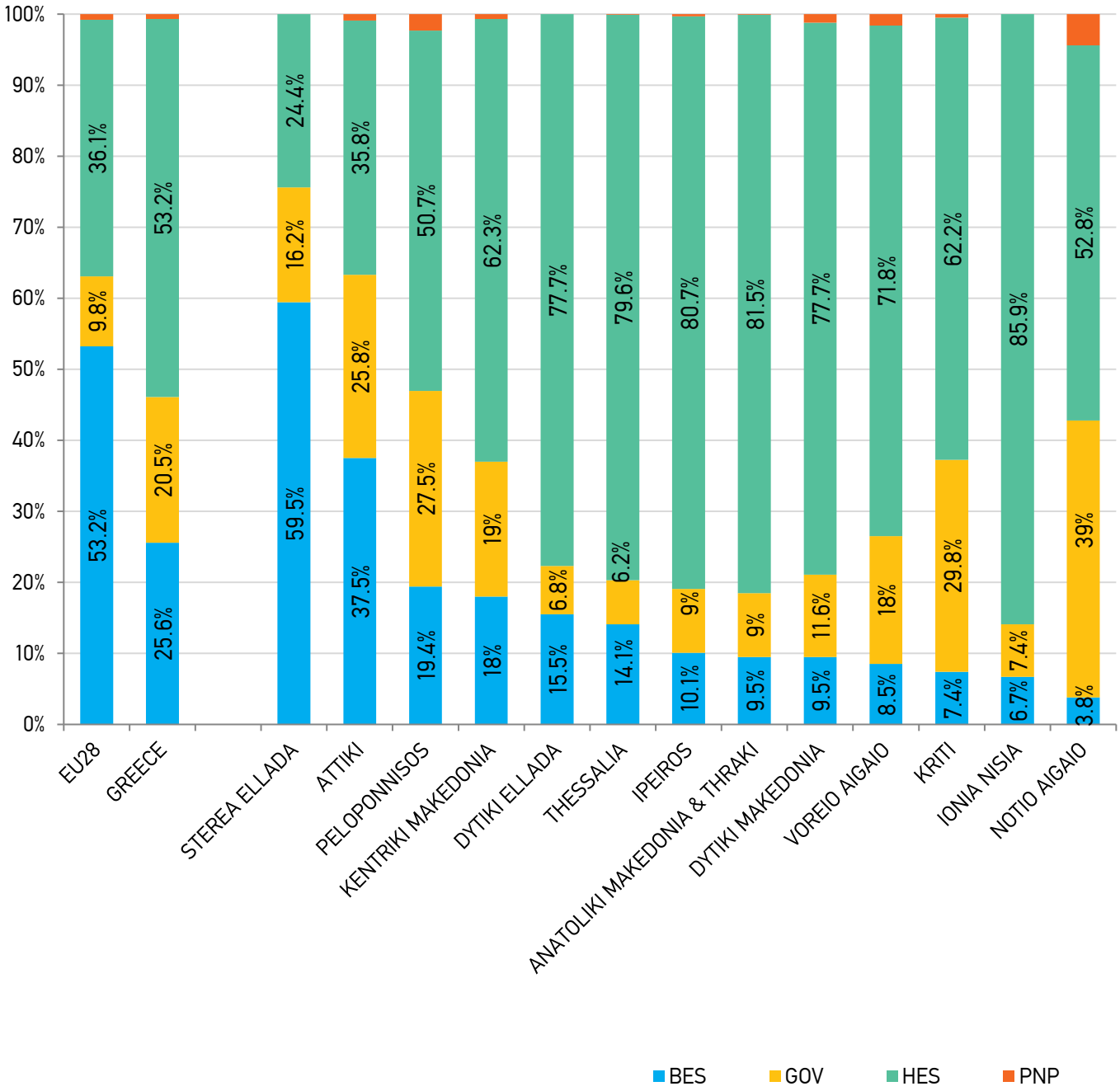


Figure 2.4 specifies further what is presented in Figure 2.3, referring to researcher and categorising them among the individual R&D sectors of performance by Region. The higher education sector is the main sector that employs researchers in all Regions, except for the Regions of Sterea Ellada and Attiki, where the business enterprise sector has the highest share. Overall for the country, the second most important sector - although with a difference from the first - is the business enterprise sector, followed by the government sector. In the EU28, most researchers are employed in the business enterprise sector, followed by the higher education sector and the government sector.

FIGURE 2.4: Researchers in the Greek Regions by R&D sector of performance, 2019
(% distribution by R&D sector of performance, calculation based on full-time equivalent)



3. Scientific excellence and extroversion in Greek regions

During the period 2014-2020, the main funding instrument of the European Commission for research projects was the 'Horizon 2020' Programme (H2020). Until the year 2020, Greece received funding from this programme that exceeded € 1.6 billion, and achieved over 1,600 participations in approved projects. These data continue not only to constitute a clear indicator of the strong extroversion of the national research and technology system, but also a potential indicator of scientific excellence.

Table 3.1 presents the performance of the regions in the 'Horizon 2020' Programme. According to the data, the majority of participations were from the Attiki Region (3,221 participations). In addition, this region received most of the funding from this programme (over € 978 million, about 60% of total H2020 funding in the country. It is followed by the Region of Kentriki Makedonia with 949 participations and 324 million € and the Region of Kriti with 490 participations and 171 million €.

TABLE 3.1: Data on the participation and funding of Greek Regions in 'Horizon 2020 Programme' 2014-2020

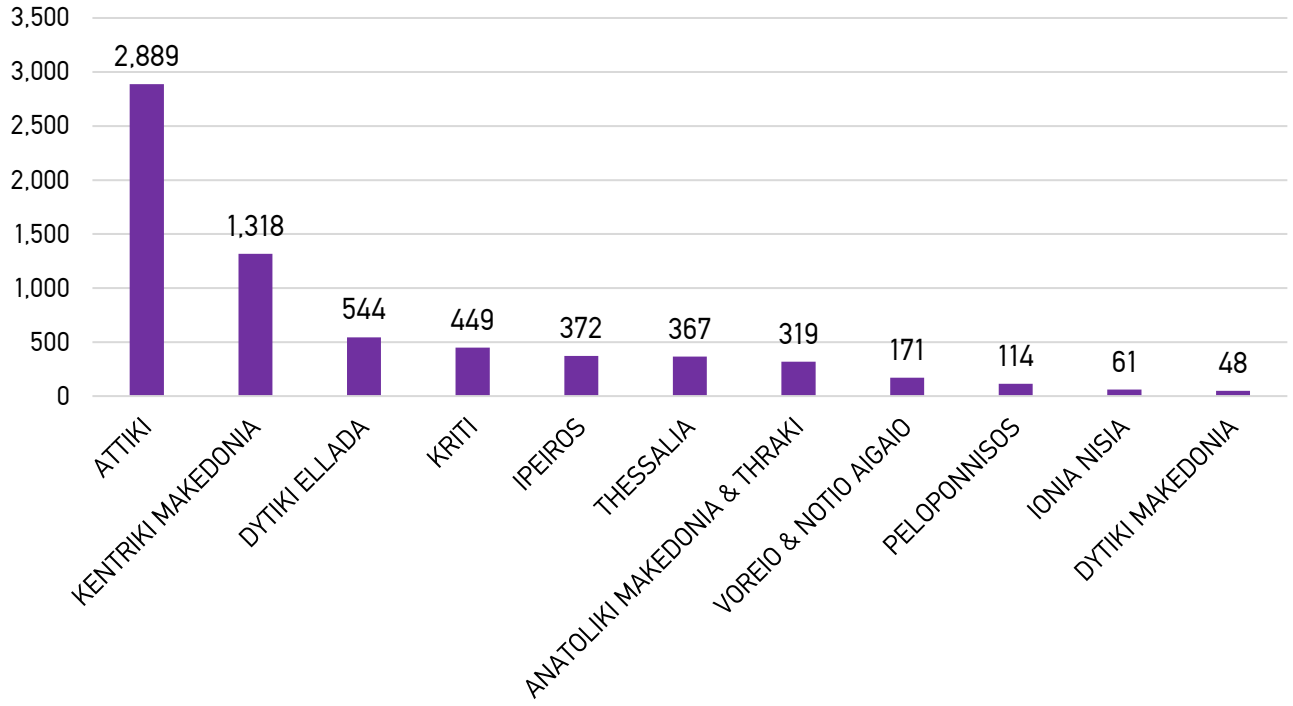
Regions	Number of participations	Community funding (mil. €)
ATTIKI	3,221	978.41
KENTRIKI MAKEDONIA	949	324.0
KRITI	490	171.6
DYTIKI ELLADA	230	84.1
THESSALIA	117	24.1
STEREA ELLADA	85	21.2
IPEIROS	73	20.8
ANATOLIKI MAKEDONIA & THRAKI	42	6.4
DYTIKI MAKEDONIA	41	6.8
PELOPONNISOS	38	6.8
VOREIO AIGAIO	37	9.5
NOTIO AIGAIO	21	3.2
IONIA NISIA	8	1.3
Total	**5,352**	**1,658.1**

Note: Date of update to ecorda 5/5/2021

Scientific publications and doctoral dissertations are a key element of research production. Doctoral dissertations concern exclusively the sector of higher education. Figure 3.1 reflects the number of doctoral dissertations, and their distribution by Region between 2016-2019.

FIGURE 3.1: Number of doctoral dissertations completed in the period 2016-2019, per Region[4]

(Number of doctoral dissertations of each Region)



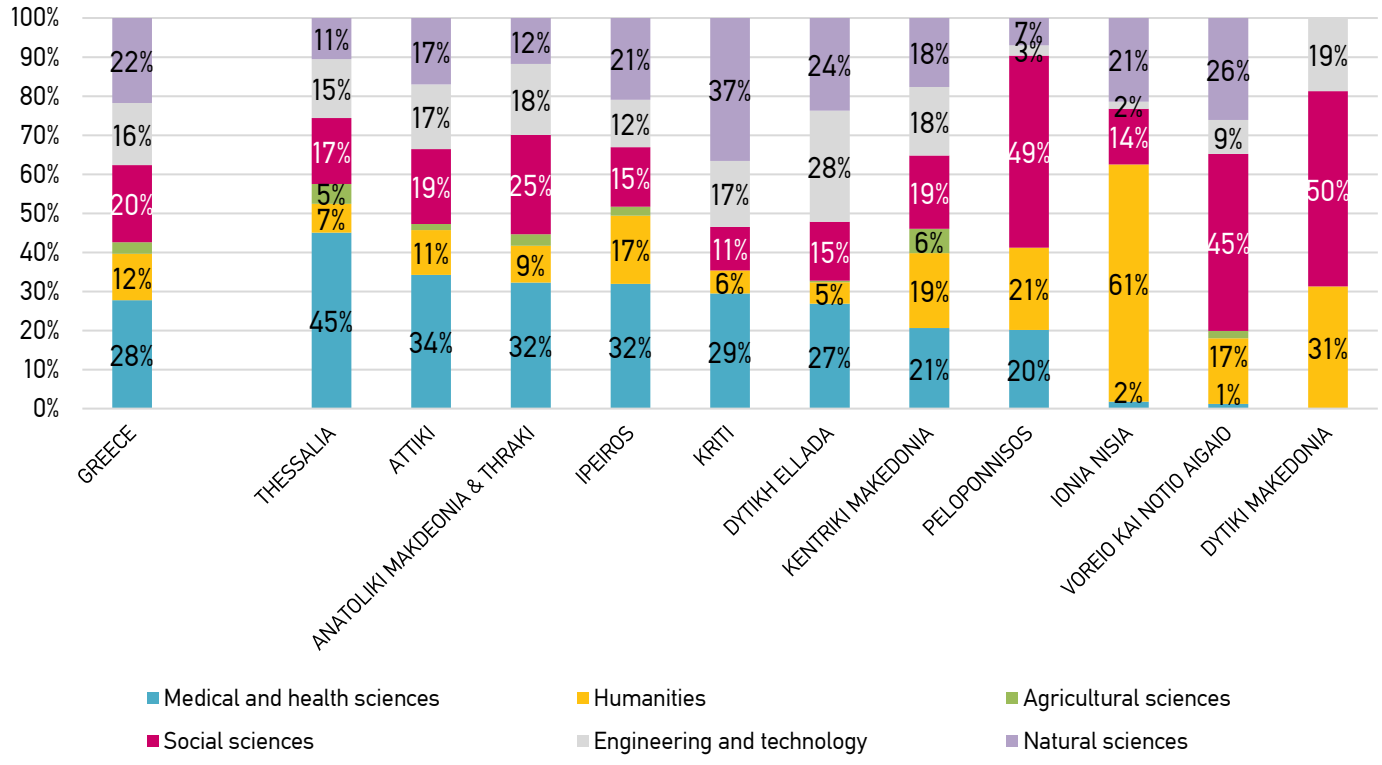
The classification of doctoral dissertations into the scientific fields reflects the fields in which the Universities of each Region are active or scientifically specialised, in terms of ISCED8 studies. This is illustrated by Figure 3.2, with the distribution of PhD theses by Frascati fields of science and Region. Most theses in Greece are allocated to 'Medicine & Health Sciences', followed by 'Natural Sciences','Social Sciences', 'Engineering Sciences & Technology', 'Humanities' and 'Agricultural Sciences', with small reclassifications among different years. If analysis takes into account distribution of theses and scientific fields between Regions, Regions of Thessalia, Attiki, Anatoliki Makedonia-Thraki, Ipeiros and Kentriki Makedonia have the highest concentration of dissertations in 'Medicine & Health Sciences', while 'Social Sciences' was the main field in the Regions of the Peloponnisos, Dytiki Makedonia, and Voreio & Notio Aigaio. Respectively. The highest concentration in the Region of Kriti is

[4] The regions of Voreio & Notio Aigaio are presented together in the figures of the doctoral dissertations, since University of the Aegean has University units in both regions.

in 'Natural Sciences', in the Region of Dytiki Ellada in 'Engineering Sciences & Technology' and in the Region of Ionia Nisia in 'Humanities'.

FIGURE 3.2: Scientific fields of doctoral dissertations in the Greek Regions, 2016-2019

(% distribution of doctoral dissertations in the six main scientific fields of the Frascati classification, by Region)



As far as scientific publications in international journals are concerned, their thematic classification is an important indicator for the scientific fields, in which each Region's research bodies and entities specialise. Thus, under certain assumptions[5], data on the publications can constitute indicators of scientific excellence and specialisation at national and regional level.

[5] Indicatively it is reported that capturing the scientific work in Humanities -and Social Sciences- with bibliometric indicators which are based on the number of publications in international Journals, has important limitations. This is due to the special characteristics of the research and the publications in this particular sector that are quite different from those of the rest scientific fields: the rhythms of research and publications are slower, monographs have a big importance as a means of scientific communication, while publications are made in many languages besides English and, therefore, are not documented in the international databases.

Table 3.2 lists, by Region, (a) the number of scientific publications in international journals, depending on the seat of the institution to which the author(s) belong, according to the Web of Science database; (b) the corresponding citations in the specific publications, and (c) the number of international collaborations for the period 2014-2018. According to data, the highest concentration of publications with international collaborations are to be found in the Region of Attiki, followed by the Region of Kentriki Makedonia, the Region of Kriti and the Region of Dytiki Ellada. Based on the number of citations, the highest performances were recorded in the Regions of Attiki, Kentriki Makedonia, Kriti and Ipeiros.

TABLE 3.2: Number of scientific publications and citations in international journals and number of international collaborations, per Region, 2014-2018

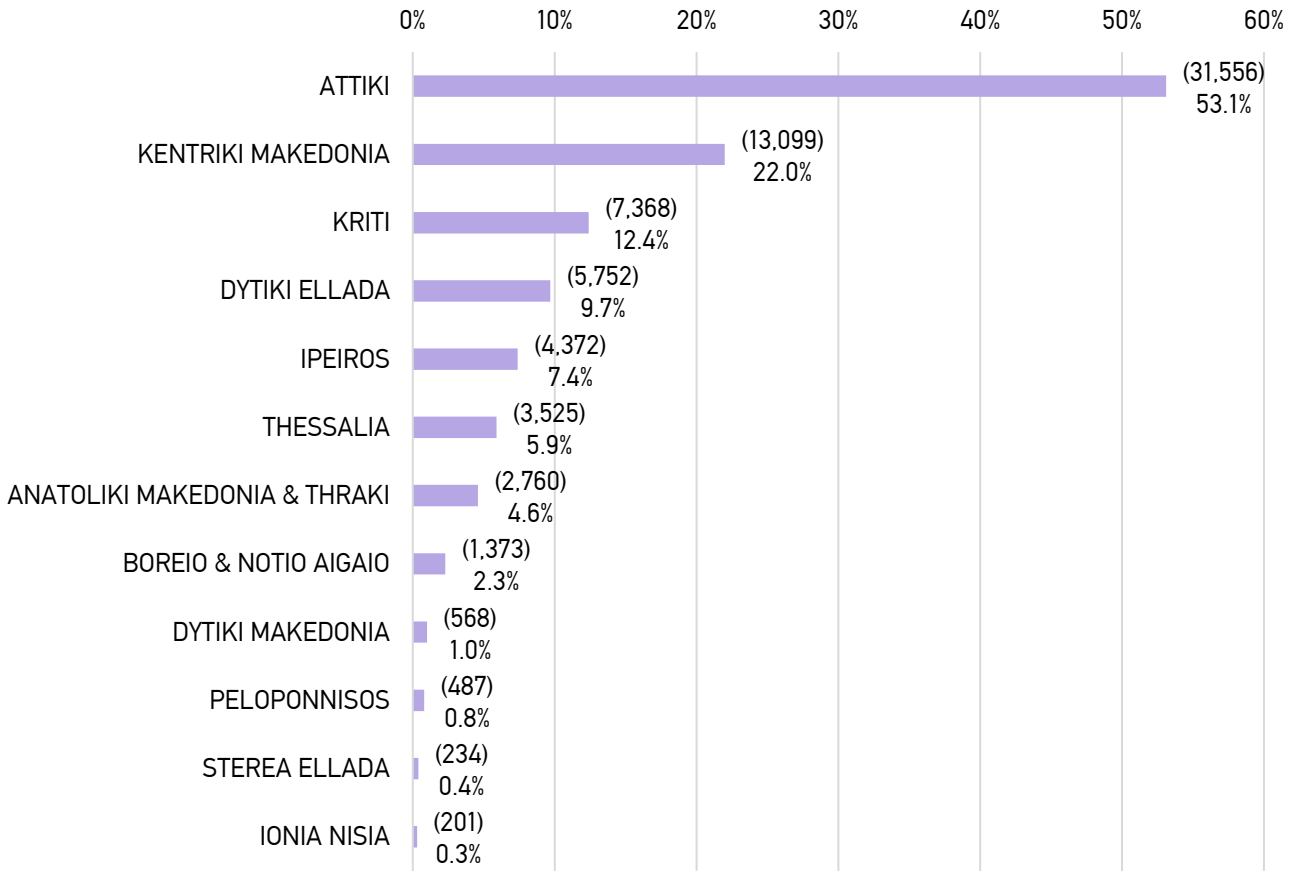
	Number of publications in international journals	Number of citations[6]	Number of international collaborations
ATTIKI	31,556	296,884	18,371
KENTRIKI MAKEDONIA	13,099	116,395	7,151
KRITI	7,368	78,674	4,630
DYTIKI ELLADA	5,752	43,969	2,962
IPEIROS	4,372	46,355	2,762
THESSALIA	3,525	22,469	1,701
ANATOLIKI MAKEDONIA & THRAKI	2,760	17,844	1,207
VOREIO & NOTIO AIGAIO	1,373	13,812	850
DYTIKI MAKEDONIA	568	5,468	297
PELOPONNISOS	487	4,038	261
STEREA ELLADA	234	1,801	152
IONIA NISIA	201	795	82

[6] According to the established methodology followed by EKT, the citations made during a five-year period are counted in the publications published in the same five-year period.

The number and participation of institutions of each Region in the five years 2014-2018 are presented in Figure 3.3. Institutions of the Attiki Region have 31,556 publications and a share of 53.1% in total publications of Greek institutions, followed by institutions of the Region of Kentriki Makedonia with 13,099 publications and a share of 22.0%, and institutions of the Region of Kriti with 7,368 publications and a share of 12.4%. The institutions of the other Regions have shares lower than 10%.

FIGURE 3.3: Number of publications and share of publications in the total publications of the Greek Regions, 2014-2018

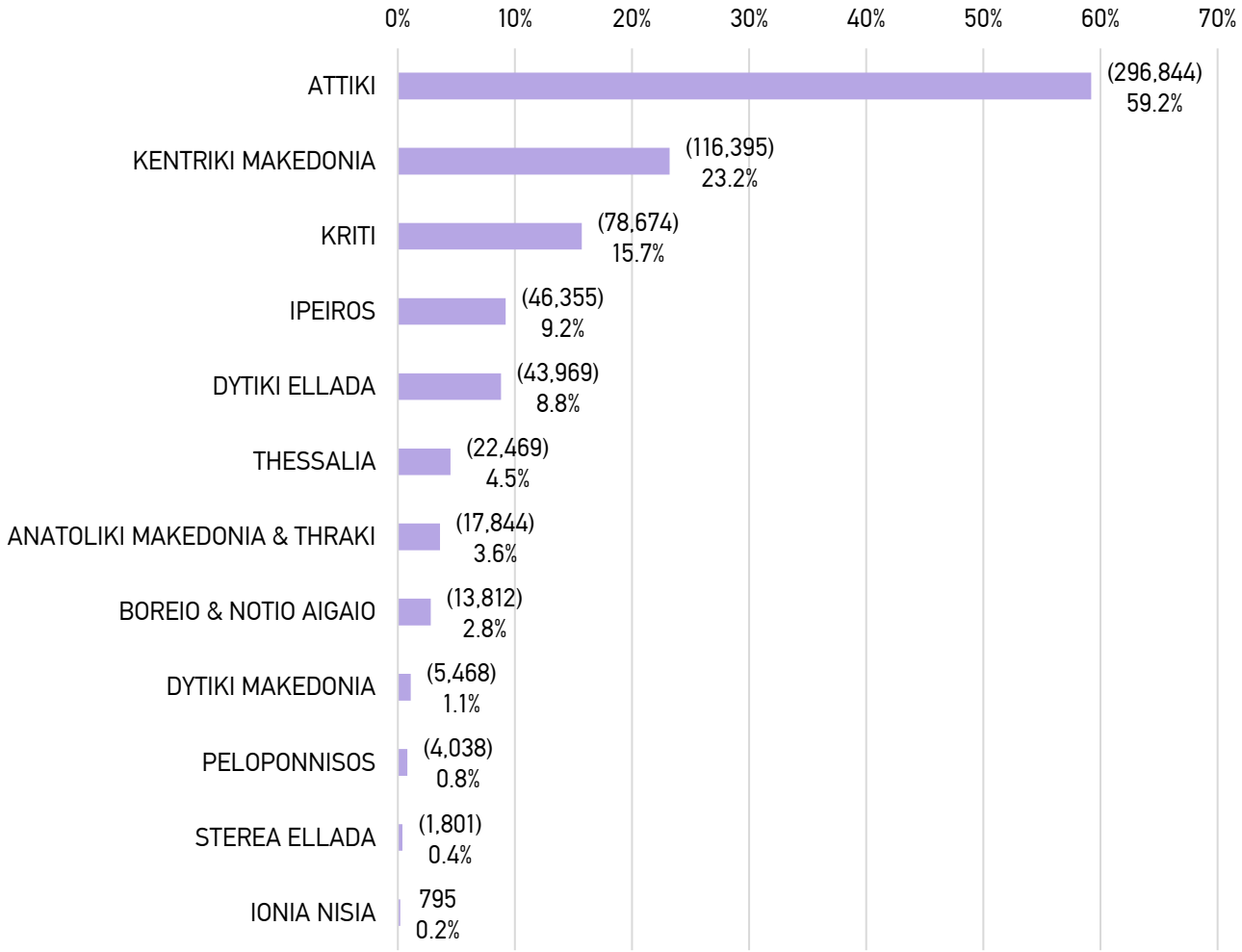
(Number of scientific publications of each Region and share of publications in the whole country)



Respectively, between 2014 and 2018, the number of citations and the share of each Region's institutions in the total number of citations received by the publications is presented in Figure 3.4. The institutions of the Attiki Region received 296,844 citations (share 59.2%), the institutions of the Region of Kentriki Makedonia 116,395 citations (share 23.2%), and the institutions of the Region of Kriti 78,674 citations (share of 15.7%). The institutions of the other Regions had shares below 10%.

FIGURE 3.4: Number of citations and share of citations of each Region in the total number of citations of the country, 2014-2018

(Number of citations in scientific publications of each Region and share of total)



Taking into account the 'Average citations per publication' indicator, i.e. citation impact, which is calculated as the ratio of the number of citations recorded in a region over a period of time to total number of publications of the same region, it seems that for the period 2014-2018, the Region of Kriti achieved the highest citation impact (10.68), followed by the Regions of Ipeiros (10.60), Voreio and Notio Aigaio (10.06), Dytiki Makedonia (9.63), Attici (9.41), Kentrikil Makedonia (8.89), Peloponnisos (8.29), Sterea Ellada (7.70), Dytiki Ellada (7.64), Anatoliki Makedonia and Thraki (6,47), Thessalia (6.37), and Ionia Nisia (3.96) (Figure 3.5).

FIGURE 3.5: Citation Impact Index by Region, 2014-2018

(Number of citations per publication in each Region)

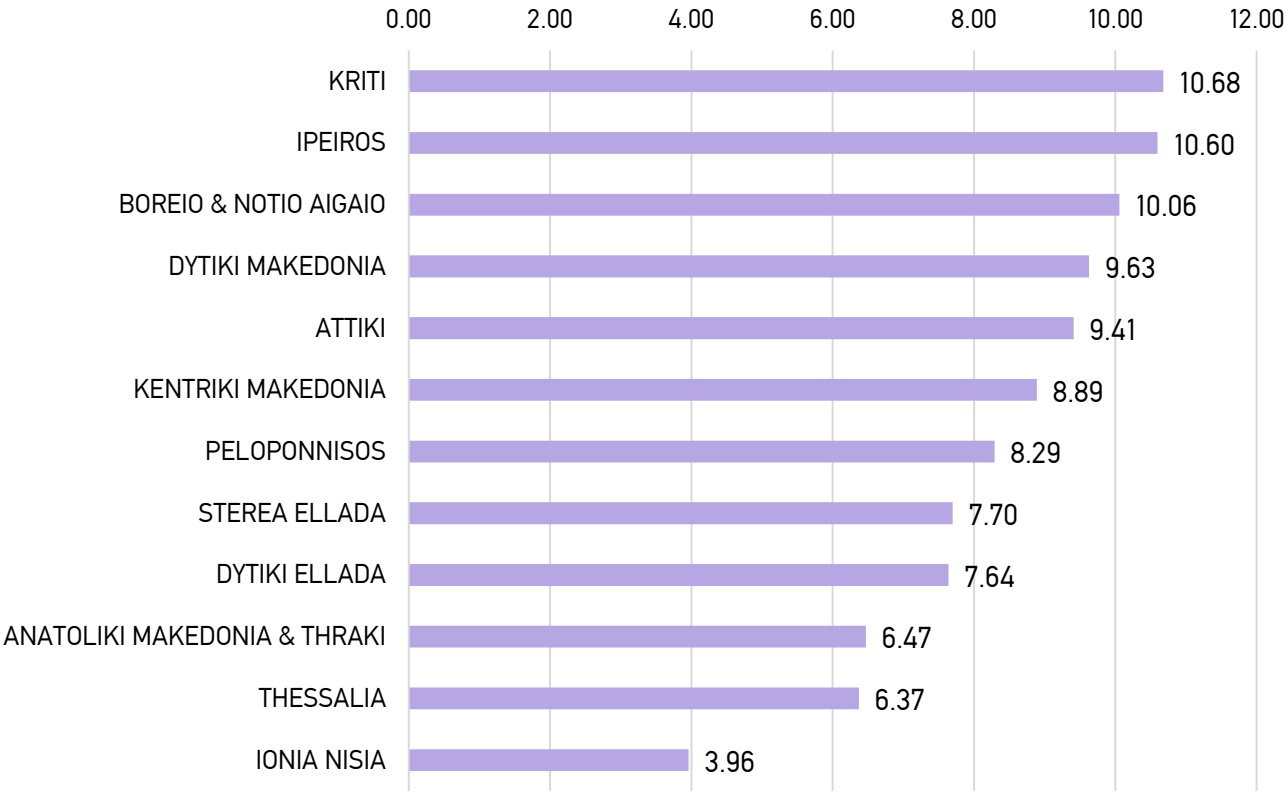
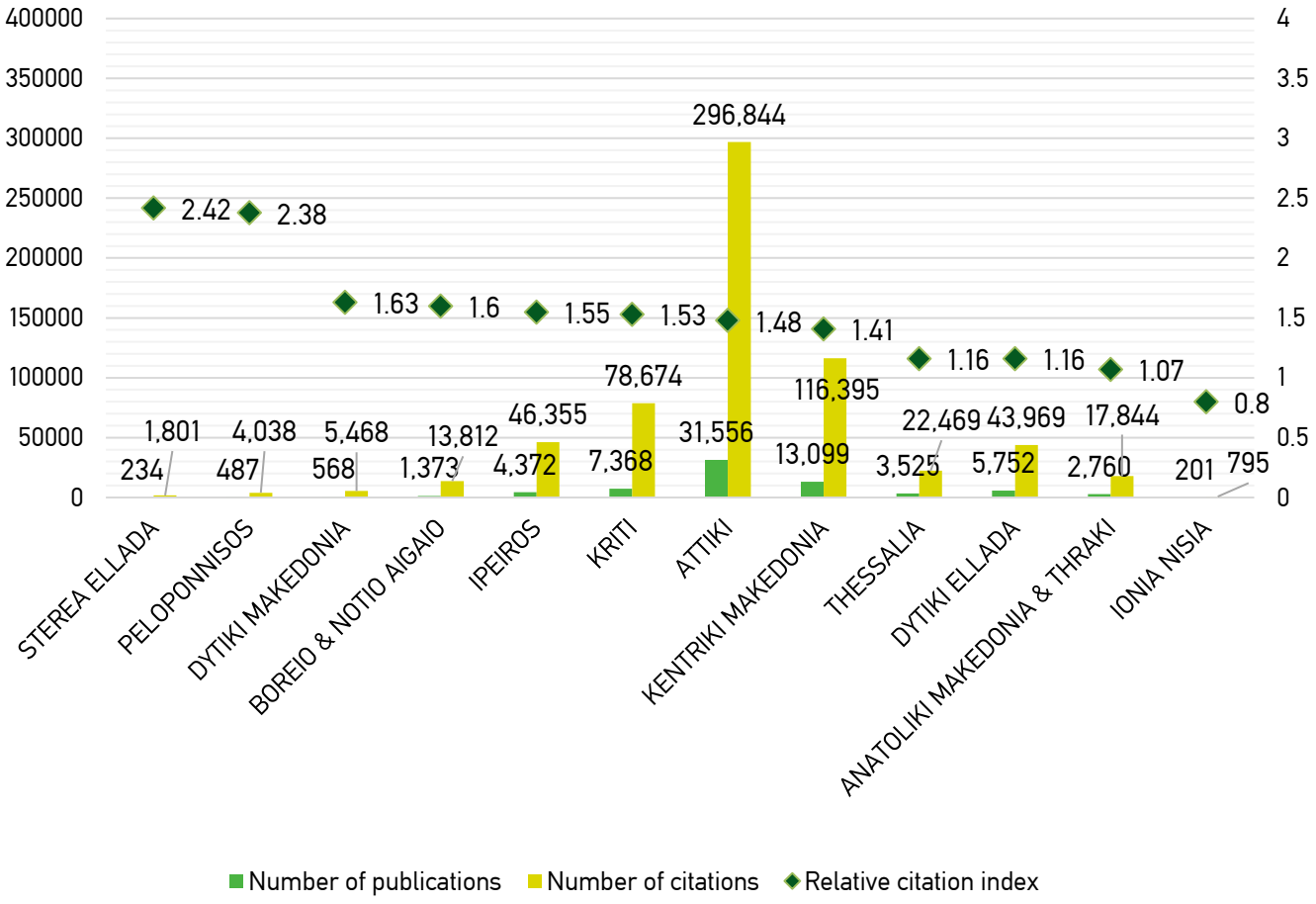


Figure 3.6 depicts the number of publications of the institutions of each region, for the five-year period 2014-2018, the number of citations that these publications received in the same five-year period, as well as the relative citation impact. In particular, relative citation impact reflects the degree to which the average of citations of the Greek publications lags, approaches or exceeds the world citations average, depending on whether relative citation impact of Greece (or a region) is lower, equal, or higher than the value 1, respectively.

In the following figure, the Regions are ranked based on the relative citation impact of their publications. The Region of Sterea Ellada leads, followed by the Region of the Peloponnisos, the Region of Dytiki Makedonia and the Regions of Voreio & Notio Aigaio[7].

FIGURE 3.6: Number of publications, number of citations and relative citation impact for publications per Region 2014-2018

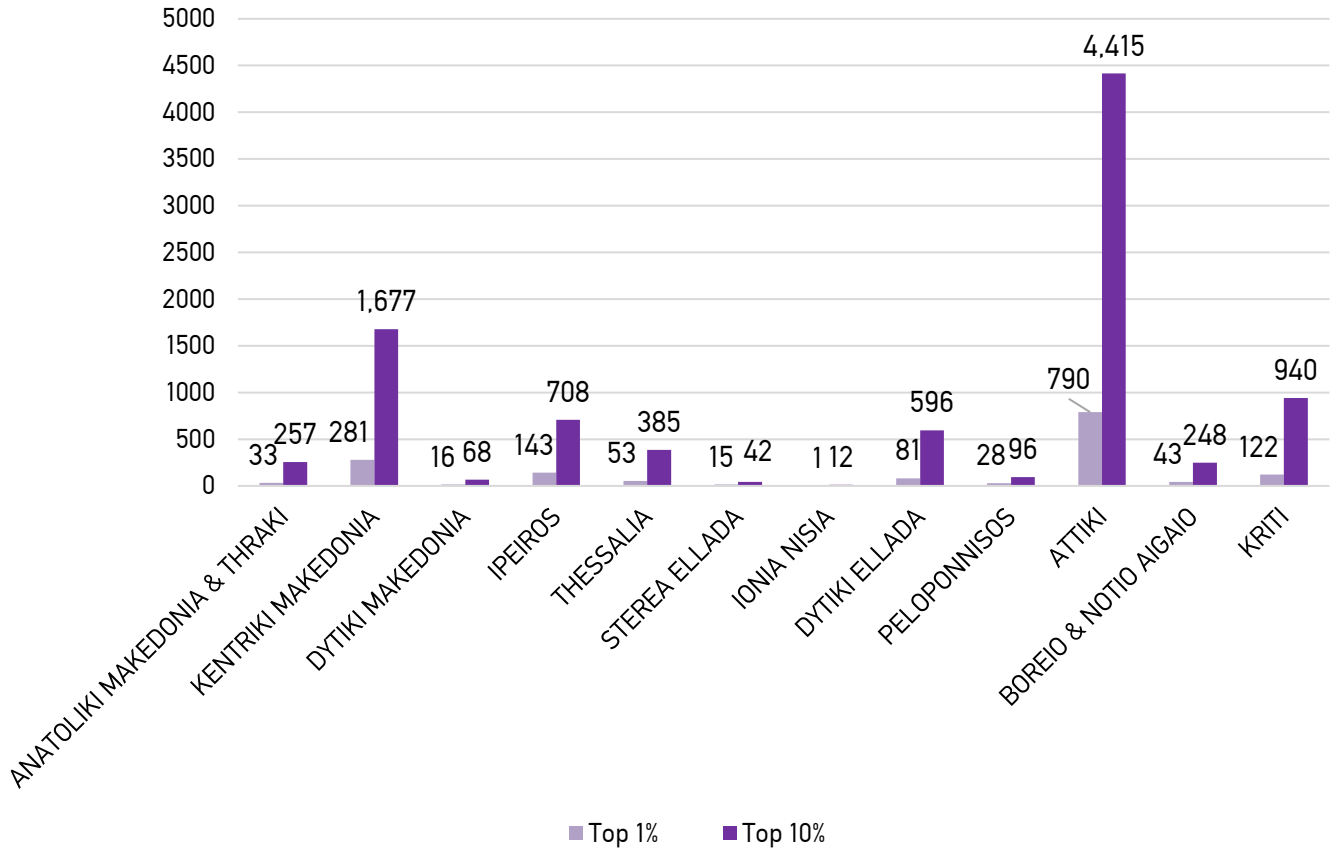
(Number of publications, their citations and normalised relative citation impact per Region)



[7] The calculation of the relative citation impact for the Regions that lead the ranking has been made on the basis of the relatively small number of their publications.

Figure 3.7 shows the number of scientific articles, notes, reviews, etc. published by institutions of each Region, ranked globally at 1% and 10% of the publications with the highest impact per year and scientific area in the five-year period 2014-2018. The 1% of the most impactful publications in the world include publications from all Greek Regions, with most of these publications coming from the Regions of Attiki (790), Kentriki Makedonia (281) and Ipeiros (143).

FIGURE 3.7: Number of publications with high impact (top-1%, 10%) by Region, 2014-2018
(Number of publications per Region ranked globally at 1% and 10% of the publications with the highest impact per year and scientific area)



Based on data of the five-year period 2014-2018, Figure 3.8 records the percentage of publications with high impact in the total number of publications of each Region. The percentage distribution of high-impact publications by Region is compared to the corresponding global distribution of 1% and 10%. Institutions from all Regions, except the Ionia Nisia Region, exceed the global average in the 1% category. Similarly, the institutions from all the Regions, except the Regions of the Ionia Nisia and Anatoliki Makedonia - Thraki, exceed the world average in the 10% category.

FIGURE 3.8: Percentage of publications with high impact by Region, 2014-2018

(Share of publications by Region ranked globally at 1% and 10% of the publications with the highest impact per year and scientific area)

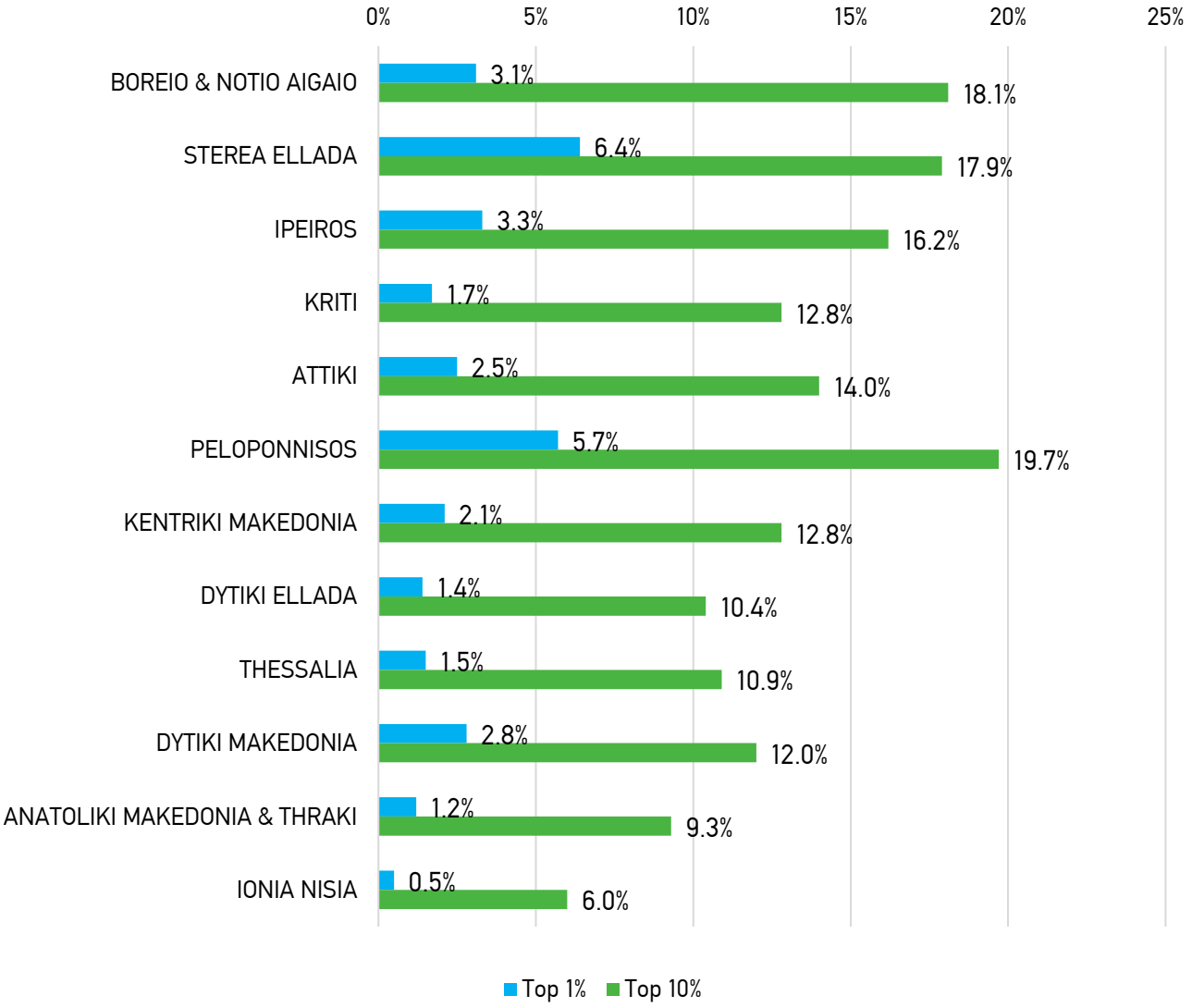


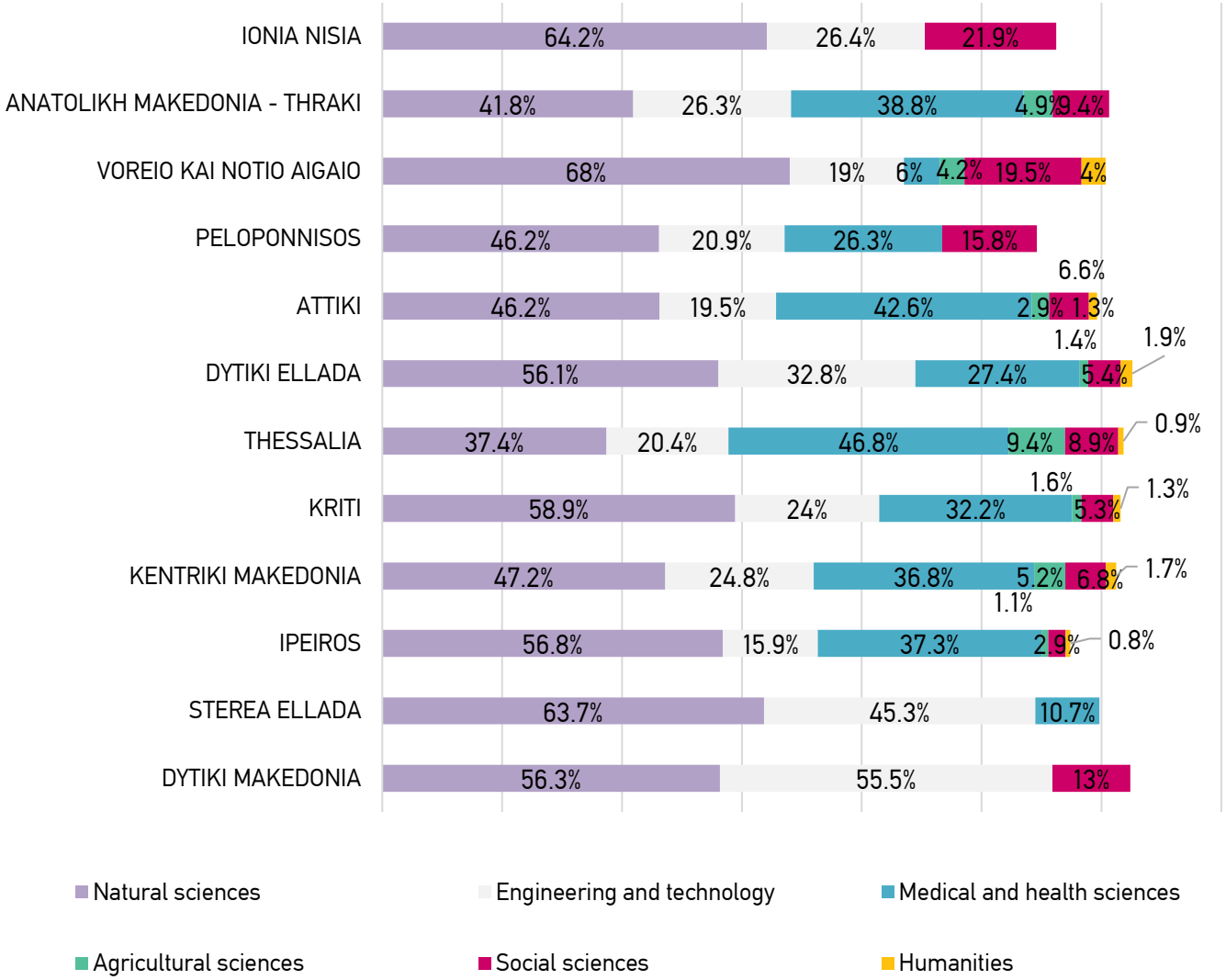
Figure 3.9 captures the thematic specialisation of scientific publications in international journals, by Region, based on the classification among major scientific fields, according to the Frascati International Classification, as in the case of the previous analysis for doctoral dissertations.

Scientific field 'Natural Sciences' is in first place in all Regions, except for the Region of Thessalia, where the highest concentration is noted in 'Medicine & Health Sciences.'

At this point, it should be noted that when a publication corresponds to more than one scientific field, then it is counted with each of the corresponding fields. For these cases, the 'whole counting' technique has been adopted, i.e. each publication is counted once for each topic field. It is obvious that in this way the sum of the shares of publications per scientific field and Region exceeds 100%.

FIGURE 3.9: Scientific fields of scientific publications in the Greek Regions, 2014-2018

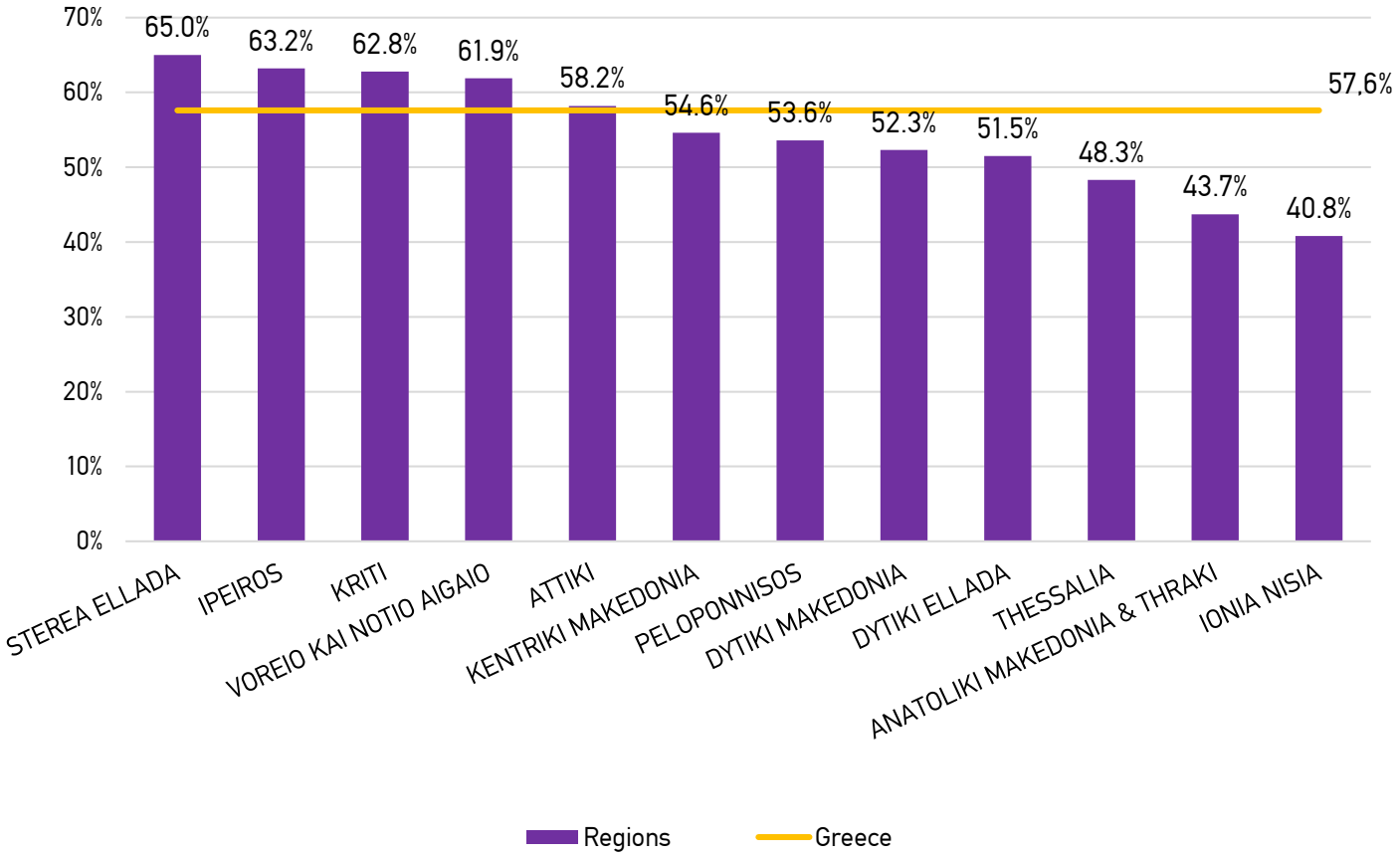
(% distribution of the total scientific publications of each Region among the six major scientific fields of the Frascati classification)



International collaboration that took place in the period 2014-2018 for writing these publications in international journals is an indicator, directly related to scientific extroversion and networking of the Greek scientific community. Figure 3.10 shows that these collaborations were more frequent in the Region of Sterea Ellada (65% of all related publications of the Region), the Region of Ipeiros (63.2%), the Region of Kriti (62.8%), the Voreio and Notio Aigaio Regions (61.9%), and the Attiki Region (58.2%), exceeding the respective national average (57.6%).

FIGURE 3.10: International collaborations for the production of scientific publications in the Greek Regions, 2014-2018

(% of scientific publications of each Region with at least one international collaboration)



Tables 3.3-3.14 present the scientific areas of excellence based on the relative citation impact, this time normalised based on a scientific field (Field normalised citation score). This normalises the regular citation impact - (Citation impact) resulting from the ratio of the number of citations to the number of publications, constituting the average citations per publication - based on the different scientific subject areas of the Web of Science database, and compares impact of a publication in relation to the impact of publications worldwide in the same scientific area. When the value of this particular relative citation impact is higher than 1, the publications examined have a higher impact than the global average. The advantage of the Field normalised citation score is that it takes into account different citation practices or norms per scientific field, and makes it possible to compare it with the corresponding global average for the impact of publications, per specialised scientific field. On this basis it should be distinguished from the regular citation impact presented in Figure 3.5.

Each of the following tables captures a specific aspect of scientific excellence and specialisation by Region. The specific tables reflect those specialised scientific areas (table lines), in which the scientific publications of each Region in international journals achieve a high field normalised citation score (more than 1). For each specialised scientific area, the field normalised citation score is shown, as well as the number of publications that achieved the specific high performance for the period 2014-2018.

TABLE 3.3: Overview of the scientific areas of excellence in the Region of Anatoliki Makedonia Thraki, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF ANATOLIKI MAKEDONIA AND THRAKI

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	agricultural engineering	1.21	13
agricultural sciences	agriculture, dairy & animal science	1.11	10
agricultural sciences	agronomy	1.19	57
engineering and technology	automation & control systems	1.87	24
engineering and technology	construction & building technology	1.37	34
engineering and technology	energy & fuels	1.17	70

REGION OF ANATOLIKI MAKEDONIA AND THRAKI

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, civil	1.15	70
engineering and technology	engineering, chemical	1.06	50
engineering and technology	engineering, electrical & electronic	1.28	179
engineering and technology	engineering, multidisciplinary	1.06	33
engineering and technology	food science & technology	1.45	51
engineering and technology	imaging science & photographic technology	1.25	9
engineering and technology	instruments & instrumentation	1.11	13

REGION OF ANATOLIKI MAKEDONIA AND THRAKI

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	materials science, composites	3.17	10
engineering and technology	materials science, multidisciplinary	1.50	42
engineering and technology	remote sensing	2.83	15
engineering and technology	robotics	2.28	14
engineering and technology	telecommunications	1.44	48
engineering and technology	transportation science & technology	1.00	8
medical and health sciences	cardiac & cardiovascular systems	2.31	48
medical and health sciences	nutrition & dietetics	1.36	20

REGION OF ANATOLIKI MAKEDONIA AND THRAKI

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	clinical neurology	1.00	51
medical and health sciences	critical care medicine	2.60	12
medical and health sciences	dermatology	1.13	23
medical and health sciences	endocrinology & metabolism	1.74	58
medical and health sciences	psychiatry	4.37	11
medical and health sciences	pharmacology & pharmacy	1.17	86
medical and health sciences	respiratory system	1.49	84
medical and health sciences	toxicology	1.46	16
natural sciences	cell biology	5.56	27

REGION OF ANATOLIKI MAKEDONIA AND THRAKI

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	chemistry, analytical	2.05	17
natural sciences	chemistry, applied	1.43	22
natural sciences	entomology	1.22	22
natural sciences	chemistry, physical	1.42	38
natural sciences	computer science, artificial intelligence	1.35	84
natural sciences	computer science, information systems	1.33	52
natural sciences	computer science, software engineering	1.05	39
natural sciences	mathematics	9.63	8

REGION OF ANATOLIKI MAKEDONIA AND THRAKI

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	geography, physical	1.54	9
natural sciences	geosciences, multidisciplinary	1.30	50
natural sciences	mathematics, applied	3.96	36
natural sciences	meteorology & atmospheric sciences	1.78	36
natural sciences	physics, atomic, molecular & chemical	2.08	19
social sciences	education & educational research	1.60	33
social sciences	operations research & management	1.72	22
social sciences	psychology, educational	2.09	11

TABLE 3.4: Overview of the scientific areas of excellence in the Region of Kentriki Makedonia, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	agricultural economics & policy	2.05	9
agricultural sciences	agricultural engineering	1.44	40
agricultural sciences	agriculture, dairy & animal science	1.33	79
agricultural sciences	agriculture, multidisciplinary	1.33	75
agricultural sciences	fisheries	1.13	64
agricultural sciences	forestry	1.46	64
agricultural sciences	horticulture	1.05	52
engineering and technology	automation & control systems	2.68	55

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	computer science, hardware & architecture	1.54	65
engineering and technology	construction & building technology	1.30	89
engineering and technology	energy & fuels	1.31	345
engineering and technology	engineering, aerospace	1.46	16
engineering and technology	engineering, chemical	1.20	402
engineering and technology	engineering, civil	1.07	219
engineering and technology	engineering, electrical & electronic	1.96	708
engineering and technology	engineering, environmental	1.63	193
engineering and technology	engineering, geological	1.17	128
engineering and technology	engineering, industrial	1.30	35
engineering and technology	engineering, manufacturing	1.08	29

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, mechanical	1.21	131
engineering and technology	engineering, multidisciplinary	1.56	62
engineering and technology	engineering, ocean	1.05	8
engineering and technology	food science & technology	1.16	275
engineering and technology	imaging science & photographic technology	1.02	42
engineering and technology	instruments & instrumentation	1.26	109
engineering and technology	materials science, composites	2.08	32
engineering and technology	mechanics	1.34	156
engineering and technology	mining & mineral processing	1.20	20
engineering and technology	neuroimaging	1.26	18
engineering and technology	nuclear science & technology	1.06	116

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	remote sensing	1.04	69
engineering and technology	robotics	1.63	23
engineering and technology	telecommunications	2.53	317
engineering and technology	thermodynamics	1.06	143
engineering and technology	transportation science & technology	2.46	61
humanities	archaeology	1.02	42
humanities	classics	4.17	13
humanities	music	1.06	14
medical and health sciences	allergy	1.88	14
medical and health sciences	anesthesiology	1.60	16
medical and health sciences	cell & tissue engineering	0.66	16

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	cardiac & cardiovascular systems	1.12	314
medical and health sciences	chemistry, medicinal	1.03	118
medical and health sciences	clinical neurology	1.34	294
medical and health sciences	critical care medicine	1.78	47
medical and health sciences	dermatology	1.63	116
medical and health sciences	emergency medicine	1.27	13
medical and health sciences	endocrinology & metabolism	2.53	343
medical and health sciences	gastroenterology & hepatology	1.24	93
medical and health sciences	geriatrics & gerontology	1.36	80
medical and health sciences	medicine, general & internal	6.77	39
medical and health sciences	health policy & services	1.08	17

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	substance abuse	1.81	17
medical and health sciences	hematology	1.00	158
medical and health sciences	infectious diseases	1.66	162
medical and health sciences	integrative & complementary medicine	1.63	10
medical and health sciences	medical informatics	1.72	27
medical and health sciences	neurosciences	1.18	318
medical and health sciences	nutrition & dietetics	1.23	113
medical and health sciences	obstetrics & gynecology	1.09	182
medical and health sciences	ophthalmology	1.88	68
medical and health sciences	otorhinolaryngology	1.11	66
medical and health sciences	parasitology	1.08	65

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	peripheral vascular disease	1.02	309
medical and health sciences	pharmacology & pharmacy	1.29	453
medical and health sciences	physiology	1.06	120
medical and health sciences	sport sciences	1.02	120
medical and health sciences	psychiatry	2.81	131
medical and health sciences	public, environmental & occupational health	8.22	148
medical and health sciences	respiratory system	1.13	141
medical and health sciences	rheumatology	1.14	67
medical and health sciences	toxicology	1.28	81
medical and health sciences	transplantation	1.07	43
medical and health sciences	tropical medicine	1.24	24

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	acoustics	1.34	38
natural sciences	astronomy & astrophysics	2.12	391
natural sciences	behavioral sciences	1.16	18
natural sciences	biodiversity conservation	1.30	47
natural sciences	biology	1.06	62
natural sciences	reproductive biology	1.57	62
natural sciences	biophysics	1.51	41
natural sciences	chemistry, analytical	1.21	219
natural sciences	chemistry, applied	1.55	128
natural sciences	chemistry, inorganic & nuclear	1.26	136
natural sciences	chemistry, physical	1.28	341

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	computer science, artificial intelligence	1.22	202
natural sciences	computer science, cybernetics	1.03	20
natural sciences	computer science, information systems	1.41	264
natural sciences	computer science, interdisciplinary applications	1.06	181
natural sciences	computer science, software engineering	1.07	175
natural sciences	computer science, theory & methods	1.73	154
natural sciences	geography, physical	1.14	43
natural sciences	spectroscopy	1.48	16
natural sciences	ecology	1.30	122
natural sciences	entomology	1.31	53
natural sciences	environmental sciences	1.22	756

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	evolutionary biology	1.07	45
natural sciences	genetics & heredity	1.57	151
natural sciences	geosciences, multidisciplinary	1.28	273
natural sciences	marine & freshwater biology	1.32	117
natural sciences	mathematical & computational biology	1.17	51
natural sciences	mathematics, applied	1.43	90
natural sciences	mathematics, interdisciplinary applications	1.65	60
natural sciences	meteorology & atmospheric sciences	1.53	213
natural sciences	microbiology	1.55	194
natural sciences	oceanography	1.23	63
natural sciences	optics	1.48	108

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	physics, atomic, molecular & chemical	1.23	68
natural sciences	physics, mathematical	1.12	50
natural sciences	physics, multidisciplinary	2.03	162
natural sciences	physics, nuclear	2.62	180
natural sciences	physics, particles & fields	3.09	572
natural sciences	polymer science	1.38	110
natural sciences	water resources	1.01	182
social sciences	anthropology	1.06	23
social sciences	psychology, biological	1.06	11
social sciences	social issues	1.84	11
social sciences	business	1.03	62

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
social sciences	psychology, experimental	1.24	62
social sciences	communication	1.42	24
social sciences	information science & library science	1.10	24
social sciences	education & educational research	1.69	76
social sciences	environmental studies	1.44	86
social sciences	gerontology	1.15	8
social sciences	psychology, social	2.33	8
social sciences	international relations	2.70	9
social sciences	operations research & management science	1.18	102
social sciences	political science	2.18	21
social sciences	social sciences, interdisciplinary	1.05	21

REGION OF KENTRIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
social sciences	psychology	1.05	45
social sciences	psychology, educational	2.71	15
social sciences	transportation	1.16	34
social sciences	urban studies	2.55	14

TABLE 3.5: Overview of the scientific areas of excellence in the Region of Dytiki Makedonia, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF DYTIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	computer science, hardware & architecture	5.99	13
engineering and technology	construction & building technology	1.24	14
engineering and technology	energy & fuels	1.24	68
engineering and technology	engineering, chemical	1.02	54
engineering and technology	engineering, civil	1.34	11
engineering and technology	engineering, electrical & electronic	2.57	97
engineering and technology	engineering, environmental	1.16	17

REGION OF DYTIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, mechanical	1.17	21
engineering and technology	mechanics	1.24	22
engineering and technology	telecommunications	3.30	65
engineering and technology	thermodynamics	1.08	23
natural sciences	chemistry, analytical	2.15	8
natural sciences	chemistry, applied	1.49	8
natural sciences	computer science, information systems	4.25	43
natural sciences	computer science, theory & methods	5.98	16
natural sciences	electrochemistry	1.39	12
natural sciences	mathematics, applied	11.56	12

REGION OF DYTIKI MAKEDONIA

Major Scientific Field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	meteorology & atmospheric sciences	1.08	14
social sciences	operations research & management science	1.93	16
social sciences	management	1.35	9

TABLE 3.6: Overview of the scientific areas of excellence in the of Region of Ipeiros, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	agriculture, dairy & animal science	1.11	9
engineering and technology	automation & control systems	2.79	9
engineering and technology	engineering, manufacturing	1.07	9
engineering and technology	energy & fuels	1.53	29
engineering and technology	engineering, chemical	1.16	59
engineering and technology	engineering, electrical & electronic	1.13	59
engineering and technology	engineering, environmental	1.37	34

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, industrial	1.66	8
engineering and technology	engineering, multidisciplinary	2.48	11
engineering and technology	food science & technology	1.04	91
engineering and technology	instruments & instrumentation	6.02	58
engineering and technology	materials science, ceramics	1.59	15
engineering and technology	metallurgy & metallurgical engineering	1.23	21
engineering and technology	materials science, composites	1.97	18
engineering and technology	materials science, multidisciplinary	1.38	236
engineering and technology	mechanics	1.03	19
engineering and technology	nanoscience & nanotechnology	1.68	99

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	nuclear science & technology	1.16	22
engineering and technology	thermodynamics	1.41	12
humanities	history	2.09	8
medical and health sciences	allergy	1.49	9
medical and health sciences	anesthesiology	2.25	12
medical and health sciences	cardiac & cardiovascular systems	1.74	164
medical and health sciences	clinical neurology	1.43	140
medical and health sciences	endocrinology & metabolism	1.60	75
medical and health sciences	radiology, nuclear medicine & medical imaging	1.37	75

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	gastroenterology & hepatology	1.82	72
medical and health sciences	health care sciences & services	2.02	26
medical and health sciences	immunology	1.01	27
medical and health sciences	medical informatics	1.14	27
medical and health sciences	infectious diseases	1.88	22
medical and health sciences	medicine, general & internal	3.68	19
medical and health sciences	ophthalmology	3.10	19
medical and health sciences	nutrition & dietetics	1.59	42
medical and health sciences	obstetrics & gynecology	1.68	48
medical and health sciences	oncology	1.10	260

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	otorhinolaryngology	1.35	13
medical and health sciences	pathology	1.15	13
medical and health sciences	toxicology	1.28	13
medical and health sciences	peripheral vascular disease	1.47	101
medical and health sciences	psychiatry	1.96	65
medical and health sciences	public, environmental & occupational health	1.77	52
medical and health sciences	respiratory system	1.15	37
medical and health sciences	sport sciences	1.04	20
medical and health sciences	urology & nephrology	1.06	55
natural sciences	acoustics	1.04	9

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	geography, physical	1.32	9
natural sciences	astronomy & astrophysics	2.86	278
natural sciences	biodiversity conservation	1.32	10
natural sciences	biotechnology & applied microbiology	1.38	56
natural sciences	chemistry, applied	1.32	54
natural sciences	chemistry, analytical	1.59	103
natural sciences	chemistry, inorganic & nuclear	1.22	84
natural sciences	chemistry, multidisciplinary	1.41	141
natural sciences	chemistry, physical	1.07	201
natural sciences	computer science, artificial intelligence	1.05	42

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	meteorology & atmospheric sciences	1.00	51
natural sciences	ecology	1.16	28
natural sciences	electrochemistry	1.47	28
natural sciences	entomology	2.14	17
natural sciences	mathematics, interdisciplinary applications	2.07	17
natural sciences	environmental sciences	1.04	121
natural sciences	genetics & heredity	3.60	60
natural sciences	geosciences, multidisciplinary	1.35	12
natural sciences	mathematical & computational biology	1.49	49
natural sciences	mathematics	1.27	180

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	mathematics, applied	1.42	190
natural sciences	microbiology	1.47	35
natural sciences	statistics & probability	1.10	35
natural sciences	physics, applied	1.70	107
natural sciences	physics, condensed matter	1.09	46
natural sciences	physics, mathematical	1.15	18
natural sciences	physics, multidisciplinary	3.30	97
natural sciences	physics, nuclear	3.19	203
natural sciences	physics, particles & fields	2.76	551
natural sciences	polymer science	1.36	119

REGION OF IPEIROS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	virology	1.27	8
social sciences	economics	1.03	30
social sciences	psychology	1.87	8
social sciences	psychology, clinical	1.07	12

TABLE 3.7: Overview of the scientific areas of excellence in the Region of Thessalia, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF THESSALIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	agricultural engineering	1.11	15
agricultural sciences	agriculture, dairy & animal science	1.35	62
agricultural sciences	agriculture, multidisciplinary	1.26	40
agricultural sciences	horticulture	4.15	8
engineering and technology	computer science, hardware & architecture	1.86	28
engineering and technology	energy & fuels	1.37	53
engineering and technology	engineering, chemical	1.59	72
engineering and technology	engineering, civil	1.09	61

REGION OF THESSALIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, electrical & electronic	1.68	84
engineering and technology	engineering, environmental	2.57	50
engineering and technology	engineering, geological	1.10	18
engineering and technology	engineering, mechanical	1.17	49
engineering and technology	engineering, multidisciplinary	1.18	21
engineering and technology	food science & technology	1.68	120
engineering and technology	instruments & instrumentation	1.44	24
engineering and technology	medical laboratory technology	1.42	17
engineering and technology	nanoscience & nanotechnology	1.07	15
engineering and technology	telecommunications	1.73	65
engineering and technology	transportation science & technology	1.39	19

REGION OF THESSALIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	allergy	1.18	9
medical and health sciences	anesthesiology	1.71	9
medical and health sciences	dermatology	1.05	9
medical and health sciences	cardiac & cardiovascular systems	1.09	92
medical and health sciences	chemistry, medicinal	1.05	30
medical and health sciences	clinical neurology	1.64	124
medical and health sciences	critical care medicine	1.44	19
medical and health sciences	medicine, general & internal	8.75	19
medical and health sciences	gastroenterology & hepatology	1.66	59
medical and health sciences	geriatrics & gerontology	1.49	16
medical and health sciences	medical informatics	1.01	13

REGION OF THESSALIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	infectious diseases	1.16	68
medical and health sciences	respiratory system	1.01	68
medical and health sciences	medicine, research & experimental	1.00	96
medical and health sciences	nursing	1.82	15
medical and health sciences	nutrition & dietetics	1.58	54
medical and health sciences	ophthalmology	2.95	21
medical and health sciences	peripheral vascular disease	1.11	108
medical and health sciences	pharmacology & pharmacy	1.01	105
medical and health sciences	public, environmental & occupational health	1.71	87
medical and health sciences	rheumatology	1.93	36
medical and health sciences	sport sciences	1.25	103

REGION OF THESSALIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	substance abuse	1.67	18
medical and health sciences	toxicology	1.65	53
medical and health sciences	tropical medicine	1.10	11
medical and health sciences	urology & nephrology	1.08	64
natural sciences	mathematics	1.08	10
natural sciences	biochemistry & molecular biology	1.19	122
natural sciences	chemistry, applied	2.02	30
natural sciences	computer science, software engineering	1.06	30
natural sciences	chemistry, physical	2.49	46
natural sciences	computer science, information systems	1.13	51
natural sciences	computer science, interdisciplinary applications	1.07	60

REGION OF THESSALIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	computer science, theory & methods	1.71	28
natural sciences	electrochemistry	1.20	27
natural sciences	entomology	1.70	96
natural sciences	oceanography	1.56	9
natural sciences	genetics & heredity	1.85	55
natural sciences	geosciences, multidisciplinary	1.40	38
natural sciences	mathematics, interdisciplinary applications	1.22	17
natural sciences	microbiology	1.09	87
natural sciences	statistics & probability	1.08	16
social sciences	business, finance	1.03	22
social sciences	environmental studies	1.08	47

REGION OF THESSALIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
social sciences	geography	1.08	18
social sciences	management	1.11	34
social sciences	operations research & management science	1.17	35
social sciences	psychology	1.48	21
social sciences	psychology, applied	1.29	24
social sciences	psychology, clinical	1.59	11
social sciences	psychology, multidisciplinary	1.05	8
social sciences	urban studies	1.69	8

TABLE 3.8: Overview of scientific areas of excellence in the Region of the Iona Nisia, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF THE IONIA NISIA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
social sciences	education & educational research	2.07	8
social sciences	information science & library science	1.13	18
natural sciences	computer science, information systems	1.33	27

TABLE 3.9: Overview of the scientific areas of excellence in the Region of the Peloponnisos, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF THE PELOPONNISOS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, electrical & electronic	1.16	60
engineering and technology	telecommunications	1.27	55
medical and health sciences	gastroenterology & hepatology	7.23	10
medical and health sciences	nursing	1.03	13
natural sciences	entomology	1.19	9
natural sciences	chemistry, multidisciplinary	3.23	57
natural sciences	computer science, interdisciplinary applications	1.19	15
natural sciences	mathematics	19.08	8

REGION OF THE PELOPONNISOS

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	physics, mathematical	5.72	8
natural sciences	computer science, theory & methods	1.26	11
natural sciences	mathematics, applied	18.56	28
natural sciences	mathematics, interdisciplinary applications	2.99	62
social sciences	business	1.71	8

TABLE 3.10: Overview of the scientific areas of excellence in the Region of Dytikis Ellada, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF DYTIKI ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	agricultural engineering	1.08	30
agricultural sciences	agronomy	1.32	12
agricultural sciences	forestry	4.27	12
engineering and technology	automation & control systems	2.30	49
engineering and technology	computer science, hardware & architecture	1.65	84
engineering and technology	construction & building technology	1.76	53
engineering and technology	engineering, multidisciplinary	1.45	53
engineering and technology	energy & fuels	1.21	162
engineering and technology	materials science, ceramics	2.03	9

REGION OF DYTIKI ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, chemical	1.24	197
engineering and technology	engineering, civil	1.43	121
engineering and technology	engineering, electrical & electronic	1.60	317
engineering and technology	engineering, environmental	1.63	135
engineering and technology	engineering, geological	1.07	96
engineering and technology	engineering, industrial	1.91	32
engineering and technology	engineering, manufacturing	2.07	77
engineering and technology	food science & technology	1.56	78
engineering and technology	instruments & instrumentation	1.88	69
engineering and technology	materials science, composites	1.44	70
engineering and technology	materials science, multidisciplinary	1.10	360

REGION OF DYTIKI ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	transportation science & technology	1.26	10
engineering and technology	nanoscience & nanotechnology	1.36	123
engineering and technology	nuclear science & technology	1.21	19
engineering and technology	robotics	1.21	24
engineering and technology	telecommunications	1.38	157
medical and health sciences	surgery	1.97	88
medical and health sciences	nutrition & dietetics	1.34	26
medical and health sciences	hematology	1.47	60
medical and health sciences	public, environmental & occupational health	1.19	60
medical and health sciences	pharmacology & pharmacy	1.23	179
medical and health sciences	physiology	1.57	12

REGION OF DYTIKI ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	psychiatry	1.44	29
medical and health sciences	rheumatology	1.15	24
medical and health sciences	substance abuse	5.54	11
medical and health sciences	toxicology	1.93	40
medical and health sciences	transplantation	1.54	15
natural sciences	astronomy & astrophysics	1.88	132
natural sciences	limnology	1.71	9
natural sciences	plant sciences	1.57	40
natural sciences	biodiversity conservation	1.35	30
natural sciences	biotechnology & applied microbiology	1.09	164
natural sciences	chemistry, applied	1.20	77

REGION OF DYTIKI ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	chemistry, inorganic & nuclear	1.19	56
natural sciences	chemistry, multidisciplinary	1.46	185
natural sciences	chemistry, organic	1.14	25
natural sciences	chemistry, physical	1.11	310
natural sciences	computer science, artificial intelligence	1.14	107
natural sciences	computer science, cybernetics	1.20	13
natural sciences	entomology	2.75	13
natural sciences	computer science, information systems	1.11	129
natural sciences	computer science, interdisciplinary applications	1.07	118
natural sciences	ecology	2.17	61
natural sciences	electrochemistry	1.30	48

REGION OF DYTIKI ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	environmental sciences	1.39	342
natural sciences	evolutionary biology	1.70	20
natural sciences	geochemistry & geophysics	1.14	49
natural sciences	geography, physical	1.09	19
natural sciences	marine & freshwater biology	1.54	45
natural sciences	meteorology & atmospheric sciences	1.50	94
natural sciences	microbiology	1.05	87
natural sciences	physics, applied	1.13	196
natural sciences	physics, fluids & plasmas	1.17	32
natural sciences	physics, multidisciplinary	1.80	71
natural sciences	physics, nuclear	2.95	59

REGION OF DYTIKI ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	physics, particles & fields	2.96	224
social sciences	business	1.07	15
social sciences	business, finance	1.25	26
social sciences	operations research & management science	1.36	68

TABLE 3.11: Overview of the scientific areas of excellence in the Region of Attiki, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	agricultural economics & policy	1.49	11
agricultural sciences	agricultural engineering	1.19	111
agricultural sciences	agriculture, dairy & animal science	1.33	110
agricultural sciences	agriculture, multidisciplinary	1.52	104
agricultural sciences	fisheries	1.60	218
agricultural sciences	forestry	1.46	50
agricultural sciences	horticulture	1.03	78
agricultural sciences	soil science	1.03	63
agricultural sciences	veterinary sciences	1.17	124

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	regional & urban planning	1.74	41
engineering and technology	automation & control systems	1.68	130
engineering and technology	computer science, hardware & architecture	1.71	183
engineering and technology	construction & building technology	1.35	206
engineering and technology	energy & fuels	1.54	752
engineering and technology	engineering, aerospace	1.39	27
engineering and technology	engineering, chemical	1.07	471
engineering and technology	engineering, civil	1.24	543
engineering and technology	engineering, electrical & electronic	1.60	1.044
engineering and technology	engineering, environmental	1.34	292
engineering and technology	engineering, geological	1.09	167

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, industrial	1.19	79
engineering and technology	engineering, marine	1.16	65
engineering and technology	engineering, mechanical	1.21	201
engineering and technology	engineering, multidisciplinary	1.39	136
engineering and technology	engineering, ocean	1.21	57
engineering and technology	food science & technology	1.13	614
engineering and technology	imaging science & photographic technology	1.56	67
engineering and technology	materials science, composites	1.02	67
engineering and technology	instruments & instrumentation	2.20	279
engineering and technology	materials science, biomaterials	1.02	70
engineering and technology	materials science, ceramics	1.50	34

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	materials science, characterization & testing	1.89	26
engineering and technology	materials science, coatings & films	1.05	77
engineering and technology	mechanics	1.36	351
engineering and technology	medical laboratory technology	1.41	100
engineering and technology	mining & mineral processing	1.40	47
engineering and technology	neuroimaging	1.85	41
engineering and technology	nuclear science & technology	1.13	312
engineering and technology	remote sensing	1.30	124
engineering and technology	robotics	1.27	18
engineering and technology	telecommunications	1.76	527
engineering and technology	thermodynamics	1.76	228

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	transportation science & technology	1.47	143
humanities	archaeology	1.17	119
humanities	architecture	4.22	10
humanities	art	2.50	25
humanities	classics	1.21	20
humanities	ethics	1.45	11
humanities	history	1.17	43
humanities	humanities, multidisciplinary	1.35	28
humanities	language & linguistics	1.57	39
humanities	linguistics	1.44	56
humanities	religion	1.27	16

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	allergy	2.86	141
medical and health sciences	cardiac & cardiovascular systems	1.43	1.380
medical and health sciences	cell & tissue engineering	1.27	30
medical and health sciences	clinical neurology	1.23	643
medical and health sciences	critical care medicine	2.21	202
medical and health sciences	dentistry, oral surgery & medicine	1.42	350
medical and health sciences	dermatology	1.44	189
medical and health sciences	rheumatology	1.89	189
medical and health sciences	emergency medicine	1.82	83
medical and health sciences	endocrinology & metabolism	1.59	693
medical and health sciences	gastroenterology & hepatology	2.11	410

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	geriatrics & gerontology	1.32	186
medical and health sciences	health care sciences & services	1.25	128
medical and health sciences	health policy & services	1.26	69
medical and health sciences	hematology	1.55	456
medical and health sciences	immunology	1.70	616
medical and health sciences	infectious diseases	1.73	519
medical and health sciences	medicine, general & internal	12.40	52
medical and health sciences	medicine, research & experimental	1.00	662
medical and health sciences	nutrition & dietetics	1.39	483
medical and health sciences	obstetrics & gynecology	1.12	473
medical and health sciences	oncology	1.69	1.743

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	otorhinolaryngology	1.71	75
medical and health sciences	parasitology	1.61	89
medical and health sciences	pathology	1.17	178
medical and health sciences	peripheral vascular disease	1.50	668
medical and health sciences	pharmacology & pharmacy	1.06	1.045
medical and health sciences	psychiatry	2.05	281
medical and health sciences	public, environmental & occupational health	3.36	638
medical and health sciences	radiology, nuclear medicine & medical imaging	1.08	474
medical and health sciences	rehabilitation	1.05	73
medical and health sciences	respiratory system	1.50	486
medical and health sciences	substance abuse	2.91	60

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	surgery	1.31	892
medical and health sciences	toxicology	1.14	185
medical and health sciences	tropical medicine	1.59	40
medical and health sciences	urology & nephrology	1.86	243
natural sciences	acoustics	1.66	70
natural sciences	astronomy & astrophysics	2.24	1.235
natural sciences	biochemistry & molecular biology	1.12	924
natural sciences	biodiversity conservation	1.75	96
natural sciences	biology	1.55	139
natural sciences	biotechnology & applied microbiology	1.03	480
natural sciences	cell biology	1.62	433

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	chemistry, analytical	1.14	335
natural sciences	chemistry, applied	1.13	220
natural sciences	chemistry, inorganic & nuclear	1.05	166
natural sciences	computer science, artificial intelligence	1.02	231
natural sciences	computer science, information systems	1.58	476
natural sciences	computer science, interdisciplinary applications	1.24	328
natural sciences	computer science, software engineering	1.14	261
natural sciences	computer science, theory & methods	1.24	226
natural sciences	ecology	1.85	242
natural sciences	entomology	1.67	209

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	environmental sciences	1.28	1.458
natural sciences	genetics & heredity	2.70	466
natural sciences	geochemistry & geophysics	1.13	268
natural sciences	geography, physical	1.50	165
natural sciences	geology	1.46	30
natural sciences	geosciences, multidisciplinary	1.21	686
natural sciences	limnology	1.33	23
natural sciences	marine & freshwater biology	1.39	434
natural sciences	mathematics	1.08	468
natural sciences	mathematics, applied	1.26	488
natural sciences	water resources	1.02	488

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	mathematics, interdisciplinary applications	1.04	164
natural sciences	meteorology & atmospheric sciences	1.59	552
natural sciences	microbiology	1.69	535
natural sciences	mineralogy	1.02	80
natural sciences	mycology	1.32	43
natural sciences	oceanography	1.49	323
natural sciences	optics	1.14	308
natural sciences	ornithology	2.04	10
natural sciences	paleontology	1.07	44
natural sciences	physics, fluids & plasmas	1.74	280
natural sciences	physics, mathematical	1.12	154

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	physics, multidisciplinary	2.05	404
natural sciences	physics, nuclear	2.90	496
natural sciences	physics, particles & fields	2.66	1.455
natural sciences	polymer science	1.01	252
natural sciences	reproductive biology	1.51	65
natural sciences	spectroscopy	1.33	77
natural sciences	virology	1.08	91
social sciences	anthropology	1.03	47
social sciences	business	1.45	134
social sciences	demography	1.36	10
social sciences	education & educational research	1.09	102

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
social sciences	ergonomics	1.11	40
social sciences	psychology, applied	1.38	40
social sciences	environmental studies	1.51	221
social sciences	geography	1.15	58
social sciences	gerontology	1.67	24
social sciences	international relations	1.66	51
social sciences	management	1.02	222
social sciences	operations research & management science	1.13	220
social sciences	political science	1.13	55
social sciences	psychology, developmental	1.22	63
social sciences	psychology, educational	1.74	18

REGION OF ATTIKI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
social sciences	psychology, social	1.94	31
social sciences	social issues	1.06	13
social sciences	sociology	1.00	22
social sciences	transportation	1.01	143

TABLE 3.12: Overview of the scientific areas of excellence in the Region of Sterea Ellada, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF STEREA ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	forestry	4.63	8
engineering and technology	engineering, electrical & electronic	1.81	54
engineering and technology	instruments & instrumentation	1.36	8
engineering and technology	telecommunications	3.07	23
natural sciences	chemistry, multidisciplinary	1.19	23
natural sciences	computer science, artificial intelligence	1.31	20
natural sciences	computer science, information systems	1.76	11
natural sciences	computer science, interdisciplinary applications	1.26	16

REGION OF STEREA ELLADA

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	mathematics, interdisciplinary applications	1.50	16
natural sciences	mathematics, applied	15.52	17

TABLE 3.13: Overview of rhe scientific areas of excellence in the Regions of the North and South Aigaio, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGIONS OF NORTH AND SOUTH AIGAIO

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	fisheries	1.81	31
agricultural sciences	regional & urban planning	1.32	9
engineering and technology	computer science, hardware & architecture	3.93	16
engineering and technology	engineering, electrical & electronic	1.20	35
engineering and technology	engineering, environmental	1.09	26
engineering and technology	food science & technology	1.79	26
engineering and technology	remote sensing	1.80	9
engineering and technology	telecommunications	1.28	51
humanities	archaeology	1.26	30

REGIONS OF NORTH AND SOUTH AIGAIO

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	public, environmental & occupational health	1.31	11
medical and health sciences	pharmacology & pharmacy	1.32	16
natural sciences	astronomy & astrophysics	2.82	103
natural sciences	biodiversity conservation	1.11	36
natural sciences	plant sciences	1.82	16
natural sciences	computer science, artificial intelligence	1.26	29
natural sciences	computer science, software engineering	2.88	29
natural sciences	computer science, information systems	1.91	58
natural sciences	computer science, interdisciplinary applications	1.44	40
natural sciences	computer science, theory & methods	2.73	15
natural sciences	ecology	1.66	60

REGIONS OF NORTH AND SOUTH AIGAIO

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	entomology	1.58	14
natural sciences	geography, physical	1.01	14
natural sciences	environmental sciences	1.41	152
natural sciences	evolutionary biology	2.03	13
natural sciences	geosciences, multidisciplinary	1.64	52
natural sciences	marine & freshwater biology	1.28	70
natural sciences	meteorology & atmospheric sciences	1.82	41
natural sciences	microbiology	1.88	9
natural sciences	physics, fluids & plasmas	1.41	9
natural sciences	oceanography	1.27	55
natural sciences	physics, multidisciplinary	2.28	35

REGIONS OF NORTH AND SOUTH AIGAIO

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	physics, nuclear	3.83	46
natural sciences	physics, particles & fields	3.12	239
natural sciences	water resources	1.06	27
social sciences	environmental studies	1.70	53
social sciences	geography	1.14	33
social sciences	information science & library science	1.59	11

TABLE 3.14: Overview of the scientific areas of excellence in the Region of Kriti, 2014-2018

(specialised scientific areas, in which publications achieve a field normalised citation score, higher than the global average (>1), and number of relevant publications)

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
agricultural sciences	agricultural engineering	2.42	10
agricultural sciences	agriculture, multidisciplinary	1.40	10
agricultural sciences	agronomy	1.44	28
agricultural sciences	fisheries	1.30	38
agricultural sciences	quantum science & technology	1.35	11
engineering and technology	automation & control systems	1.93	27
engineering and technology	construction & building technology	1.80	48
engineering and technology	energy & fuels	1.36	184
engineering and technology	engineering, chemical	1.23	178

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	engineering, civil	1.72	94
engineering and technology	engineering, electrical & electronic	1.54	258
engineering and technology	engineering, environmental	1.72	150
engineering and technology	engineering, industrial	1.57	16
engineering and technology	medical laboratory technology	1.59	16
engineering and technology	engineering, manufacturing	1.08	11
engineering and technology	robotics	2.92	11
engineering and technology	imaging science & photographic technology	1.35	26
engineering and technology	food science & technology	1.50	75
engineering and technology	instruments & instrumentation	1.10	57
engineering and technology	materials science, ceramics	1.01	8
engineering and technology	materials science, textiles	1.20	8

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
engineering and technology	materials science, multidisciplinary	1.31	533
engineering and technology	mechanics	1.08	77
engineering and technology	nanoscience & nanotechnology	1.64	202
engineering and technology	remote sensing	1.19	52
engineering and technology	telecommunications	1.54	99
engineering and technology	transportation science & technology	1.91	53
humanities	archaeology	1.15	23
humanities	history	1.73	15
humanities	humanities, multidisciplinary	2.44	10
humanities	language & linguistics	1.75	8
medical and health sciences	allergy	2.35	16
medical and health sciences	anesthesiology	2.10	11

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	medicine, legal	1.06	11
medical and health sciences	cardiac & cardiovascular systems	1.19	138
medical and health sciences	cell & tissue engineering	1.03	10
medical and health sciences	obstetrics & gynecology	1.12	26
medical and health sciences	critical care medicine	1.91	41
medical and health sciences	otorhinolaryngology	1.33	18
medical and health sciences	emergency medicine	1.11	15
medical and health sciences	endocrinology & metabolism	2.45	81
medical and health sciences	gastroenterology & hepatology	2.13	57
medical and health sciences	rheumatology	1.89	48
medical and health sciences	immunology	2.17	61
medical and health sciences	infectious diseases	1.90	73

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	psychiatry	4.37	73
medical and health sciences	medicine, general & internal	9.98	9
medical and health sciences	medicine, research & experimental	1.17	156
medical and health sciences	neurosciences	1.09	139
medical and health sciences	nutrition & dietetics	1.02	98
medical and health sciences	oncology	1.16	314
medical and health sciences	parasitology	1.35	46
medical and health sciences	pediatrics	1.28	55
medical and health sciences	peripheral vascular disease	1.19	92
medical and health sciences	pharmacology & pharmacy	1.14	173
medical and health sciences	primary health care	1.21	19
medical and health sciences	public, environmental & occupational health	8.17	191

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
medical and health sciences	respiratory system	1.50	93
medical and health sciences	substance abuse	2.45	37
medical and health sciences	surgery	1.28	157
medical and health sciences	toxicology	1.82	95
medical and health sciences	tropical medicine	1.55	31
medical and health sciences	urology & nephrology	2.14	31
natural sciences	acoustics	1.68	31
natural sciences	astronomy & astrophysics	1.04	283
natural sciences	behavioral sciences	1.13	14
natural sciences	biochemistry & molecular biology	1.80	294
natural sciences	biology	1.84	57
natural sciences	biotechnology & applied microbiology	1.34	108

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	cell biology	2.52	197
natural sciences	chemistry, analytical	1.24	105
natural sciences	chemistry, applied	1.30	55
natural sciences	chemistry, inorganic & nuclear	1.61	84
natural sciences	chemistry, multidisciplinary	1.39	280
natural sciences	zoology	1.30	34
natural sciences	chemistry, physical	1.27	428
natural sciences	computer science, artificial intelligence	1.19	79
natural sciences	computer science, information systems	1.03	131
natural sciences	physics, fluids & plasmas	1.84	35
natural sciences	developmental biology	1.27	16
natural sciences	ecology	1.16	56

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	physics, mathematical	1.09	56
natural sciences	electrochemistry	1.29	64
natural sciences	entomology	2.17	44
natural sciences	environmental sciences	1.48	519
natural sciences	evolutionary biology	2.10	48
natural sciences	genetics & heredity	1.36	97
natural sciences	geography, physical	1.35	29
natural sciences	geosciences, multidisciplinary	1.21	133
natural sciences	marine & freshwater biology	1.20	77
natural sciences	microbiology	1.59	77
natural sciences	meteorology & atmospheric sciences	2.01	180
natural sciences	oceanography	1.72	43

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
natural sciences	optics	1.31	206
natural sciences	physics, applied	1.39	388
natural sciences	physics, condensed matter	1.27	209
natural sciences	physics, multidisciplinary	2.15	162
natural sciences	physics, nuclear	1.25	12
natural sciences	physics, particles & fields	1.36	104
natural sciences	polymer science	1.07	120
natural sciences	spectroscopy	1.02	39
natural sciences	virology	2.76	15
social sciences	business	2.24	10
social sciences	education & educational research	1.31	34
social sciences	information science & library science	1.64	8

REGION OF KRITI

Major scientific field	Sub-field	Field Normalised Citation Score	Number of Publications
social sciences	environmental studies	1.49	22
social sciences	transportation	1.49	22
social sciences	management	1.65	39
social sciences	operations research & management science	1.30	63
social sciences	psychology	1.41	30
social sciences	psychology, clinical	1.64	24
social sciences	psychology, developmental	1.33	19
social sciences	social sciences, interdisciplinary	1.50	19
social sciences	psychology, educational	2.24	12
social sciences	psychology, experimental	1.00	25

4. Innovation in Greek Regions

This section presents data on enterprises' innovation in the Greek Regions, based on data from the Community Innovation Survey. This survey is the official European statistical survey on business innovation, which is conducted every two years in all EU Member States through a single standard questionnaire.

The survey concerns the activities of enterprises, their connection with innovation and the introduction of innovations by enterprises. The measurement of innovation is based on the concepts and definitions set out in the Oslo Manual, a joint publication of the OECD and Eurostat.

The revised 2018 edition of the Oslo Manual introduced significant breakthroughs in the conceptual framework and the measurement of innovation that began to be applied by the survey with a reference period of 2016-2018 and onwards. Consequently, the relevant indicators from this three-year period are not comparable over time with the previous three reference years[8]. Indicatively, according to the new version of the Oslo Manual, an innovation is a new or improved product (good or service), or a process that differs significantly from the previous products or processes of the business, and that was introduced to the market or put on the market by the enterprise. On this basis, two types of innovation can be distinguished, product innovation and business process innovation.

Overall, Greek enterprises seem to be achieving remarkable performance in the field of innovation, since as shown in Figure 4.1, in almost all Regions enterprises undertake some type of innovation at a rate higher than 50%. The highest performances - exceeding the average national performance (60.3%) - are recorded in the Region of Kentriki Makedonia (62.6%), in the Region of Attiki (61.6%) and in the Region of Kriti (60.8%). The corresponding community average is 50,3%[9].

[8] Until 2016, the reference population included enterprises with product innovation or/ and process innovation. From 2018 and onwards, in implementation of the new Oslo manual (edition 2018), the reference population includes all innovative enterprises.

[9] In the section on innovation in enterprises, data available from the Community Innovation Survey (CIS) refer to 27 EU Member States.

FIGURE 4.1: Percentage (%) of innovative enterprises in the Greek Regions, 2016-2018

(Enterprises that implement at least one type of innovation, as % of total enterprises in Region)

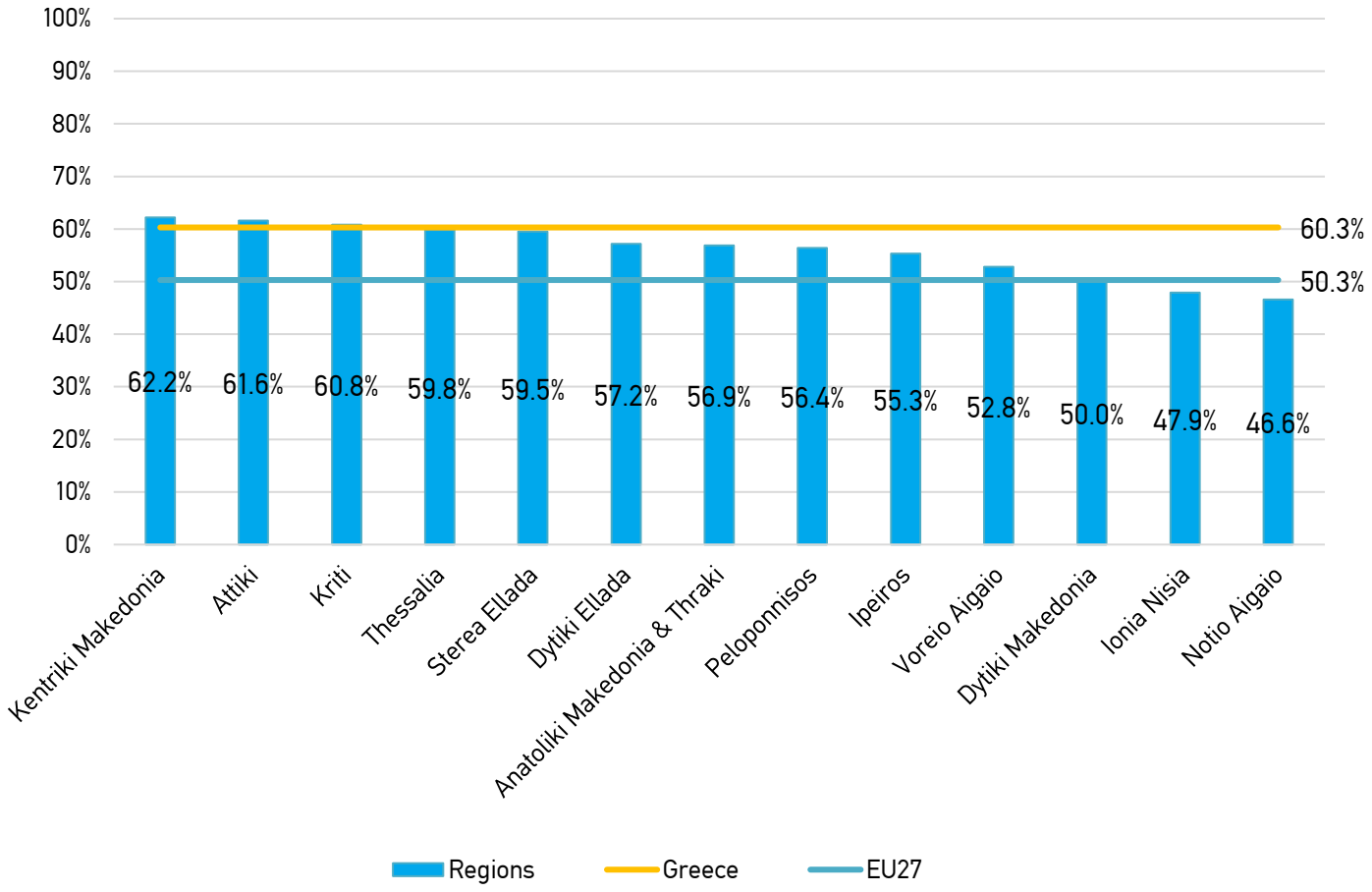
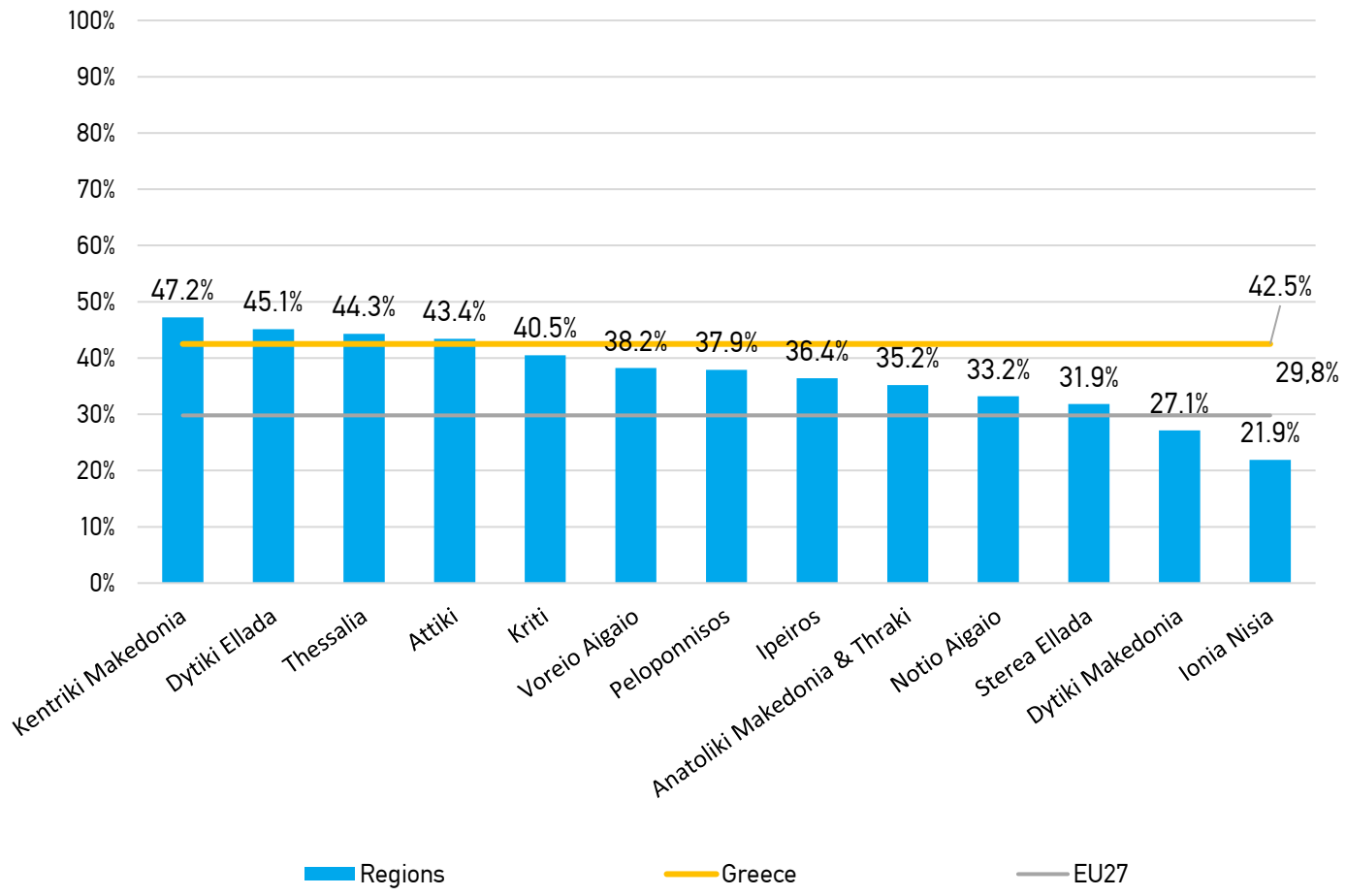


Figure 4.2 shows Greek Regions' performance in terms of enterprises that introduce product innovations, i.e. producing a new or improved product. In this context, higher performance than the corresponding national performance (42.5%) is recorded in the Regions of Kentriki Makedonia (47.2%), Dytiki Ellada (45.1%), Thessalia (44.3%) and Attiki (43.4%). The corresponding community average is 29.8%.

FIGURE 4.2: Percentage (%) of enterprises with product innovation in the Greek Regions, 2016-2018

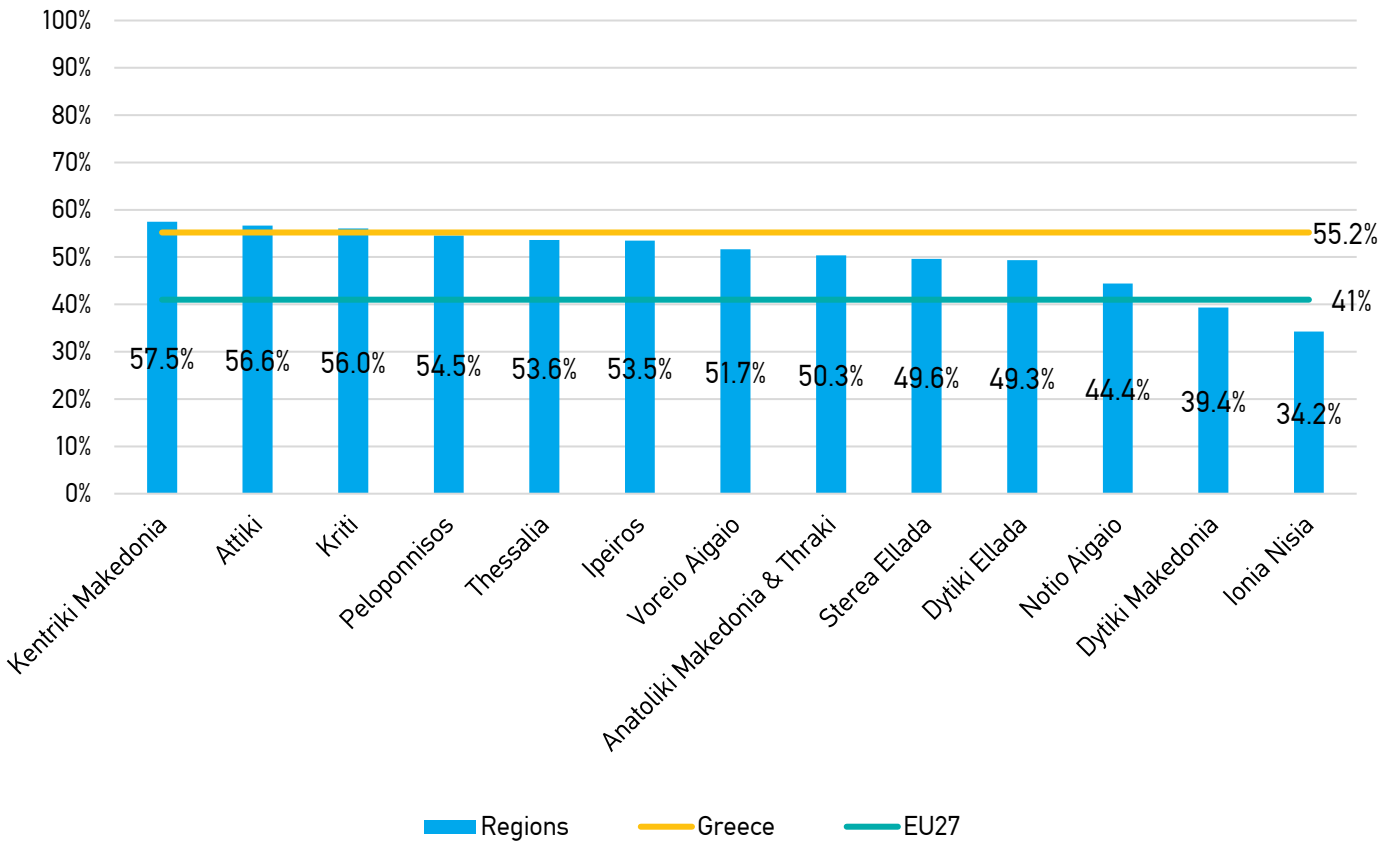
(Enterprises that innovate in products (goods or services), as % of total enterprises in Region)



Business process innovation comprises every new or improved business process implemented, which differs significantly from the ones followed in the past by it. Figure 4.3 depicts the performance of the Greek Regions in business process innovation as a percentage (%) of the total number of companies in each Region. Based on the data, the Regions of Kentriki Makedonia, Attiki and Kriti achieved performances above the national average (55.2%). The corresponding community average is 41.0%.

FIGURE 4.3: Percentage (%) of enterprises with business process innovations, in the Greek Regions, 2016-2018

(Enterprises that carry out business process innovations, as % of total enterprises in Region)

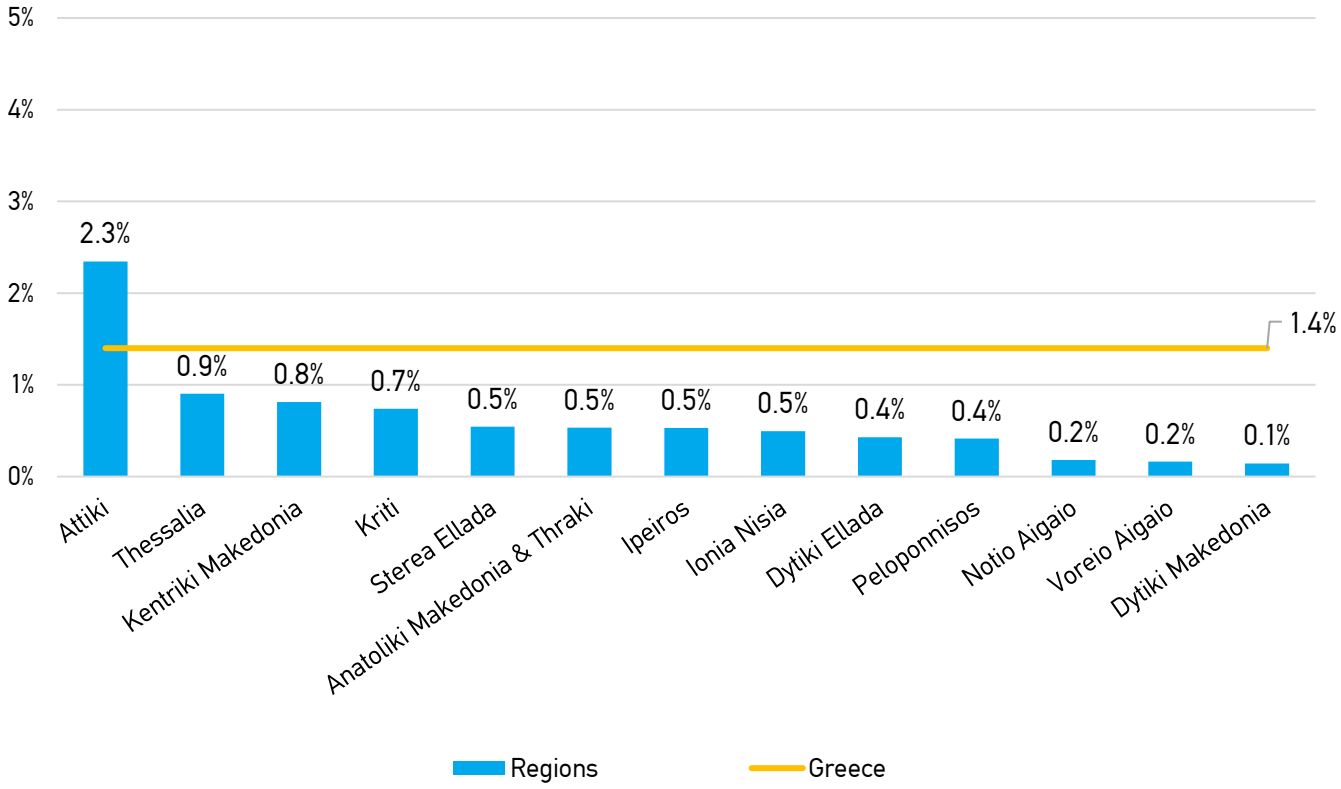


Expenditure for innovative activities include in-house and outsourced Research & Development (R&D), purchase of machinery, equipment, software and buildings, acquisition of external knowledge from other enterprises or organisations, training for innovative activities, promotional activities / introduction of innovations in the market, industrial design etc.

Figure 4.4 presents these expenditure of enterprises in the whole country and per Region, as a percentage (%) of the country's GDP and as a percentage (%) of the GDP of each Region. It should be noted that the costs for innovative activities relate to the total costs incurred by enterprises for the implementation of their innovations within the last year of the three years under review – i.e. 2018 for the three-year period 2016-2018. Based on the data, the Attiki Region recorded the highest performance (2.3% of its GDP), which is the only region higher than the corresponding national average (1.4%).

FIGURE 4.4: Business expenditure for innovative activities in the Greek Regions, 2018

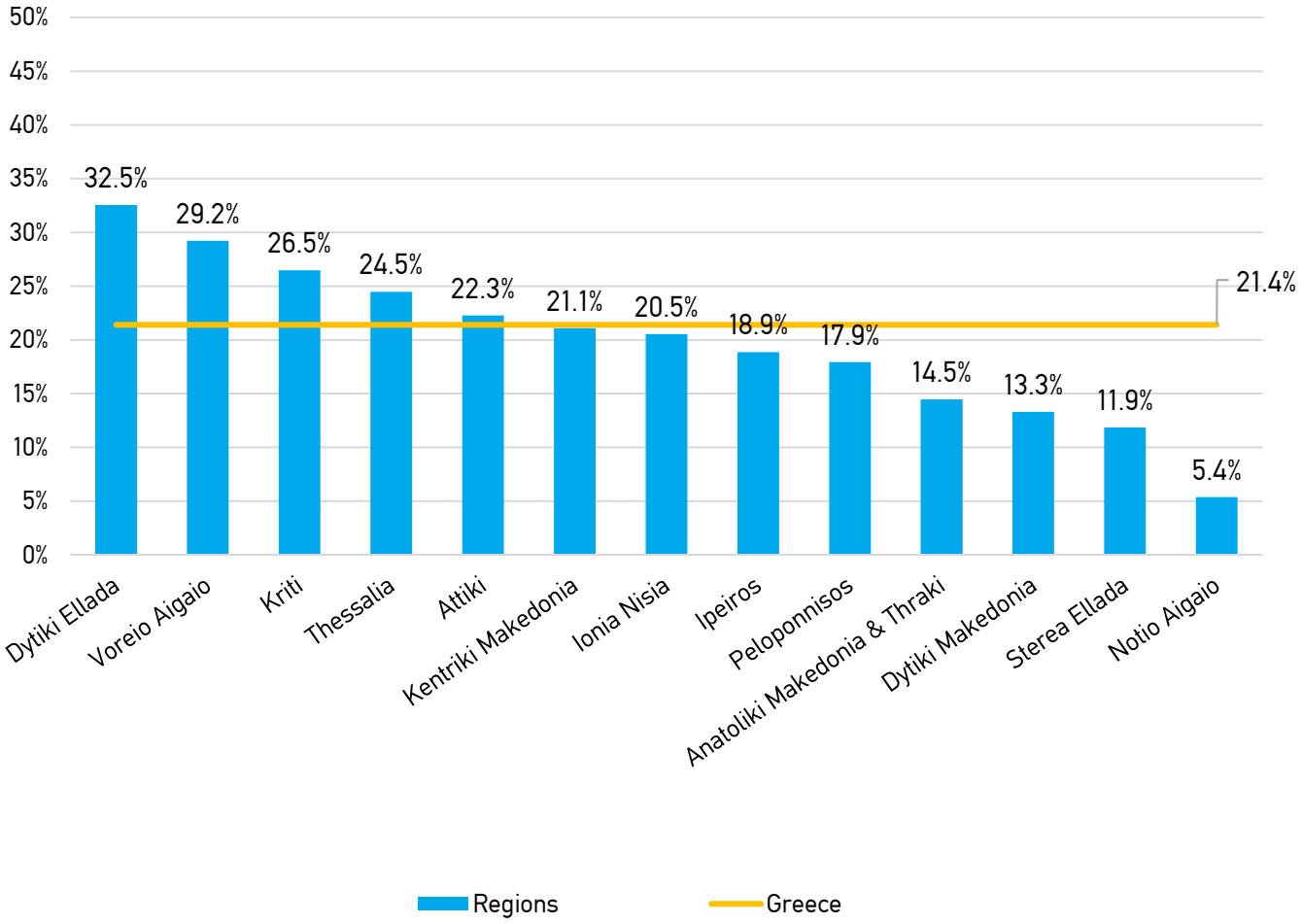
(Expenditure for innovative business activities, per Region, as % of GDP of each Region)



As far as co-operation between enterprises or bodies for the development of any type of innovation is concerned, Figure 4.5 presents the relevant performance of each Region as a percentage of the total number of enterprises. It should be noted here that this co-operation presupposes the active participation of innovative enterprises and other enterprises/bodies in innovative activities, without necessarily both members of the partnership benefiting commercially. Based on the data, the Regions of Dytiki Ellada, Voreio Aigaio, Kriti, Thessalia and Attiki achieve performances above the respective national average (21.4%).

FIGURE 4.5: Percentage (%) of enterprises collaborating with third parties for the development of innovations, in the Greek Regions, 2016-2018

(Enterprises that collaborated with any enterprise/entity, for the development of innovations, as % of total enterprises in Region)



5. Methodological Notes

Research & Development Statistics - chapters 1, 2

Indicators are derived from the official R&D statistics collected by the National Documentation Centre under EC Regulation 995/2012. Regional indicators are produced based on the regional distribution of R&D activities as stated by the institutions and entities, and not based on their registered office or central administration. Data for the European Union are taken from the relevant Eurostat database (data accessed July 2021).

Official Research and Development - R&D statistics produce indicators on R&D personnel as well as the (internal) expenditure incurred for these activities across all sectors of the economy: Business Enterprise Sector – (BES), Government Sector – (GOV), Higher Education Sector (HES), Private Non-Profit Institutions (PNP), and for the country as a whole.

This publication presents indicators, processed at regional level, based on the regional distribution of R&D activities, as stated by the entities, from the final analytical data on expenditure and R&D personnel in 2019, which were submitted to Eurostat in June 2021 by EKT, in accordance with the relevant European Regulation (995/2012).

The full range of R&D indicators and related EKT publications are available at https://metrics.ekt.gr/research-development.

Basic concepts and definitions:

standard classifications and guidelines for the production of Research and Development-R&D statistics are outlined in the Frascati Manual (2015): Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris.

According to the Frascati Manual, R&D comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

R&D covers not only the activities carried out by typical research bodies or R&D departments, but more broadly all R&D activities carried out either formally or occasionally by bodies or departments carrying out other activities.

All types of R&D activities are recorded: basic research, applied research, experimental development.

Sectors of R&D performance

Statistics for R&D (expenditure and personnel) are collected and analysed by sector of R&D performance, i.e. the sector where R&D activities are carried out. Bodies and institutions that perform R&D and constitute the statistical units that provide the data are categorised in four sectors of R&D performance, based on the Frascati manual (OECD, 2015), as follows:

Business Enterprise Sector – (BES):

includes all enterprises, organisations and institutions whose primary activity is the production of goods or services (other than higher education). In addition, this sector includes public enterprises as well as private non-profit institutions serving the enterprises. Economic activity (NACE Rev.2) and employment size classes as defined in the European Commission Regulation 995/2012 are covered.

Higher Education Sector – (HES):

includes the Universities (which, from 2019 onwards, include the former Technological Educational Institutions after their abolition), ASPAITE, Research University Institutes, University Hospitals and other faculties & academies. Implementing the revised Frascati (OECD, 2015) from 2016 onwards, post-secondary education institutions are no longer included in the Higher Education Sector (HES).These institutions belong to the BES or PNP sectors, according to their legal form.

Government Sector – (GOV):

includes all entities engaged in R&D activities that are supervised by different ministries: such as Research Centres overseen by the General Secretariat for Research and Innovation (GSRI) (in alphabetic order in Greek: National Observatory of Athens, National Hellenic Research Foundation (which included the National Documentation Centre until 2019), Centre for Research and Technology Hellas, National Center for Scientific Research 'DEMOKRITOS', Hellenic Centre for Marine Research, National Centre for Social Research, Greek Atomic Energy Commission, Hellenic Pasteur Institute, 'Alexander Fleming' Biomedical Sciences Research Center, Athena-Research & Innovation Centre in Information Communication & Knowledge Technologies, Foundation for Research & Technology – Hellas), other public research bodies (indicative and non-exhaustive: Athens Academy, Research Foundation –Academy of Athens, Biomedical Research Foundation, Academy of Athens, Hellenic Agricultural Organisation-Dimitra, Benaki Phytopathological Institute, Hellenic Survey of Geological & Mining Exploration (HSGME), Centre for Renewable Energy Sources, Mediterannean Agronomic Institute of Chania, Computer Technology Institute and Press 'Diophantus', etc), archaeological and cultural institutions, service of Modern Monuments and Technical Works, public museums, public hospitals, Hellenic Republic Ministry of National Defence bodies/ directorates/ hospitals, Independent Authorities, Ministry of Health bodies, management bodies for protected areas, etc

Private Non Profit Sector – (PNP):

This sector includes non-market, private non-profit institutions that provide services for citizens such as professional and scientific associations, aid organisations, humanitarian organisations, trade unions, consumer associations, etc. They include (indicatively but non-exhaustively): Piraeus Bank Group Cultural Foundation, Hellenic Co-operative Oncology Group, INSTAP Study Centre of East Crete, Foundation of the Hellenic World, Information Technologies Research and Training Laboratory 'Athens Information Technologies', Hellenic Institute for Occupational Health & Safety, Goulandris Natural History Museum, Foundation for Economic & Industrial Research, American College of Greece, Research and Analysis diaNEOsis Organisation, Nicholas & Dolly Goulandris Foundation - Museum of Cycladic Art, Hellenic Institute for Research on Cancer, American School of Classical Studies in Athens, L'Ecole Française d'Athène, Italian Archaeological school in Athens, Hellenic Foundation for European and Foreign Policy, Hellenic Society for the Study and Protection of Monk Seals, Lambrakis Foundation, South East European Research Centre, Research Centre for the Humanities, CALLISTO, Arcturus, WWF Hellas etc.

Gross expenditure on R&D (GERD)

R&D expenditure data included in statistics refer to intramural expenditure. As intramural expenditure are regarded expenditure for R&D performed within an entity (statistical unit), regardless of the source of funds.

They include both current expenditure (personnel costs, other running costs such as operating expenses - rent, telephone, consumables, travel, subscriptions, etc.), as well as capital expenditure (purchase of equipment, land and buildings). R&D activities carried out through outsourcing or third parties (extramural expenditure) are not included in the R&D indicators.

R&D personnel

R&D personnel includes all those involved in R&D activities, scientists and engineers (researchers), highly trained technical personnel and personnel who directly support the implementation of R&D activities (e.g. workers, manufacturers, administrators, etc.).Also included are those involved in planning and managing the work of other researchers. R&D personnel is divided into two categories of employment based on the type of work:

Researchers: Scientists whose professional activities aim at conceiving and creating new knowledge. They implement R&D and improve or develop concepts, theories, models, techniques, methods and tools, software, or business methods. Researchers also include those who are preparing a doctoral dissertation.

Other R&D personnel: Personnel involved in R&D activities performing scientific and technical tasks, usually under the guidance of researchers (e.g. technicians, programmers, manufacturers, personnel collecting literature, conducting statistical surveys and interviews, etc.), as well as personnel

performing a variety of tasks directly related to R&D activities that are necessary for their completion (e.g. legal aid, staff, secretaries or other administrators).

Full time equivalent (FTE) is the unit used to measure employed in R&D personnel in a comparable way, and is calculated based on the time that each person devotes to R&D activities. Hence, a full-time employee in R&D during a year is regarded as one FTE, while a part-time employee is regarded as a percentage of one FTE, in analogy with his/ her working hours on R&D.

Legal Framework

Research and Development statistics are compiled under European Commission Regulation 995/2012 (valid for the data of 2012 onwards). The National Documentation Centre (www.ekt.gr) is the agency (under Decision 7303/B2-577/25-9-2017 –[GG B' 3482] as amended) and national authority (under Decision 7304/B2-576/25-9-2017 [GG B' 3482] as amended) of the Hellenic Statistical System for the production of Research, Development and Innovation in Greece. EKT conducts the collection and processing of R&D statistics since April 2012, with the first reference year being 2011. The production of the statistical data presented in this publication was carried out with the co-operation of the Hellenic Statistical Authority (Memorandum of Co-operation 15.12.2020).

Conducting the study

The survey is conducted on all entities who are known to implement or may implement R&D (R&D performers and potential R&D performers). EKT has developed and maintains a Registry of Greek bodies with R&D activities, in all sub-sections of performance - BES, GOV, HES and PNP. The data were collected through electronic questionnaires completed by the bodies included in the registry, using a census survey in the GOV, HES and PNP sectors and a combination of census and sample surveys in the BES sector. The registry is updated on a regular basis. In combination with the data collection through questionnaires, and in order to reduce the burden on the surveyed respondents and the collection time, while improving the quality of the data, the following administrative data provided by the competent bodies were used by EKT:

- HES Sector: Funding data and university personnel - Ministry of Education and Religious Affairs / General Directorate of Financial Services & General Directorate of Higher Education
- GOV Sector: Funding data and personnel of the Ministry of Culture & Sports / Directorate of Financial Management & Directorate of e-Government.
- Information on funding and personnel of Public Hospitals - Ministry of Health / Finance Directorate & e-Government Directorate (e-platform ESY.net).

The collected data were controlled for their accuracy and corrected where necessary in co-operation with the respondents. Relevance checks were also conducted between the collected data and secondary data provided by the databases below. The data were provided by the competent bodies maintaining the databases.

- Monitoring Information System (MIS)
- E corda database - European Commission
- Official statistics on government budget allocations for R&D (GBARD) - data collected by EKT and submitted to Eurostat.

For the processing and analysis of the data, the appropriate statistical methodology was followed, as were the Eurostat guidelines that enable the specific survey to be conducted in a harmonised manner by all the member countries.

Participation in EU R&D Projects (Programme Framework) - chapter 3

Indicators related to the Greek participation in European competitive programmes ('Horizon 2020' Programme) are produced by the National Documentation Centre after processing the data of the ecorda database of the European Commission, and additional data collected by EKT in the context of its role as a National Contact Point.

Data presented in the present publication refer to the most recently available data of the 'Horizon 2020' Programme for the period 2014-2020. Data for the 'Horizon' Programme may change due to updates to the Ecorda database.

Regional indicators are produced based on the registered office or central administration of the bodies.

The full EKT series on Greek participation in Horizon 2020 is available at the address: https://metrics.ekt.gr/eu-participation .

Doctoral dissertations - chapter 3

Data are part of the official national statistics based on the National Archive of PhD Theses (NAPhD) which by law is maintained by EKT. The distribution of doctoral dissertations in the Regions was based on the registered office or central administration of the Universities.

Data are drawn from the submission form and the accompanying electronic questionnaire completed by the young doctorate holders in the National Archive of PhD Theses (NAPhD) maintained by EKT.

Thematic categorisation into scientific areas is based on the Frascati classification (Fields of Research & Development, 2015) into six main scientific fields and 42 subfields:

Major scientific field	Subfield
Natural Sciences:	• Mathematics • Computer and Information Sciences • Physical sciences • Chemical sciences • Earth and related Environmental sciences • Biological sciences • Other Natural Sciences
Engineering and Technology	• Civil engineering • Electrical engineering, Electronic engineering, Information engineering • Mechanical engineering • Chemical engineering • Materials engineering • Medical engineering • Environmental engineering • Environmental biotechnology • Industrial biotechnology • Nano-technology • Other Engineering and Technologies
Medical and Health Sciences	• Basic medicine • Clinical medicine • Health sciences • Medical biotechnology • Other Medical sciences

Major scientific field	Subfield
Agricultural Sciences and Veterinary	• Agriculture • Forestry and Fisheries • Animal and Dairy science • Veterinary science • Agricultural biotechnology • Other Agricultural Sciences
Social Sciences	• Psychology and Cognitive sciences • Economics and business • Educational sciences • Sociology • Law • Political science • Social and economic geography • Media and communications • Other Social Sciences
Humanities and the Arts	• History & Archaeology • Language and Literature • Philosophy, Ethics and Religion • Arts (Arts, History of Arts, Performing Arts, Music) • Other Humanities

Scientific publications in international journals - chapter 3

Statistics for the Greek scientific publications are part of the official statistics for Research, Technology, Development and Innovation (RDI) produced by EKT as the competent body of the Greek Statistical System.

The indicators are produced after a bibliometric analysis of the primary data obtained from the Web of Science and Scopus databases.
The object of bibliometric analysis is the recording and processing of data related to scientific publications and the extraction of relevant 'bibliometric indicators', such as the number of publications, citations from other publications, their correlation with specific bodies, scientific fields, etc.
In addition to the number of publications, the most common bibliometric indicators used to assess the impact and originality of a scientific work are based on the analysis of citations to publications by other scientific publications.
Bibliometric indicators presented in the present publication are based on data from the Web of Science database. The distribution of scientific publications in the Regions was based on the registered office or central administration of the institutions.

Basic concepts

EKT follows the most valid methodological approaches and is aligned with the developments in the field of bibliometric science. In addition, it has developed specialised software applications for the processing of primary data derived from international databases and the calculation of bibliometric indicators (determining institution names, thematic categorisation, normalisation, calculation, graphic display).

Number of publications: In accordance with international practices for the measurement of scientific publications, only articles, research notes and reviews are taken into account.

In cases of collaborations between more than one institution, the 'whole counting' technique is followed, i.e. each publication is counted once for each institution. Similarly, in cases where a publication is included in more than one scientific area, it is counted once in each scientific area.

Number of citations:

To normalise the differences associated with the normal increase of the number of citations to previous publications, the technique of measuring citations using a variable time window was adopted. The analysis is carried out in overlapping 5-year periods. Specifically, the reports made during a five-year period are counted in the publications published in the same five-year period.

Institution categories:

Greek institutions were classified into four sectors of R&D performance according to the classification criteria of the Frascati manual, which is used internationally for the production of official Research and Development (R&D) statistics. This ensures international comparability.

International collaborations:

International collaboration rate is calculated as the percentage (%) of publications with at least one international collaboration.

Highly-cited publications (Top 1% or 10%):

The percentage (%) of total number of publications that belong to the top 1% or 10% of most frequently cited publications worldwide, in the same year.

Scientific fields:

The distribution of scientific publications in scientific areas is carried out by the international databases (the Web of Science in this case) based on the journal in which they are published. For reasons of international comparability, EKT has correlated the specialised subject areas of the databases with the six main scientific fields of the Frascati classification (Fields of Research and Development, 2015) and their subfields.

As regards the scientific areas, it is noted that important differences exist in the practice of publishing research studies, in the time of the devaluation of research results, and in the practices of citation patterns, depending upon the scientific areas. For instance, in medicine and molecular biology there is a very high productivity in terms of the quantity of scientific publications published per year. Usually, the number of citations to these publications increases to a maximum within a short period of time after their publication. Whereas, in the Social Sciences the publication rate is rather low, and many studies may still be cited decades after their release.

In the humanities, most of the scientific publications are books, monographs and articles published in national scientific journals, and, therefore, are not recorded in international databases. In other scientific areas (e.g. in some fields of computer science) it is common practice to publish important research results at conferences, which are not counted in the number of scientific publications, without necessarily corresponding publication in scientific journals.

These differences do not negate the importance of bibliometric indicators, which are now used internationally as a valuable data source, but their interpretation in the right context must be taken into account, something that applies to all indicators.

Scientific excellence:

Excellence in specialised subject areas included in each of the six scientific fields of the Frascati classification is determined by the impact of scientific publications in these areas.

Impact is measured by the Field normalised citation score, which is used to eliminate differences in scientific fields, and which EKT calculates for Greek scientific publications through specialised software that it has developed. Normalisation is carried out at the publication level. In particular, the reports of each publication are divided by the average of the citations received worldwide by the publications of the respective subject area and the respective year of publication. A Field normalised citation score > 1 indicates a score higher than the global average.

The complete series of EKT's bibliometric studies is available at: https://metrics.ekt.gr/scientific-publications.

Innovation in enterprises - chapter 4

Indicators are derived from the official Community Innovation Survey statistics carried out by the National Documentation Centre under EC Regulation 995/2012. Regional indicators are produced based on the registered office or central administration of the enterprises.

The Community Innovation Survey is the official European statistical survey on innovation in the countries of the European Union. It is conducted every two years in all EU member countries through a single standard questionnaire in accordance with the European legislation, the methodological guidelines of the Oslo manual, and the Eurostat guidelines, ensuring high quality and comparability in the indicators of the EU member states.

The research concerns the activities of the enterprises, their connection with innovation and the introduction of innovations by the enterprises. Data is collected on product innovations (goods or services), business process innovations, business innovation activities, the introduction of new products to the business and the market, strategies, knowledge flows and business partnerships, various forms of financing, the impact of legislation on innovation activities, as well as the obstacles that enterprises face in developing innovation. The data are published in detail on the relevant EKT website (https://metrics.ekt.gr/innovation) and by Eurostat in the relevant database, by sector of economic activity and by size class (number of employees) of enterprises.

This publication provides data on key indicators concerning the performance of Greek enterprises in innovation in the period 2016-2018.

Basic concepts

The measurement of innovation is based on the concepts and definitions set out in the Oslo Manual, in a joint publication of the OECD and Eurostat. The revised 4th edition of the Oslo manual, published in 2018, was used for the study with reference to the period 2016-2018 onwards.

The revised edition of the Oslo Manual introduced significant breakthroughs in the conceptual framework and measurement of innovation in terms of the contemporary business processes and practices, the business and public sector innovation models, the understanding of in-house factors and capabilities that enhance innovation, the role of the wider economic environment and the availability of resources such as skilled human resources, networks, knowledge flows and digital technologies, as well as the improvement of the use of innovation statistics for further research and analysis.

According to the new version of the Oslo Manual, innovation is defined as a new or improved product (good or service) or a business process that differs significantly from the previous products or previous business processes, and that was introduced to the market or put into operation by the business. The new edition of the Oslo handbook has undergone significant changes in the definitions of innovation types. More specifically, there are now two types of innovation: innovations that change the products of the enterprise (product innovations) and innovations that change the business processes of the company (innovations of business processes). The products include the goods and services of the company, or a combination thereof.

Business processes include all of the enterprise's core product-related activities and all other supporting activities. Previous editions of the Oslo Handbook distinguished four types of innovation: product innovation, which remains, and process innovation, organisational innovation and marketing innovation, which together now constitute the new type of business process innovation. Consequently, from the three years 2016-2018 onwards, the types of innovation are not comparable over time with the previous three reference years. More specifically, the two types of innovation are defined as follows:

Product innovation: a new or improved product (good or service) that differs significantly from the previous products of the enterprise, and has been introduced to the market. Also included are products that were originally developed by other enterprises or organisations, but are new and improved for the enterprise in question.

Business process innovation: a new or improved business process, for one or more of the enterprise's business operations, which differs significantly from the previous business processes of the enterprise, and has been implemented by the enterprise. Business processes include the main business functions necessary for the production of goods and services and all other supporting activities such as logistics, accounting, IT applications, work organisation and marketing activities. Business processes can be developed either within the enterprise or sourced externally.

Innovative activities include all the development, economic and commercial activities carried out by an enterprise, with the aim of introducing new or improved products (goods or services) or/ and business processes. Innovative activities include in-house R&D, outsourced third party R&D, purchase of

machinery, equipment, software, intellectual property rights, acquisition of external knowledge, designing goods / services, preparation of production & distribution, personnel training, marketing and market research activities.

Innovative activities include all scientific, technological, organisational, economic and commercial activities that lead, or are intended to lead, to the introduction of product or process innovations.

Legal framework

The collection of data on Enterprise Innovation is carried out in compliance with Regulation (EC) No. 1608/2003 of the European Parliament and of the Council related to the production and development of Community statistics on science and technology, and the implementation rules of this Decision are defined in the Implementing Regulation (EU) No 995/2012. The implementing regulation defines the data to be collected, and the activities and sectors to be covered by the survey, as well as the frequency of data collection, the deadlines for submitting the data to the European Statistical Office (Eurostat) and each survey's reference period.

The National Documentation Centre (www.ekt.gr), is the competent national authority of the Hellenic Statistical System for the production of official statistics of Research, Development and Innovation (Government Gazette 4671/19.12.2019). EKT has been collecting and processing statistics on Enterprise Innovation since 2012, with the first three-year reference period being 2010-2012. The production of the statistical data presented in this publication was carried out in collaboration with the Hellenic Statistical Authority (Memorandum of Co-operation 15.12.2020).

Target population

The target population of the survey for the three-year period 2016-2018 was the total population of enterprises with 10 or more employees in any of the following sectors of economic activity:

Sector of economic activity	
Industry	B (05-09): Mining and Quarrying
	C (10-33): Manufacturing
	D (35): Electricity, gas, steam and air conditioning supply
	E (36-39): Water supply: Sewage, waste management and remediation activities

	G (46): Wholesale trade, except for motor vehicles and motorcycles
	H (49-53): Transportation and storage
	I (58-63): Information and communication
Services	K (64-66): Financial and insurance activities
	M (71): Architectural and engineering activities and related technical consultancy
	(72): Scientific research and development
	(73): Advertising and market research

Data collection method

Data for the 'Innovation Survey' were collected through a combination of census and sample survey. The research unit was the enterprise. Enterprises with 500 or more employees and known R&D performers (based on the results from the statistical survey on R&D carried out by EKT with the reference year 2018) were surveyed by census. The remaining enterprises of the target population were surveyed using a sample drawn from the statistical enterprise registry that is maintained by ELSTAT. A one-stage stratified sampling was applied with the following stratification criteria for the enterprises:

- Regions (at NUTS-2 level): a total of 13 regions
- Two-digit sector of economic activity: a total of 11 clusters (as presented in the table above)
- Size class of the enterprise: 10-19, 20-49, 50-99, 100-249 , 250-499 employees

The sample of companies was selected based on the specifications and accuracy requirements proposed by Eurostat in the research methodological guidelines. In total, 6,616 enterprises from the population participated in the survey, of which 208 were covered by census survey and 6,408 enterprises constituted the survey's sample.

Conducting the survey

EKT carried out the statistical survey on Innovation in collaboration with ELSTAT. The data collection was carried out with electronic questionnaires through a specially designed online environment developed by EKT. In addition, electronic procedures were implemented for the real-time monitoring of the survey process and the daily quality control of the collected data, based on the specified quality indicators.

Within the context of the collaboration with ELSTAT, approximately 180 external collaborators-researchers of ELSTAT were used nationwide. EKT's electronic communication network, both with the collaborators and with the regional services of ELSTAT, both ensured the quality of the collection, and optimised the time needed to conduct the research.

Following, EKT proceeded to process and analyse the data, produce the innovation indicators for Greece and submit them to Eurostat.

MetricsEKT
Regional Indicators

HELLENIC REPUBLIC
Ministry of Digital Governance

EKT NATIONAL DOCUMENTATION CENTRE

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European Regional Development Fund

EPAnEK 2014-2020
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COMPETITIVENESS
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