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International Collaboration in various aspects of innovation in the selected South and East European countries

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List of key messages

The analysed statistical region within SEE countries differ from developed EU countries in terms of international collaboration in various aspects of innovation. On average, the institutions/organisation in the region within the developed EU countries use more R&D collaboration, EPO patents, better included in global production in comparison with their counterpart in SEE countries.

The analysed Croatia's statistical region are better in terms of international scientific co-publication in comparison with their counterparts in Bulgaria and Romania. These results can be explained higher R&D expenditure in public sector in Croatia's statistical region.

Croatia shows relative strength comparing EU average in terms of non-R&D innovative expenditure.

In terms of involvement of SME in innovation cooperation measured by normalised scores Croatia's analysed statistical region are somewhat better comparing the analysed statistical region in Bulgaria and Romania. However, on country level innovators in these countries are observed as relative weaknesses of their Innovation System.

Introduction

- ▶ We utilise results of Regional Innovation Scoreboard for 2017 and we focus on the statistical regions in following countries:
 - ▶ Croatia,
 - ▶ Bulgaria
 - ▶ Romania
- ▶ These economies are the latest EU members and belong to group of countries New Member States. Under term international innovation collaboration, we want to highlight collaborations which include innovation and R&D activities and other related activities which describes capacity for utilization of technology (e.g. co-patenting, co-publications).

Paper Structure

First Part

we will present concept Globalisation of Innovation production followed by the short analysis of characteristics of internationalisation of business activities among SEE countries



Second Part

we will introduce the main findings which include Innovation and R&D collaboration data among the selected statistical region within SEE countries. In Croatia, we analyse the statistical region on NUTS 2 level, whereas in Romania and Bulgaria we analyse the statistical regions on NUTS1. We analyse only two NUTS 1 region in Romania. The main reason is the number of NUTS 1 level in Romania and similarity in terms of characteristics among the regions.



Focus will be on data, which describe R&D internationalisation and Innovation internationalisation of these economies. The analysis shows their comparative position towards the EU average. Regarding the analysis, the focus will be on analysis on the data which describe various aspects of the innovation collaboration. In this way, it is possible analyse interaction among firms, institutions and universities

The Globalization of Innovation Production

Picci (2009)

- Picci examined the factors facilitating international collaboration, using patents data available through PATSTAT.
- He found that degree of internationalization of R&D activities, while showing an upward trend, is still relatively limited.

Danguy (2014)

- Adding to the findings of Picci (2009), he investigates R&D international collaborations distinguishing across countries and industrial sectors.
- Danguy opts for a broader approach that disentangles industry level heterogeneity.
- In his study, he shows that the degree of openness depends on the relative technological specialization.
- Home-base augmenting strategies seem to be more likely to explain international collaboration than home-base exploiting strategies (see also Kuemmerle, 1997).
- This means that R&D collaborations are negatively related to the revealed technological advantage of countries for instance (Breschi and Tarasconi, 2013).

Kerr, S. and Kerr, W. (2015)

- They sum up the reasons why companies decide to cooperate with foreign institutions and business partners.
- They argue, in fact, that new knowledge creation and diffusion, new market entry and access to specialized skills that may be lacking in the local market of origin are the leading factors governing the current patterns of international R&D collaborations.

Innovation performance in the context of internationalisation of economic activities in Central Eastern and South Eastern Europe (CESEE) countries

The period from the nineties of the last century until the financial crisis that occurred in 2008 was characterised by a strong internationalisation of economic activities in these countries (Whitley, 1998).

Export performance and foreign direct investments (FDI) were the most important instruments. The dissolution of markets contributed to the decrease of importance of large entities dominant on these markets in that time.

The appearance of small business entities during transition, which is a result of stronger competition on Eastern European markets did not contribute to the increase of average R&D intensity of their business sector.

R&D capacities in these countries are still weak

The analysis of innovation collaboration among the selected statistical regions in South Eastern European Countries

Bačić and Aralica (2017: 555) Regional competitiveness in terms of RISs is based on innovation diffusion built on upon knowledge created in regional area (Asheim and Gertler, 2006) and upon use of knowledge external to the region (cf. Aralica, et al. 2008) – via import (e.g. equipment acquisition) and/or foreign direct investments.

That is a reason why various type of collaboration are important on regional level.

International collaboration facilitates regional competitiveness in these countries.

Croatia – NUTS 2 analysis

Innovation system

- Relative strengths of the innovation system are in Firm investments, Human resources, and Employment impacts. Relative weaknesses are in Intellectual assets, Attractive research systems, and Innovators.

Structural differences

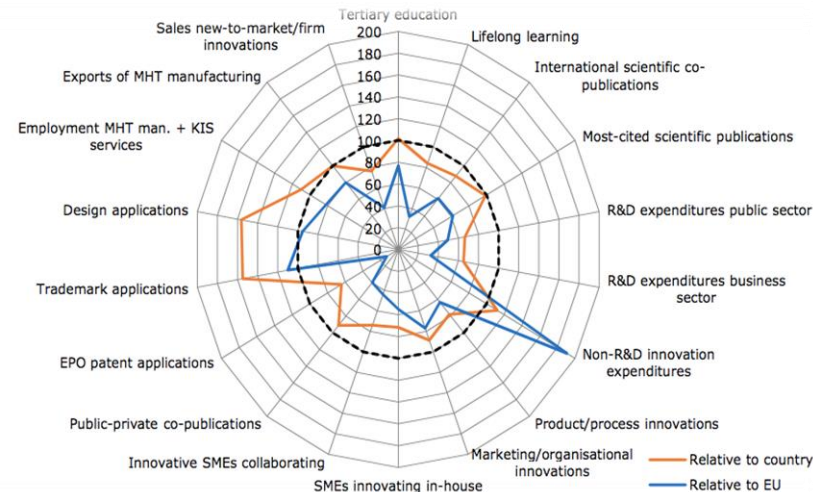
- Notable differences are a larger share of employment in Agriculture & Mining, a smaller share of employment in High and Medium high-tech manufacturing, a larger share of foreign controlled enterprises, a lower share of enterprise births, lower buyer sophistication, lower GDP per capita, a lower and negative growth rate of GDP, a lower and negative growth rate of population, and lower population density.

Croatia – Jadranska Hrvatska (HR03)

	Data	Norm alised score	Relative to	
			HR	EU
Tertiary education	30.7	0.423	102	77
Lifelong learning	3.4	0.150	84	32
International scientific co-publications	573	0.255	88	61
Most-cited scientific publications	4.7	0.337	99	62
R&D expenditures public sector	0.52	0.269	66	49
R&D expenditures business sector	0.47	0.147	65	32
Non-R&D innovation expenditures	±	0.573	±	±
Product/process innovations	±	0.283	±	±
Marketing/ org. innovations	±	0.299	±	±
SMEs innovating in-house	±	0.251	±	±
Innovative SMEs collaborating	±	0.158	±	±
Public-private co-publications	24.8	0.118	91	40
EPO patent applications	0.27	0.051	64	13
Trademark applications	0.75	0.432	155	110
Design applications	0.14	0.497	156	95
Employment MHT manuf./KIS services	10.5	0.437	110	82
Exports of MHT manufacturing	43.3	0.506	100	80
Sales new-to-market/firm innovations	±	0.192	±	±
Average score	--	0.299	--	--
Country EIS-RIS correction factor	--	0.783	--	--
Regional Innovation Index 2017	--	0.234	--	--
RII 2017 (same year)	--	--	96.1	51.5
RII 2017 (cf. to EU 2011)	--	--	--	52.9
Regional Innovation Index 2011	--	0.252	--	--
RII 2011 (same year)	--	--	101.4	56.9
RII - change between 2011 and 2017	--	-4.0	--	--

	HR03	HR	EU28
Share of employment in:			
Agriculture & Mining (A-B)	6.5	11.5	5.1
Manufacturing (C)	13.5	17.2	15.5
Utilities & Construction (D-F)	9.8	9.8	8.5
Services (G-N)	63.5	54.8	63.2
Public administration (O-U)	6.5	6.5	7.1
Average employed persons per enterprise (firm size), 2013-2014	5.1	6.8	5.4
GDP per capita (PPS), 2014	15600	16100	27600
GDP per capita growth (PPS), 2010-2014	1.84	1.62	2.00
Population density, 2015	57	74	117
Urbanisation, 2015	55.8	61.2	74.1
Population size, 2016 (000s)	1390	4190	510280

You can see how HR3 as a Moderate innovator achieved a relative performance in 2017 between 50% and 90% of the EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents Public and Private co-publications.



Croatia – Kontinentalna Hrvatska (HR04)

	Data	Normalised score	Relative to	
			HR	EU
Tertiary education	0.0	0.413	99	75
Lifelong learning	0.0	0.195	109	41
International scientific co-publications	0	0.307	106	74
Most-cited scientific publications	0.0	0.342	100	63
R&D expenditures public sector	0.00	0.458	113	84
R&D expenditures business sector	0.00	0.257	113	56
Non-R&D innovation expenditures	±	0.494	±	±
Product/process innovations	±	0.393	±	±
Marketing/ org. innovations	±	0.352	±	±
SMEs innovating in-house	±	0.389	±	±
Innovative SMEs collaborating	±	0.234	±	±
Public-private co-publications	0.0	0.135	104	45
EPO patent applications	0.00	0.089	113	23
Trademark applications	0.00	0.140	50	36
Design applications	0.00	0.182	57	35
Employment MHT manuf./KIS services	0.0	0.376	95	70
Exports of MHT manufacturing	0.0	0.506	100	80
Sales new-to-market/firm innovations	±	0.265	±	±
Average score	--	0.307	--	--
Country EIS-RIS correction factor	--	0.783	--	--
Regional Innovation Index 2017	--	0.241	--	--
RII 2017 (same year)	--	--	98.8	53.0
RII 2017 (cf. to EU 2011)	--	--	--	54.4
Regional Innovation Index 2011	--	0.240	--	--
RII 2011 (same year)	--	--	96.8	54.3
RII - change between 2011 and 2017	--	0.1	--	--

	HR04	HR	EU28
Share of employment in:			
Agriculture & Mining (A-B)	13.9	11.5	5.1
Manufacturing (C)	18.9	17.2	15.5
Utilities & Construction (D-F)	9.8	9.8	8.5
Services (G-N)	50.7	54.8	63.2
Public administration (O-U)	6.5	6.5	7.1
Average employed persons per enterprise (firm size), 2013-2014	7.8	6.8	5.4
GDP per capita (PPS), 2014	16400	16100	27600
GDP per capita growth (PPS), 2010-2014	1.59	1.62	2.00
Population density, 2015	88	74	117
Urbanisation, 2015	64.0	61.2	74.1
Population size, 2016 (000s)	2800	4190	510280

You can see how HR4 as a Moderate innovator achieved a relative performance in 2017 between 50% and 90% of the EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents Public and Private co-publications.



Bulgaria – NUTS 1 analysis

Innovation system

- Relative strengths of the innovation system are in Intellectual assets, Employment impacts, and Human resources. Relative weaknesses are in Innovators, Finance and support, and Attractive research systems.

Structural differences

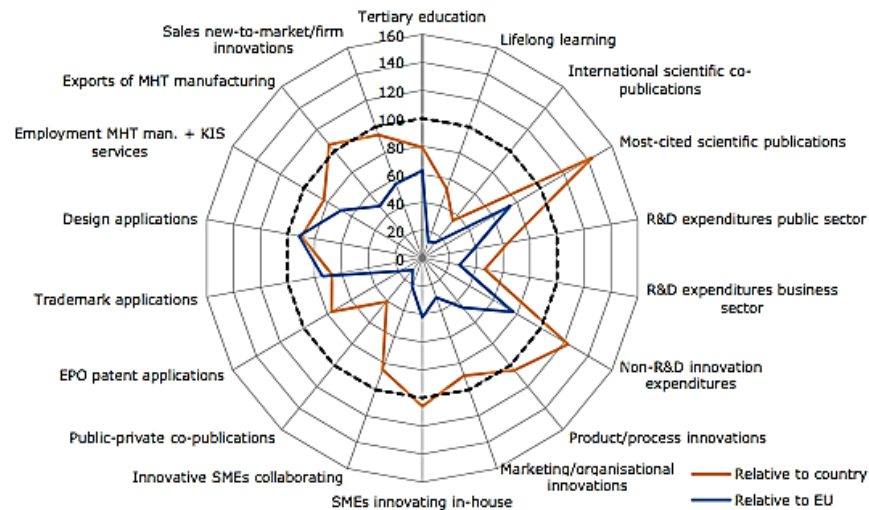
- Notable differences are a larger share of employment in Agriculture & Mining and in Manufacturing, a smaller share of employment in High and Medium high-tech manufacturing and in Knowledge-intensive services, a larger share of Micro enterprises and SMEs in turnover, a smaller share of Large enterprises in turnover, a larger share of foreign controlled enterprises, a larger share of enterprise births, lower GDP per capita, a higher growth rate of GDP, a lower and negative growth rate of population, and lower population density.

Bulgaria – Severna i iztočna Bulgaria (BG3)

	Data	Normalised score	Relative to	
			BG	EU
Tertiary education	26.8	0.346	79	63
Lifelong learning	1.3	0.059	53	12
International scientific co-publications	38	0.061	35	15
Most-cited scientific publications	5.6	0.405	144	74
R&D expenditures public sector	0.11	0.211	64	39
R&D expenditures business sector	0.15	0.126	46	28
Non-R&D innovation expenditures	±	0.231	±	±
Product/process innovations	±	0.205	±	±
Marketing/ org. innovations	±	0.117	±	±
SMEs innovating in-house	±	0.194	±	±
Innovative SMEs collaborating	±	0.078	±	±
Public-private co-publications	3.6	0.033	41	11
EPO patent applications	0.19	0.072	76	19
Trademark applications	3.24	0.291	67	74
Design applications	0.94	0.477	90	91
Employment MHT manuf./KIS services	10.2	0.366	83	68
Exports of MHT manufacturing	27.3	0.307	106	49
Sales new-to-market/firm innovations	±	0.265	±	±
Average score	--	0.213	--	--
Country EIS-RIS correction factor	--	0.836	--	--
Regional Innovation Index 2017	--	0.178	--	--
RII 2017 (same year)	--	--	84.4	39.3
RII 2017 (cf. to EU 2011)	--	--	--	40.3
Regional Innovation Index 2011	--	0.182	--	--
RII 2011 (same year)	--	--	86.7	41.0
RII - change between 2011 and 2017	--	-0.7	--	--

	BG3	BG	EU28
Share of employment in:			
Agriculture & Mining (A-B)	8.8	7.6	5.1
Manufacturing (C)	21.6	19.9	15.5
Utilities & Construction (D-F)	10.2	9.8	8.5
Services (G-N)	51.9	55.0	63.2
Public administration (O-U)	7.5	7.7	7.1
Average employed persons per enterprise (firm size), 2013-2014	5.6	6.1	5.4
GDP per capita (PPS), 2014	9900	12800	27600
GDP per capita growth (PPS), 2010-2014	4.51	2.94	2.00
Population density, 2015	54	66	117
Urbanisation, 2015	64.2	69.0	74.1
Population size, 2016 (000s)	3600	7150	510280

You can see how BG3 as a Modest innovator achieved a relative performance in 2017 below 50% of the EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents Public and Private co-publications.

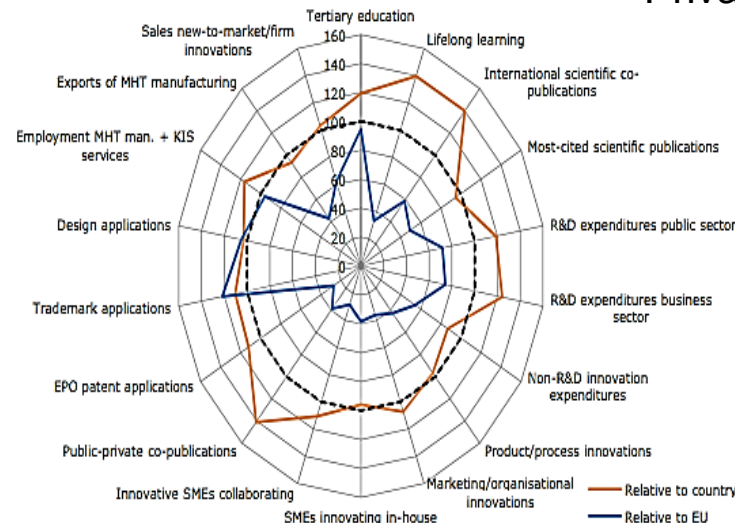


Bulgaria – Yugozapadna i yuzhna tsentralna Bulgaria (BG4)

	Data	Normalised score	Relative to	
			BG	EU
Tertiary education	37.0	0.522	119	95
Lifelong learning	2.7	0.156	140	33
International scientific co-publications	378	0.245	140	59
Most-cited scientific publications	3.6	0.267	95	49
R&D expenditures public sector	0.38	0.391	119	72
R&D expenditures business sector	0.76	0.338	124	74
Non-R&D innovation expenditures	±	0.163	±	±
Product/process innovations	±	0.190	±	±
Marketing/ org. innovations	±	0.140	±	±
SMEs innovating in-house	±	0.176	±	±
Innovative SMEs collaborating	±	0.102	±	±
Public-private co-publications	19.0	0.114	141	38
EPO patent applications	0.37	0.106	112	27
Trademark applications	8.77	0.479	110	122
Design applications	1.24	0.548	103	105
Employment MHT manuf./KIS services	14.3	0.513	116	96
Exports of MHT manufacturing	24.4	0.271	93	43
Sales new-to-market/firm innovations	±	0.291	±	±
Average score	--	0.278	--	--
Country EIS-RIS correction factor	--	0.836	--	--
Regional Innovation Index 2017	--	0.233	--	--
RII 2017 (same year)	--	--	110.1	51.3
RII 2017 (cf. to EU 2011)	--	--	--	52.6
Regional Innovation Index 2011	--	0.223	--	--
RII 2011 (same year)	--	--	106.3	50.4
RII - change between 2011 and 2017	--	2.3	--	--

	BG4	BG	EU28
Share of employment in:			
Agriculture & Mining (A-B)	6.5	7.6	5.1
Manufacturing (C)	18.4	19.9	15.5
Utilities & Construction (D-F)	9.5	9.8	8.5
Services (G-N)	57.8	55.0	63.2
Public administration (O-U)	7.8	7.7	7.1
Average employed persons per enterprise (firm size), 2013-2014	6.4	6.1	5.4
GDP per capita (PPS), 2014	15700	12800	27600
GDP per capita growth (PPS), 2010-2014	1.49	2.94	2.00
Population density, 2015	86	66	117
Urbanisation, 2015	74.0	69.0	74.1
Population size, 2016 (000s)	3560	7150	510280

You can see how BG4 as a Moderate innovator achieved a relative performance in 2017 between 50% and 90% of the EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents Public and Private co-publications.



Romania – NUTS 1 analysis

Innovation system

- Relative strengths of the innovation system are in Innovation-friendly environment, Sales impacts, and Human resources. Relative weaknesses are in Innovators, Firm investments, and Finance and support.

Structural differences

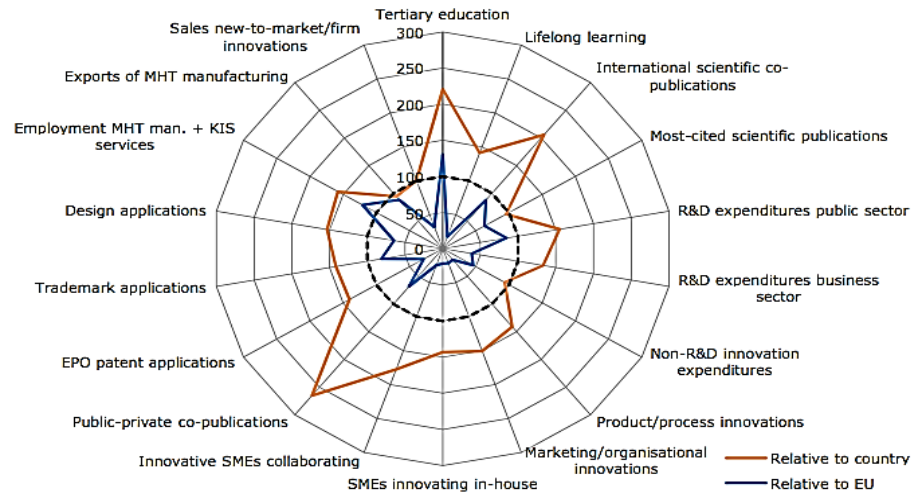
- Notable differences are a larger share of employment in Agriculture & Mining, a lower share of employment in High and Medium high-tech manufacturing, Services and Public administration, a larger share of foreign controlled enterprises, a lower number of Top R&D spending enterprises and a lower average R&D spending of these enterprises, a larger share of enterprise births, lower GDP per capita, a higher growth rate of GDP, a lower and negative growth rate of population, and lower population density.

Romania – Bucuresti - Ilfov (RO32)

	Data	Normalised score	Relative to	
			RO	EU
Tertiary education	48.4	0.718	221	130
Lifelong learning	1.6	0.083	141	18
International scientific co-publications	797	0.366	206	88
Most-cited scientific publications	4.7	0.344	96	63
R&D expenditures public sector	0.53	0.462	155	85
R&D expenditures business sector	0.25	0.175	133	38
Non-R&D innovation expenditures	±	0.138	±	±
Product/process innovations	±	0.089	±	±
Marketing/ org. innovations	±	0.082	±	±
SMEs innovating in-house	±	0.094	±	±
Innovative SMEs collaborating	±	0.087	±	±
Public-private co-publications	49.9	0.203	265	68
EPO patent applications	0.41	0.111	141	29
Trademark applications	3.91	0.320	142	81
Design applications	0.47	0.337	153	65
Employment MHT manuf./KIS services	18.0	0.645	158	121
Exports of MHT manufacturing	47.6	0.560	94	89
Sales new-to-market/firm innovations	±	0.152	±	±
Average score	--	0.276	--	--
Country EIS-RIS correction factor	--	0.777	--	--
Regional Innovation Index 2017	--	0.214	--	--
RII 2017 (same year)	--	--	142.4	47.2
RII 2017 (cf. to EU 2011)	--	--	--	48.5
Regional Innovation Index 2011	--	0.275	--	--
RII 2011 (same year)	--	--	129.7	62.1
RII - change between 2011 and 2017	--	-13.7	--	--

	RO32	RO	EU28
Share of employment in:			
Agriculture & Mining (A-B)	1.2	29.3	5.1
Manufacturing (C)	9.4	18.1	15.5
Utilities & Construction (D-F)	10.5	9.5	8.5
Services (G-N)	70.9	38.1	63.2
Public administration (O-U)	8.1	5.0	7.1
Average employed persons per enterprise (firm size), 2013-2014	8.4	5.7	5.4
GDP per capita (PPS), 2014	35600	15300	27600
GDP per capita growth (PPS), 2010-2014	2.78	3.96	2.00
Population density, 2015	1300	86	117
Urbanisation, 2015	96.5	58.1	74.1
Population size, 2016 (000s)	2290	19760	510280

You can see how RO32 as a Modest innovator achieved a relative performance in 2017 below 50% of the EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents Public and Private co-publications.

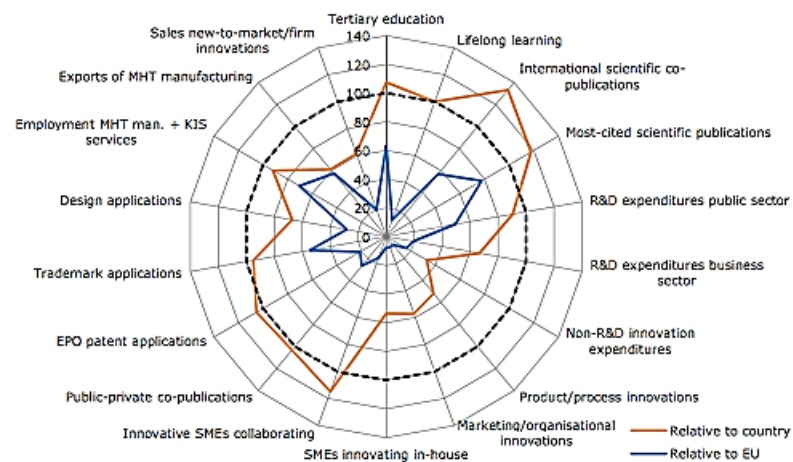


Romania – Nord-Vest (RO11)

	Data	Normalised score	Relative to	
			RO	EU
Tertiary education	27.0	0.349	107	63
Lifelong learning	1.3	0.059	100	12
International scientific co-publications	356	0.237	133	57
Most-cited scientific publications	6.0	0.423	118	78
R&D expenditures public sector	0.18	0.269	90	49
R&D expenditures business sector	0.09	0.088	67	19
Non-R&D innovation expenditures	±	0.049	±	±
Product/process innovations	±	0.033	±	±
Marketing/ org. innovations	±	0.031	±	±
SMEs innovating in-house	±	0.035	±	±
Innovative SMEs collaborating	±	0.056	±	±
Public-private co-publications	10.8	0.079	103	27
EPO patent applications	0.24	0.083	105	21
Trademark applications	1.76	0.215	95	55
Design applications	0.09	0.148	67	28
Employment MHT manuf./KIS services	10.5	0.376	92	70
Exports of MHT manufacturing	31.8	0.363	61	57
Sales new-to-market/firm innovations	±	0.093	±	±
Average score	--	0.166	--	--
Country EIS-RIS correction factor	--	0.777	--	--
Regional Innovation Index 2017	--	0.129	--	--
RII 2017 (same year)	--	--	85.6	28.4
RII 2017 (cf. to EU 2011)	--	--	--	29.1
Regional Innovation Index 2011	--	0.196	--	--
RII 2011 (same year)	--	--	92.4	44.2
RII - change between 2011 and 2017	--	-15.1	--	--

	RO11	RO	EU28
Share of employment in:			
Agriculture & Mining (A-B)	26.0	29.3	5.1
Manufacturing (C)	23.3	18.1	15.5
Utilities & Construction (D-F)	8.9	9.5	8.5
Services (G-N)	37.8	38.1	63.2
Public administration (O-U)	3.9	5.0	7.1
Average employed persons per enterprise (firm size), 2013-2014	4.9	5.7	5.4
GDP per capita (PPS), 2014	13500	15300	27600
GDP per capita growth (PPS), 2010-2014	3.64	3.96	2.00
Population density, 2015	77	86	117
Urbanisation, 2015	53.2	58.1	74.1
Population size, 2016 (000s)	2580	19760	510280

You can see how RO11 as a Modest innovator achieved a relative performance in 2017 below 50% of the EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents Public and Private co-publications.



Romania – Centru (RO12)

	Data	Norm alised score	Relative to	
			RO	EU
Tertiary education	24.6	0.308	95	56
Lifelong learning	1.1	0.041	70	9
International scientific co-publications	136	0.137	77	33
Most-cited scientific publications	5.6	0.399	111	73
R&D expenditures public sector	0.07	0.168	56	31
R&D expenditures business sector	0.25	0.175	133	38
Non-R&D innovation expenditures	±	0.154	±	±
Product/process innovations	±	0.061	±	±
Marketing/ org. innovations	±	0.059	±	±
SMEs innovating in-house	±	0.055	±	±
Innovative SMEs collaborating	±	0.044	±	±
Public-private co-publications	4.7	0.042	55	14
EPO patent applications	0.11	0.053	67	14
Trademark applications	1.20	0.177	78	45
Design applications	0.21	0.225	102	43
Employment MHT manuf./KIS services	14.2	0.509	125	95
Exports of MHT manufacturing	44.1	0.516	87	82
Sales new-to-market/firm innovations	±	0.101	±	±
Average score	--	0.179	--	--
Country EIS-RIS correction factor	--	0.777	--	--
Regional Innovation Index 2017	--	0.139	--	--
RII 2017 (same year)	--	--	92.5	30.7
RII 2017 (cf. to EU 2011)	--	--	--	31.5
Regional Innovation Index 2011	--	0.173	--	--
RII 2011 (same year)	--	--	81.6	39.1
RII - change between 2011 and 2017	--	-7.6	--	--

	RO12	RO	EU28
Share of employment in:			
Agriculture & Mining (A-B)	14.4	29.3	5.1
Manufacturing (C)	27.7	18.1	15.5
Utilities & Construction (D-F)	11.0	9.5	8.5
Services (G-N)	41.5	38.1	63.2
Public administration (O-U)	5.4	5.0	7.1
Average employed persons per enterprise (firm size), 2013-2014	5.5	5.7	5.4
GDP per capita (PPS), 2014	14100	15300	27600
GDP per capita growth (PPS), 2010-2014	3.06	3.96	2.00
Population density, 2015	69	86	117
Urbanisation, 2015	58.3	58.1	74.1
Population size, 2016 (000s)	2340	19760	510280

You can see how RO12 as a Modest innovator achieved a relative performance in 2017 below 50% of the EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents Public and Private co-publications.

