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Strengthening scientific and research capacity of the Institute of Economics, Zagreb as a cornerstone for Croatian socioeconomic growth through the implementation of Smart specialization strategy

Dissemination Report, SmartEIZ

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

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List of key messages

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

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

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

- In terms of involvement of SMEs in innovation cooperation measured by normalised scores, Croatia's analysed statistical regions are somewhat better compared to the analysed statistical regions of Bulgaria and Romania. However, on a country level, innovators in these countries are considered as a relative weakness within the Innovation System.

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Introduction

In this report we utilise the results of the Regional Innovation Scoreboard for 2017 and we focus on the statistical regions in the following countries: Croatia, Bulgaria and Romania. This is a report about various types of international innovation collaborations in those countries. These economies are the latest EU members and belong to the group of New Member States. Under the term international innovation collaboration, we understand collaborations which include innovation and R&D activities and other related activities, describing a capacity for utilization of technology (e.g. co-publications).

It is widely accepted that the international R&D collaboration is an important strategy in this globalized economy. Many studies have investigated to what extent R&D endeavours are actually carried out across countries in a globalized fashion and what is the value generated by those activities on international market compared to R&D performed on national market. More and more, in fact, external networks and interactions among different actors have been exploited in science and technology with the aim of generating greater value (Wagner et al., 2015; Kerr, S. and Kerr, W., 2015).

Over time, different indirect approaches have been used to measure the internationalization of R&D collaborations, such as Foreign Direct Investments (FDI) in R&D (e.g. Penner-Hahn and Shaver, 2004; Picci, 2009; Filippetti et al., 2013), foreign-owned R&D facilities (e.g. Hsu et al, 2014), patent citations (Criscuolo et al., 2002), international co-patenting (e.g. Giuliani et al., 2016; Singh, 2007; Branstetter et al. 2015; Alnuaimi et al., 2012) or employees' mobility and surveys.

However, there are differences among developed countries and new member states in terms of Internationalization of R&D collaboration. Characteristics of these

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collaborations depend on the characteristics of these economies. Reciting Radosevic (2017), the majority of South-East European economies are lower middle-income economies which are growing based on *production* as opposed to *technological capability*. Their enterprises compete based on the efficient use of standard technologies, skills of their labour force, and the capacity to absorb foreign technology. However, by and large they are outside of European production and technology networks and they are only partly integrated into the global economy through buyer-driven value chains (Broadman, 2005).

In the first part of the text, we will present the concept of Globalisation of Innovation production followed by a short analysis of characteristics of internationalisation of business activities among SEE countries. After that, we will introduce the main findings which include Innovation and R&D collaboration data among the selected statistical regions in SEE countries. In Croatia, we analyse the statistical region on NUTS 2 level, whereas in Romania[1] and Bulgaria we analyse the statistical regions on NUTS 1 level. Focus will be on the data which describe R&D and Innovation internationalisation of these economies. As mentioned before, these countries are the newest EU members. The analysis shows their comparative position towards EU average. Regarding the analysis, the focus will be on the analysis of the data which describe various aspects of innovation collaboration. In this way, it is possible to analyse interaction among firms, institutions and universities, i.e. organisations responsible for knowledge creation and knowledge diffusion on a domestic market as well as the international markets.

The Globalization of Innovation Production

[1] We analyse only two NUTS 1 regions in Romania. The main reason is their number and similarities in terms of characteristics among the regions.

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In his work, Picci (2009) examined the factors facilitating international collaboration, using patents data available through PATSTAT. All priority applications filed at any one of the EU27 national patent offices, the European Patent Office (EPO), the United States Patent and Trade Mark Office (USPTO), or the Japanese patent office from 1990 to 2005, were considered. The applications were studied at a country level, hence, the determinants of collaboration between pairs of countries are considered.

He found that the degree of internationalization of R&D activities, while showing an upward trend, is still relatively limited. On top of that, using a gravity model, the author described countries' co-invention frequency, showing evidence that collaboration is positively related to the countries' economic size and negatively related to their distance, even with elasticity which is sensibly lower than the one for the international trade. Other variables have been found to positively determine R&D collaborations, such as the presence of a common border, a common language, a common market, a common currency area and a higher level of mutual trust. These findings are consistent with the literature on bilateral trade of goods and services.

Another notable attempt to discuss the extent, and research the causes of the internationalization of inventive activities was made by Danguy (2014). Adding to the findings of Picci (2009), he investigates R&D international collaborations distinguishing across countries and industrial sectors. While most studies focus on specific kinds of firms or focus on selected countries, Danguy opts for a broader approach that disentangles the industry level heterogeneity. Patents with priority filing between 1980 and 2005 were retrieved from PATSTAT for 21 manufacturing industries and 29 OECD countries. In his study, he shows that the degree of openness depends on the relative technological specialization. In particular, 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 (Breschi and Tarasconi, 2013). In other words, firms are more

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likely to perform R&D internationally in fields where they are relatively weak at home. Similar interesting insights in this regard came also from the study of Criscuolo et al. (2002).

Building upon the extensive literature, Kerr, S. and Kerr, W. (2015) 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. On the other hand, the literature highlights how much companies can benefit from international co-invention endeavours – represented by global collaborative patents – in terms of enhanced knowledge about products and services targeted at customers in foreign countries, as well as stronger cultural sensitivity and specialized knowledge on how to conduct business in respective countries.

Innovation performance in the context of internationalisation of economic activities in CESEE[2] countries

Since technological transfer from developed countries is crucial for advancement in the use of technology and knowledge in CESEE countries, the internationalisation of innovation activities became a vital question regarding policies related to innovation development from the last decade of the last century onwards. Thus, the internationalisation can be perceived as an opportunity for enhancing participation of companies from these countries in the markets of developed 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). In this context, export performance and foreign direct investments

[2] Central Eastern and South Eastern Europe

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(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 as well as the orientation of these business entities towards the Western economies, did not contribute to the increase of average R&D intensity of their business sector, as compared to the previous period of the eighties of the last century. R&D capacities in these countries are still weak, and are frequently concentrated within several R&D performers (as in the case of Croatia), which is parallel to a high share of non R&D performers in these economies (Radosevic and Ciampi Stancova, 2015).

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

Reciting Bačić and Aralica (2017: 555), regional competitiveness in terms of RISs is based on innovation diffusion built upon knowledge created in regional area (Asheim and Gertler, 2006) and upon the 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 types of collaborations are important on a regional level. International collaboration facilitates regional competitiveness in these countries. The analysis shows the Innovation system within the selected countries on NUTS 1 level, except in Croatia, where the analysis was done for NUTS 2 level. The focus will be on data which describe various types of collaborations plus R&D collaboration. We are analysing the strengths of the regions comparing them to the averages on national levels, as well as to EU average through the Regional Innovation Index (RII).

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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 seen in 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, the lower GDP per capita, lower and negative growth rate of the GDP, lower and negative growth rate of population, and lower population density.

Jadranska Hrvatska (HR03) is a Moderate - Innovator, and the innovation performance has decreased over time. The following table shows the normalized scores per indicator and relative results compared to the country and the EU. The table also shows the RII in 2017 compared to that of the country and the EU in 2017, the RII in 2017 compared to that of the EU in 2011, and performance change over time.

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	Data	Normalised score	Relative to HR	Relative to 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	--	--

Table 1 - The normalized scores per indicator and relative results. Source: Regional Innovation Scoreboard. "Regional Profiles Croatia." (2017).

The radar graph shows relative strengths compared to Croatia (red line) and the EU (blue line), highlighting relative strengths (e.g. Non-R&D innovation expenditures) and weaknesses (e.g. Business R&D expenditures).

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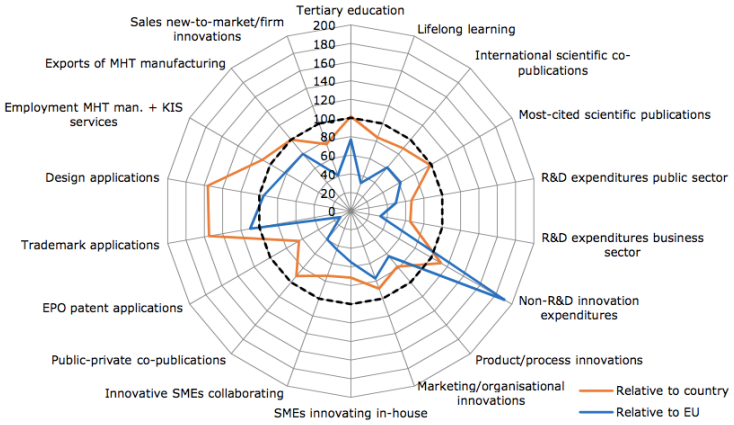

Figure 1 - Relative strengths compared to Croatia (red line) and the EU (blue line). Source: Regional Innovation Scoreboard. "Regional Profiles Croatia." (2017).

The table below shows data highlighting possible structural differences. For instance, the region is somewhat less densely populated, with higher employment share in services, and lower shares in manufacturing and agriculture.

	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

Table 2 - Data highlighting possible structural differences. Source: Regional Innovation Scoreboard. "Regional Profiles Croatia" (2017)

From the above tables 1-2 and figure 1, you can see how HR3 as a Moderate innovator achieved a relative performance in 2017 between 50% and 90% of 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, and Public and Private co-publications.

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Kontinentalna Hrvatska (HR04) is a Moderate - Innovator, and the innovation performance has remained stable over time.

The following table shows normalised scores per indicator and relative results compared to the country and the EU. The table also shows the RII in 2017 compared to that of the country and the EU in 2017, the RII in 2017 compared to that of the EU in 2011, and performance change over time.

	Data	Normalised score	Relative to HR	Relative to 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	--	--

Table 3 - The normalized scores per indicator and relative results. Source: Regional Innovation Scoreboard. "Regional Profiles Croatia" (2017)

The radar graph shows relative strengths compared to Croatia (red line) and the EU (blue line), highlighting relative strengths (e.g. Non-R&D innovation expenditures) and weaknesses (e.g. EPO patent applications).

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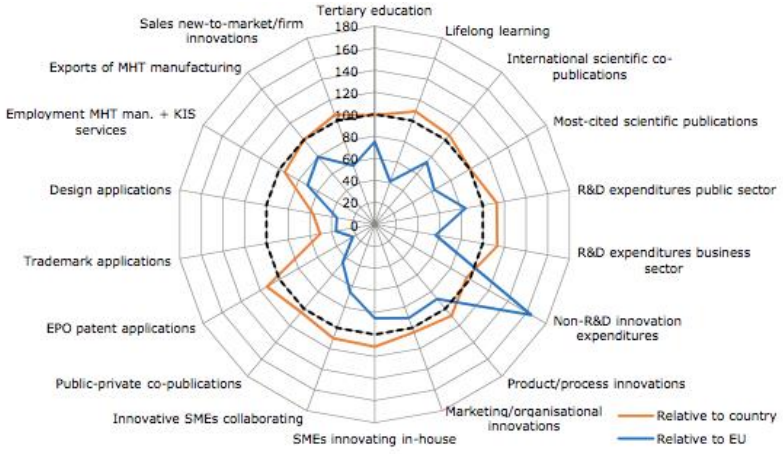

Figure 2 - Relative strengths compared to Croatia (red line) and the EU (blue line). Source: Regional Innovation Scoreboard. "Regional Profiles Croatia" (2017)

The table below shows data highlighting possible structural differences. For instance, the region is somewhat more densely populated, with higher than average employment shares in manufacturing and agriculture, and lower share in services.

	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

Table 4 - Data highlighting possible structural differences. Source: Regional Innovation Scoreboard. "Regional Profiles Croatia" (2017)

From the above tables 3-4 and figure 2, you can see how HR4 as a Moderate innovator achieved a relative performance in 2017 between 50% and 90% of 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

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sector, Innovative SMEs collaborating, EPO patents, and 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 seen in 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, the lower GDP per capita, a higher growth rate of GDP, a lower and negative growth rate of population, and lower population density.

Severna i iztochna Bulgaria (BG3) is a Modest Innovator, and innovation performance has decreased slightly over time.

The following table shows the normalised scores per indicator and relative results compared to the country and the EU. The table also shows the RII in 2017 compared to that of the country and the EU in 2017, the RII in 2017 compared to that of the EU in 2011, and performance change over time.

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	Data	Normalised score	Relative to BG	Relative to 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	--	--

Table 5 - The normalised scores per indicator and relative results compared to the country and the EU. Source: Regional Innovation Scoreboard. "Regional Profiles Bulgaria" (2017)

The radar graph shows relative strengths compared to Bulgaria (red line) and the EU (blue line), highlighting relative strengths (e.g. Design applications) and weaknesses (e.g. Public-private co-publications).

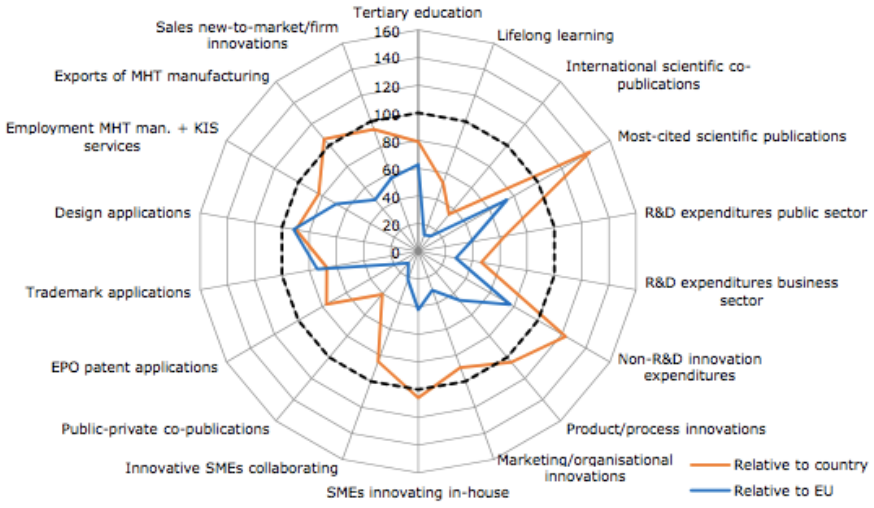

Figure 3 - Relative strengths compared to Bulgaria (red line) and the EU (blue line), highlighting relative strengths and weaknesses. Source: Regional Innovation Scoreboard. "Regional Profiles Bulgaria" (2017)

The table below shows data highlighting possible structural differences. For instance,

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the region is somewhat less densely populated, with more employment in manufacturing and less in services, and the lower GDP per capita (but higher growth) than the average.

	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

Table 6 - Data highlighting possible structural differences. Source: Regional Innovation Scoreboard. "Regional Profiles Bulgaria" (2017)

From the above tables 5-6 and figure 3, you can see how BG3 as a Modest innovator achieved a relative performance in 2017 below 50% of 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, and Public and Private co-publications.

Yugozapadna i yuzhna tsentralna Bulgaria (BG4) is a Moderate - Innovator, and the innovation performance has increased over time.

The following table shows the normalised scores per indicator and relative results compared to the country and the EU. The table also shows the RII in 2017 compared to that of the country and the EU in 2017, the RII in 2017 compared to that of the EU in 2011, and performance change over time.

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	Data	Normalised score	Relative to BG	Relative to 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	--	--

Table 7 - The normalised scores per indicator and relative results compared to the country and the EU. Source: Regional Innovation Scoreboard. "Regional Profiles Bulgaria" (2017)

The radar graph shows relative strengths compared to Bulgaria (red line) and the EU (blue line), highlighting relative strengths (e.g. Trademark applications) and weaknesses (e.g. Exports of MHT manufacturing).

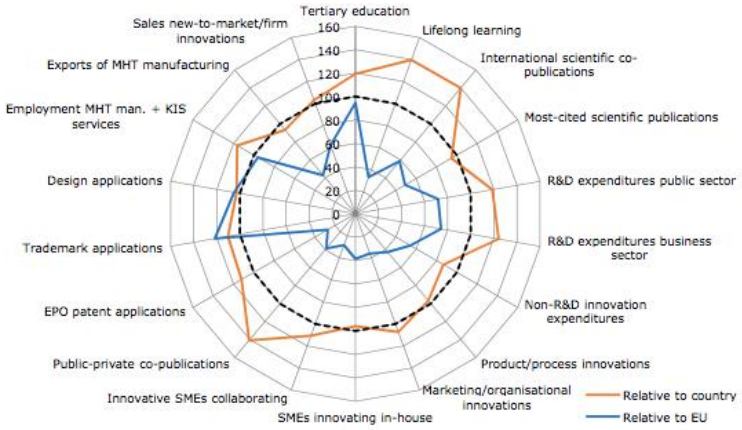

Figure 4 - Relative strengths compared to Bulgaria (red line) and the EU (blue line), highlighting relative strengths and weaknesses. Source: Regional Innovation Scoreboard. "Regional Profiles Bulgaria." (2017).

The table below shows data highlighting possible structural differences. For instance, the region is more densely populated with slightly more employment in services, and

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a higher GDP per capita.

\	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

Table 8 - Data highlighting possible structural differences. Source: Regional Innovation Scoreboard. "Regional Profiles Bulgaria" (2017)

From the above tables 7-8 and figure 4, you can see how BG4 as a Moderate innovator achieved a relative performance in 2017 between 50% and 90% of 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, and Public and Private co-publications.

Romania – The analysis of the selected NUTS 1 region

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 seen in a larger share of employment in Agriculture & Mining, a lower share of employment in High and Medium high-tech manufacturing, Services

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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, the lower GDP per capita, a higher growth rate of GDP, a lower and negative growth rate of population, and lower population density.

Bucuresti - Ilfov (RO32) is a Modest Innovator, and the innovation performance has decreased significantly over time.

The following table shows the normalized scores per indicator and relative results compared to the country and the EU. The table also shows the RII in 2017 compared to that of the country and the EU in 2017, the RII in 2017 compared to that of the EU in 2011, and performance change over time.

	Data	Normalised score	Relative to RO	Relative to 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	--	--

Table 9 - The normalized scores per indicator and relative results compared to the country and the EU. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

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The radar graph shows relative strengths compared to Romania (red line) and the EU (blue line), highlighting relative strengths (e.g. Tertiary education) and weaknesses (e.g. Sales of new innovations).

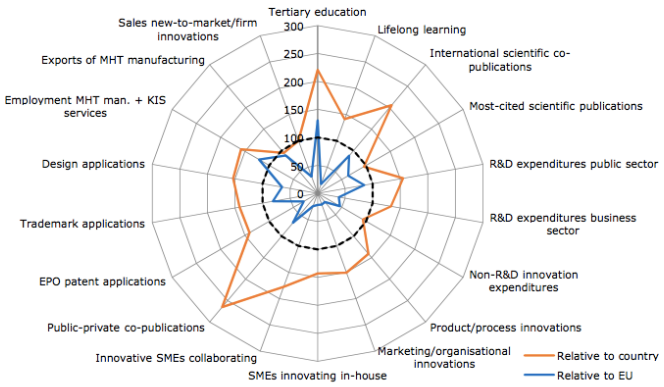

Figure 5 - Relative strengths compared to Romania (red line) and the EU (blue line), highlighting relative strengths and weaknesses. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

The table below shows data highlighting possible structural differences. For instance, the region is highly densely populated, with considerably higher employment shares in services and public administration, and much higher than the average GDP per capita.

	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

Table 10 - Data highlighting possible structural differences. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

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From the above tables 9-10 and figure 5, you can see how RO32 as a Modest innovator achieved a relative performance in 2017 below 50% of 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, and Public and Private co-publications.

Nord-Vest (RO11) is a Modest - Innovator, and the innovation performance has decreased significantly over time.

The following table shows the normalised scores per indicator and relative results compared to the country and the EU. The table also shows the RII in 2017 compared to that of the country and the EU in 2017, the RII in 2017 compared to that of the EU in 2011, and performance change over time.

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	Data	Normalised score	Relative to RO	Relative to 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	--	--

Table 11 - The normalized scores per indicator and relative results compared to the country and the EU. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

The radar graph shows relative strengths compared to Romania (red line) and the EU (blue line), highlighting relative strengths (e.g. Tertiary education) and weaknesses (e.g. Non-R&D innovation expenditures).

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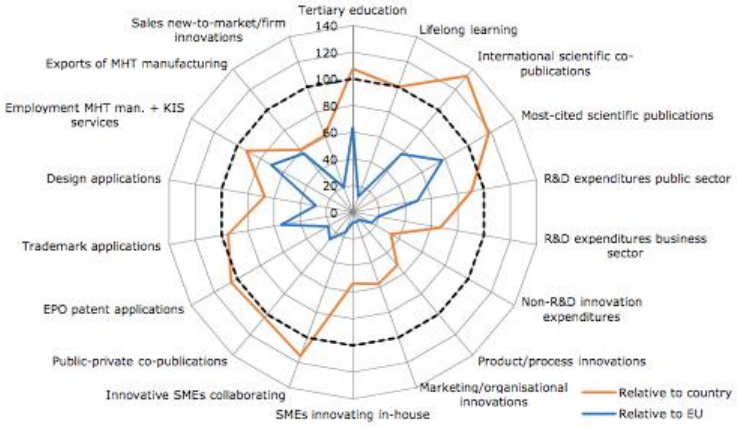

Figure 6 - Relative strengths compared to Romania (red line) and the EU (blue line), highlighting relative strengths and weaknesses. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

The table below shows data highlighting possible structural differences. For instance, the region has higher employment shares in manufacturing, lower shares in public administration, and somewhat lower than the average GDP per capita.

	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

Table 12 - Data highlighting possible structural differences. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

From the above tables 11-12 and figure 6, you can see how RO11 as a Modest innovator achieved a relative performance in 2017 below 50% of EU average in 2017 with reference to the following indicators: International scientific co-publications, R&D

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expenditure in the public sector, R&D expenditure in the business sector, Innovative SMEs collaborating, EPO patents, and Public and Private co-publications.

Centru (RO12) is a Modest - Innovator, and the innovation performance has decreased over time.

The following table shows the normalised scores per indicator and relative results compared to the country and the EU. The table also shows the RII in 2017 compared to that of the country and the EU in 2017, the RII in 2017 compared to that of the EU in 2011, and performance change over time.

	Data	Normalised score	Relative to RO	Relative to 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	--	--

Table 13 - The normalized scores per indicator and relative results compared to the country and the EU. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

The radar graph shows relative strengths compared to Romania (red line) and the EU (blue line), highlighting relative strengths (e.g. Employment in MHT manufacturing and KIS services) and weaknesses (e.g. Public sector R&D expenditures).

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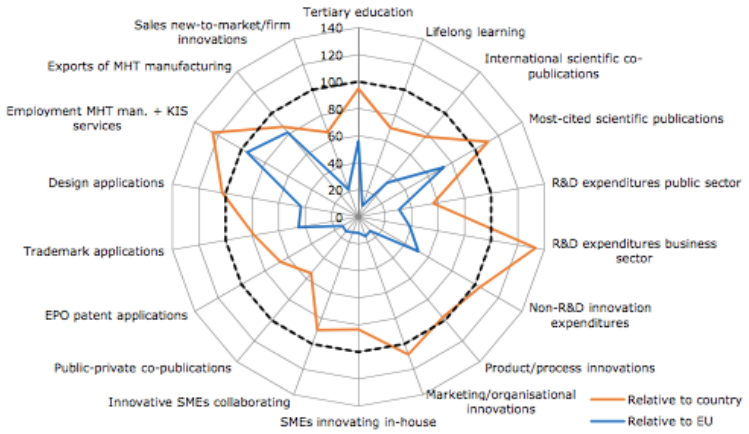

Figure 7 - Relative strengths compared to Romania (red line) and the EU (blue line), highlighting relative strengths and weaknesses. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

The table below shows data highlighting possible structural differences. For instance, the region is less densely populated, with higher employment shares in manufacturing and utilities & construction, and lower share in agriculture.

	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

Table 14 - Data highlighting possible structural differences. Source: Regional Innovation Scoreboard. "Regional Profiles Romania" (2017)

From the above tables 13-14 and figure 7, you can see how RO12 as a Modest innovator achieved a relative performance in 2017 below 50% of 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, and Public and Private co-publications.

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