INNOVATION SCOREBOARD INDICATORS BETWEEN SERBIA AND HUNGARY

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Abstract

The world cannot be imagined without innovation progress therefore its measurement and evaluation are highly important. The aim of the paper is to present the importance of innovation progress in the framework of the EU and present the innovation capacities between Hungary and Serbia in the time frame of one decade based on defined innovation inputs distributed through selected outputs. The paper presents the main innovation scoreboard indicators of Serbia and Hungary in the period between 2011 and 2020 presented as descriptive data and at the end wrapped in Data Envelopment analysis with the help of the Malmquist index. In total eight indicators describing human capital, innovation assets, and business research activities were considered for the analysis. In conclusion, Hungary performed better compared to Serbia, and during the examined period neither of the country faced significant falls but as well the progress is quite static and slow.

Keywords*: Innovation scoreboard, DEA, Hungary, Serbia, innovation progress.*

JEL classification*: O3, O31, O32, R1*

LCC*: JN, HC, HT.*

Introduction

Innovation in Europe

The high and rapid development of technologies in every sector globally is taking a vast share as induces great benefits for both society and the economy. According to the OECD (2015), innovation provides a base for strengthening the labor market, new businesses, economic growth, and improving quality of life. Innovative economics can ensure higher living standards, increase national readiness levels, overcome challenges, and deliver higher productivity. Zauskova et.al. (2013) agreed that innovation is an essential part of the economic growth of a country when it comes to expansion of the global market scale, addressing that companies are more open to adoption of new ideas, technological developments, and solutions, where stakeholders are more involved in the process of product development which is considered as an innovative activity. Even 10 years earlier a significant increase in open innovations and investments coming from different sectors could be noticed.

Only countries that can support and secure innovations are highly ranked globally, and it is a rising trend in the 21st century. However, innovation-based growth is still not only rising in highly developed countries. Developing countries are generating a high focus on this topic and are trying to establish mutual innovation policies and measures, to increase their innovation capacities and

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balance their innovation inputs and outputs (see Johnson Cornell University, INSEAD, WIPO, 2015) as they find room to enrich their growth capacities. Although the EU is quite aware of it, knowing how diverse it is, not every member state country has equal innovation capacities and performance levels. More developed regions could adapt to the changes easier and grow faster-attracting investors and more likely skilled labor forces while on the other hand, less developed regions had fewer capacities and the utilization process is slower (Manfred - Nijkamp, 2013). It can be stated that innovation is a modern tool for economic development. But yet the topic is not new. In 1963 OECD addressed for the first time the economic importance of the innovations, which stepped out of the science and technological framework (see OECD, 1963). It was clearly stated that innovation is not only an R&D activity but also part of an economic dimension.

As Schluter (2016) summarized with Research & Innovation Smart Specialized Strategic development plan (RIS3), the opportunity to catch up with the high innovation standards is given even to the developing countries and those which are lagging behind the strategic program are clear, for the countries seeking to identify the innovation niches and their innovation frontier as, besides innovations designs, its commercialization and distribution to the market are highly important. Making some innovations commercially available shall pass through two main phases: technological development and marketization (commercialization). The first part is focused more on capacity studies, demonstration activities, piloting, technology transfer, and coordination of the innovation activities, while the second phase is focused on the market risk assessment and defining marketing mix elements (product, price, place, and promotion) (Lipkova - Brada, 2016).

There are some weak points when it comes to setting up the EU as an innovative leader noted by Lipkova (2012), those are insufficient business spending on research and development (R&D), low investments in R&D (share of GDP is lower than 2 %), an insufficient number of researchers, especially highly skilled due to brain-drain, further development in high-tech and research systems is lagging together with the innovation activates in the private sector. Those are just some of the factors that prevent the EU to become one of the innovation leaders among top world performers such as the U.S, Japan, and China. According to the final report provided by the European Commission (EC, 2016), the case scenario envisioned that the South-East region will grow much faster than European, and the way Europe can overcome it, is by specializing in one specific domain of STI (*Science & Technology & Innovation*), to standardize and improve exchange processes with the industry, and outsource knowledge from stronger regions.

The EU is quite aware of its current position in the innovation market and to gain its competitive advantage it is managing different measures, actions, funding, programs, and policies. With the 2000 Lisbon Strategy, it was just confirmed that the overall goal for the EU is to become a worldwide knowledge-based region where research and innovation would lead toward economic growth. In 2010 the Innovation Union (IU) was established as a public body to assist in performing on defined Lisbon Strategy's goals: Europe to be a top science performer, make innovation processes more efficient, establish innovation partnership and culture, manage EU institutions, national and regional authorities responsible for innovation policy execution (EC, 2015; IU 2010). With the "Europe 2020" strategy developmental goals were enlarged, not just focusing on the knowledge-based economy but achieving broaden objective: smart, sustainable, and inclusive economy driven by innovation. In 2013 National Research and Innovation Strategies for Smart Specialization (*RIS3*) 2014-2020 and 2021-2027 were introduced aligning to ensure knowledge-based development, encourage competitive advantage and potential for excellence, and support technological and practice-based innovations (EC, 2014).

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Besides all, the IU is examining innovation readiness level and performance by each member state country by evaluating created scheme so-called Regional Innovation Scoreboard, a dashboard based on the evaluation of the set of 25 indicators about the innovation scheme. RIS indicators can be grouped into three main categories: indicators that ensure conditions for the innovations to be created (e.g., human and financial resources), business activities (e.g., business innovators, innovation assets), and outputs (employment in the innovation sector, export of innovative products). With EIS *(European Innovation Scoreboard)* performance the EU can trace and compare performance in the domain of research and innovation activities, not just between member states' countries but as well overall EU performance compared to the other regions on the global scale. In this way, the EU can make decisions on which areas need more attention and in which direction smart specialization measurements shall be driven.

Just to get some overview, comparing the EU, Hungary, and Serbia - what their positions are when it comes to financial support, human resources, and innovation activities - some data and figures were taken for 2020 from the statistical database of Eurostat. So far, the EU's average Gross domestic expenditures on R&D (GERD) was 228.346 million euros, while this number in Hungary was 631.4 million euros and only 242.12 million euros in Serbia. If we think about human resources, the EU employed in the same year 613.592 researchers, Hungary 25.804, and Serbia approximately 10.000 researchers less. The number of patent applications reported to EP in the EU was slightly over 57.000 while in Hungary it was 181, while this data for Serbia as per the Eurostat record is not available as Serbia is not an EU member state country. The number of business innovators in the EU was over 950.000, in Hungary it was recorded at around 11.000, and in Serbia quite a similar number as well. Still for getting a better overview some descriptive data related to Hungary and Serbia will be provided in this paper.

European Regional Innovation Scoreboard

As it was already mentioned the IU launched a set of a significant number of indicators to measure the innovation performance of 27 EU member states and 4 non-EU countries (Norway, Switzerland, UK, and Serbia) on NUTS III level. For the report published in 2021 a total of 21 indicators were taken into account, classified into four main pillars focusing on measuring human resources; financial support and investments; digitalization and use of information technologies, economic and social impact, and environmental sustainability, and intellectual assets. Based on this set of indicators each country and NUTS II and NUTS III regions are classified. "*Innovation Leader*" performance is above 125% of the average EU level, and only five countries belong to this group: Switzerland, Sweden, Finland, Denmark, and Belgium. A country/region whose performance is in the range of 100% and 125 %, in total is a *"Strong Innovator"*. There are nine countries in this group (e.g. the Netherland, the UK, Germany, and Luxembourg). Moderate Innovators' performance is between 70% and 100%, here there are as well nine countries grouped (e.g. Italy, Cyprus, Malta). Countries that face performance under 70% of the overall average are named *"Emerging Innovators"* that count in a total of eight countries (some of them are: Croatia, Hungary, and Serbia). As can be seen in Figure 1. the whole of Hungary is classified as an *"Emerging Innovator"*, where the lowest performance is recorded in three regions - Észak-Alföld, Észak-Magyarország, and Dél-Dunántúl - which score is around 50% below the European average, while only Budapest has a higher score (97%) and therefore meets the average level, and it is characterized as "*Moderate Innovator"*. In Serbia, all regions are on the same innovation level reaching a score of 50%, while the Belgrade region (capital) is characterized as a *"Moderate Innovator"* meeting the score of 80%.

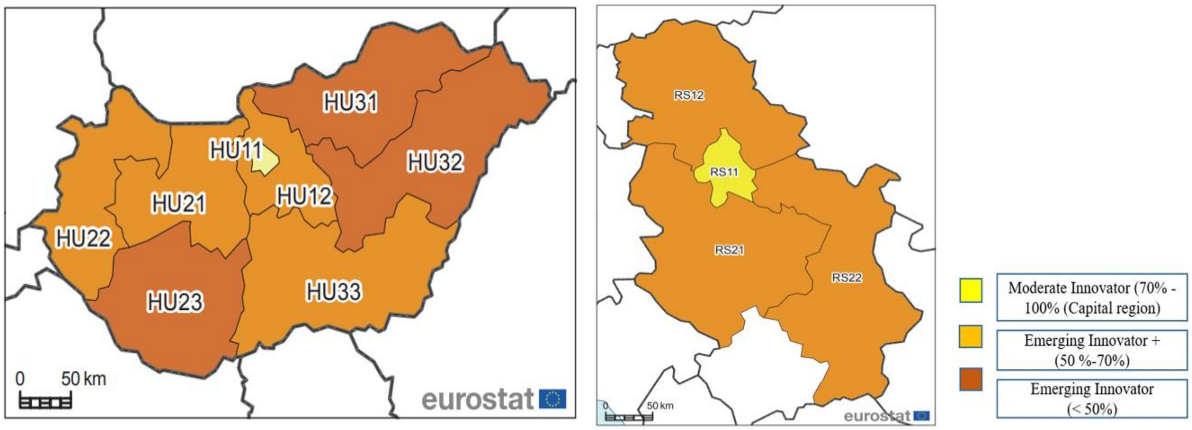

Figure 1: EIS score map of Hungary and Serbia, 2022

Source: European Innovation Scoreboard, 2021: 29. and 35.

There are vast oscillations concerning innovation development between countries and regions. The Global Innovation Index (GII) explains this phenomenon as a geographical misbalance of innovation activities which are usually grouped in clusters, e.g. the reason can be an organization of innovation hubs in capital areas, or neighboring countries unifying and in that way creating regional innovation cluster (Berquist et.al., 2017), which was also confirmed by Landabaso (1997) who noted that extensive geographical concentration of the novel high-tech developments in advanced regions of Europe is present. This is certainly one of the aims, as the creation of centers of excellence, rather agile and flexible, can bring better competitive advantages. The authors investigated the 'technological gap' in Europe and its causes as well. One of them is the funding scheme in Europe: more developed countries have better tailored public systems for utilization of the financial resources.

Another very important factor is research personnel which also varies - in some countries like Germany and the Netherlands it is much higher compared to Greece or Portugal. Bottazzi and Peri (2000) confirm that increment of R&D leads toward raise of innovations, meaning that having an expenditure (costs of R&D) of innovations will result in a higher innovations' productivity level. They also agreed that characteristics of the region and expenditures of R&D have a greater impact on the level of innovations' productivity. Gossling and Ruten (2007) examined several factors that might have an impact on the level of innovativeness in the EU regions. They took five indicators into account - wealth (GRP per capita), GDP, cultural diversity, the talent of the population (population with higher education), and density of the population - and came up with the result that GRP does not have a high impact on boosting the innovations while other factors bring positive results in correlation with innovations in the NUTS 2 level regions.

Materials and methods

In this paper descriptive and secondary data analysis - DEA (*Data Envelopment Analysis*) with the Malmquist productivity index (mi) were employed, as it is suitable for measuring the efficiency of the regional innovation system (RIS) based on the given inputs and outputs for an examined period (between 2011 and 2020 based on the data availability, data for 2021 and 2022 are not yet present in statistical databases). Data were sourced from three databases: Eurostat, the Hungarian Central Statistical Office, and the Statistic Office of the Republic of Serbia. Some of the main limitations of setting up a broad indicator framework were the lack of data for the defined time frame and very limited data related to the innovations in Serbia. Initially, 16 variables were selected but due to the data availability limitations (time gaps), different measuring units, and nonlinearity, in total eight variables were selected for this analysis.

According to the literature, DEA has already found proven and wide implementation in measuring innovation system efficiencies of different regions. For instance, Firsova and Chernyshova (2020) measured RIS (*Regional Innovation Scoreboard*) for regions in Russia (input variables: R&R personnel, R&D investments, number of innovative enterprises, number of patents, output: the volume of innovation goods, hi-tech share in GDP, investments in fixed assets, patents used in commercialization). Radonjic (2020) did an efficiency analysis of 25 regions in Serbia taking into account four variables (inputs: infrastructure capital, investment per capita, the share of employees, and output: GVA), while Maleti and Aldea (2012) implemented the same methodology for EU27 based on nine variables (six inputs: number of graduated PhDs, international scientific publications, public R&D expenditures, business R&D expenditures, public-private co-publications, PCT patents, number of trademarks; output: employment in the knowledge-intense sectors, high-tech product exports, and knowledge-intense service exports). Edquist *et.al.*, (2015) investigated the efficiency of Norway according to the EU RIS and came with negative criticism as output and input indicators shall be measured more precisely and statistical data considered more carefully. Based on their DEA analysis Norway is not the number one innovator in Europe but still, it has high performance.

For this case six DEA input (number of graduated BSc students, BERD share in R&D activities, GDP share in R&D activities, number of registered European Patents and domestic trademarks), and two output indicators (employees in high-tech and knowledge sector, and number of R&D units) were defined for both examined countries, Hungary and Serbia, which can be seen in Table 1 and 2. Analysis was based on the output-oriented DEA method that reflects productive differences coming from the maximum outputs conditioned by the given level of inputs (Caves et.al., 1982).

Table 1: **DEA Inputs, 2022**

DEA variable	Description	Data Source
Graduated (BSc) Students	Number of graduated students holding BSc degree	NSOS[1] & HCST[2]
BERD on R&D per capita	Business enterprise expenditures on R&D sector euro/capita	Eurostat

GDP on R&D in higher education per capita	GDP expenditures euro/capita in higher education performing R&D activities	Eurostat
Entered European Patents	Number of registered patients at EPO	Eurostat & NSOS
Trademarks - domestic applicants	Number of registered domestic trademarks	Eurostat &NSOS
Number of R&D entities from the public, private, non-profit and NGO sector	Number of R&D entities engaged in the research activities including public, private, civil, and NGO sector	NSOS & HCST

*1 National Statistic Office of Serbia

**2 Hungarian Center for Statistical Office

Source: Authors' edition, 2022

Table 2: DEA Outputs

DEA variable	Description	Data Source
Employees in high tech and knowledge sector	Number of total employees in the high-tech and knowledge sector	Eurostat
Business entities delivering professional, scientific, and technical activities	Number of businesses enterprise that is producing and delivering results of innovation activities	NSOS* & HCST**

*1 National Statistic Office of Serbia

**2 Hungarian Center for Statistical Office

Source: Author's edition, 2022

Table 3 presents some descriptive information (min., max., mean and standard deviation) on the used dataset. As per the overview, the number of graduated BSc students in both countries is in the same range, GDP per capita expenditures on R&D in the higher education sector are twice higher in Serbia compared to Hungary, while Hungary outperforms Serbia in all other indicators, especially in case of the number of R&D units, followed by the number of employees in high-tech and knowledge sectors, as well as the number of business enterprises in the professional and scientific sectors.

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Table 3: Basic statistic parameters of Input and Output Indicators for Serbia and Hungary, 2022

Indicator	*Country*	*Min*	*Max*	*Mean*	*Stand. dev.*
Graduated (BSc) Students	Serbia	41331	50728	46264.1	3249.94
	Hungary	42856	56792	45251	4187.22
BERD on R&D per capita	Serbia	14.43	23.9	14.43	7.46
	Hungary	75.3	171.9	119.83	34.49
GDP on R&D in higher education per capita	Serbia	33.39	60.21	45,27	10.22
	Hungary	15.6	31.4	23.18	4.89
Entered European Patents	Serbia	2	1586	675	636.67
	Hungary	3195	6205	4557	1009.43
Trademarks - domestic applicants	Serbia	1113	1586	1302.4	149.14
	Hungary	3491	4599	3997.4	287.86
Number of R&D units	Serbia	237	337	280.7	33.07
	Hungary	2727	3662	3158.8	315.28
Employees in high tech and knowledge sector	Serbia	48400	103800	74740	17673.22
	Hungary	193800	274400	219490	27681.21
Business entities delivering professional, scientific, and technical activities	Serbia	10541	12606	11575.9	645.65
	Hungary	107379	152714	125568.6	17436.76

Source: Author's calculation, 2022

Results and discussion

The linkage between knowledge, innovation, and productivity has been examined by different experts, but more attention was given to the so-called Knowledge Spillover Theory Entrepreneurship (KSTE), whereby Kang *et.al.* (2021) stated that knowledge represents an indirect or intangible input for the regional productivity growth. Dahlstrand and Stevenson (2010) noted that a common mistake among academics and policymakers is perceiving innovations primarily as an invention, but it should include diffusion of knowledge as well. Hirsch-Kreinsen et.al. (2003) claim that engineering, design, and production knowledge have high value when it comes to generating practical knowledge. Formal knowledge and research results are providing a background for the high and/or low tech-based technological commercially available developments. The generators of knowledge production are among all, universities, research institutions, consultancy companies, and similar. Therefore, in this perspective for the analysis number of BSc students and the number of R&D units (public, private, and non-profit research institutions) were taken into account as the first higher academic degree and with the assumption that every graduate student has the capabilities to be a knowledge generator.

As per Graphs 1 and 2 below it can be seen that regarding the number of graduated students Hungary and Serbia have quite similar numbers, even in the past years Serbia has a slightly higher number, but when it comes to the number of R&D units' difference is very significant as in Hungary is more than three times higher, providing better initial inputs for generating innovations.

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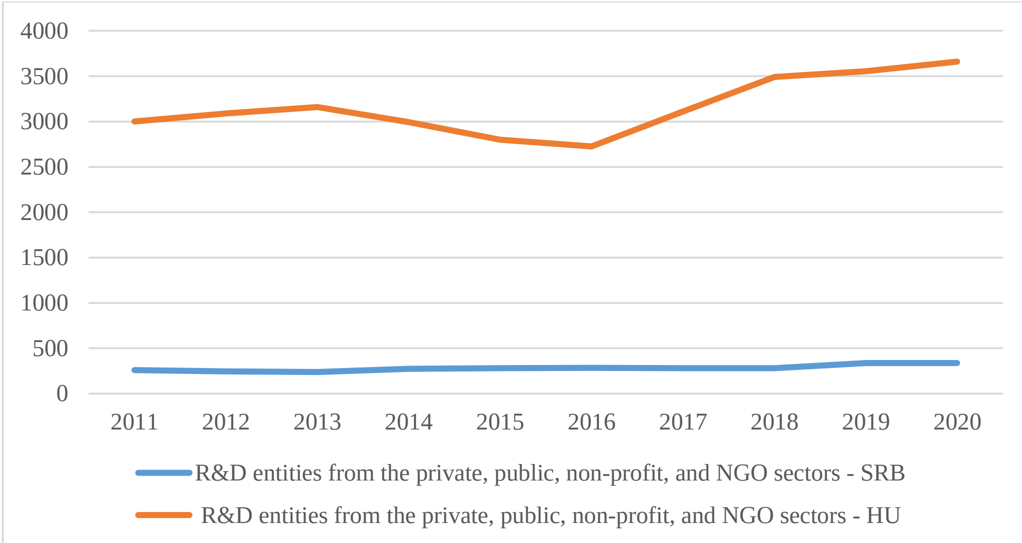

Figure 1: **R&D entities from the private, public, non-profit, and NGO sectors in Serbia and Hungary, 2011-2020**

Source: *Author's edition based on NSOS & HCST, 2022*

When it comes to the number of graduated students in the last couple of years it can be seen (Figure 2.) that it is almost equal, initially looking back Serbia had a higher number of graduated students but shall be taken into account that Hungary has for 1/3 larger population comparing to Serbia therefore per capita Serbia is launching a higher number of graduates every year.

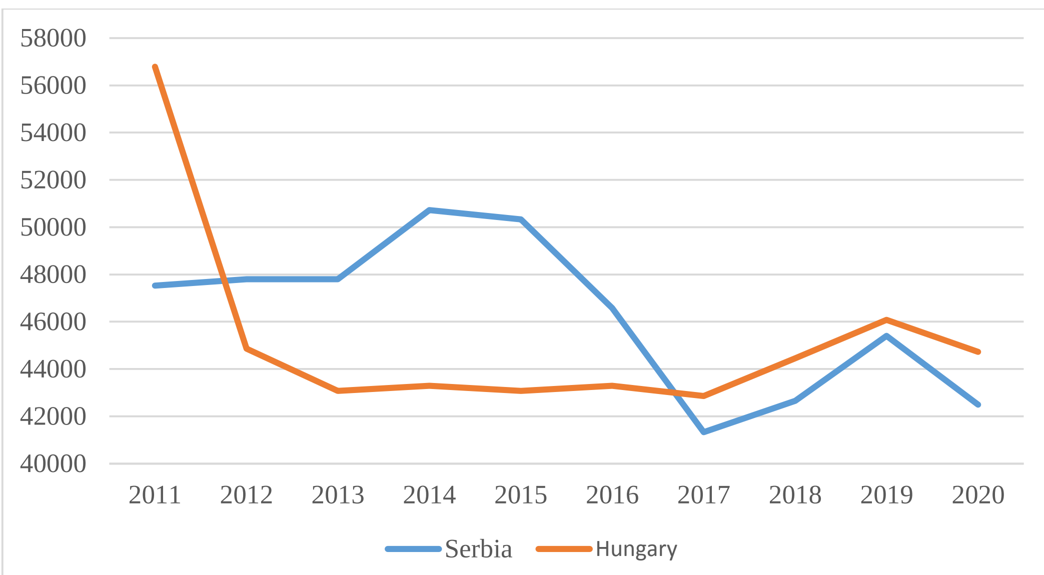

Figure 2: Number of BSc graduated students in Serbia and Hungary, 2011 and 2020

Source: *Author's edition based on NSOS & HCST, 2022*

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Share of BERD (*Business Expenditures on R&D*) and GDP (*Gross Domestic Product*) in the R&D in the higher education sector activities are two widely used indicators when it comes to monitoring financial investments and their impact. BERD shows how much companies invest in R&D activities, e.g., OECD (2018) is using it as one of the main science and technology indicators to conduct cross-country and timely analysis. BERD indicator is suggested to be used by the governments to compare their performance compared to the other countries and follow the trends over time (see e.g., Azagra-Caro - Grabowlitz, 2008). Abdal et. al. (2016) are pointing out that BERD in the knowledge-intensive industries is getting higher attention, as companies with investments in R&D activities are finding their strategic way toward building their competitive edge. Although Walwyn (2015) explains that it is an expenditure for the company used to cover the performance of the R&D and this performance is in most cases more effective and easier to convert into added value compared to the governmental expenditures on R&D which happen to be much higher than obtained R&D performance. BERD has a significant importance when it comes to the increment of innovation activities. The BERD/capita in Hungary rapidly decreased in the last ten years (Figure 3) while Serbia did not face such significant changes. Still, in Hungary, it is four times higher compared to Serbia, but later can be seen that number of patents and registered trademarks is also quite higher as there is a higher number of registered business enterprises, especially those focused on the R&D sector.

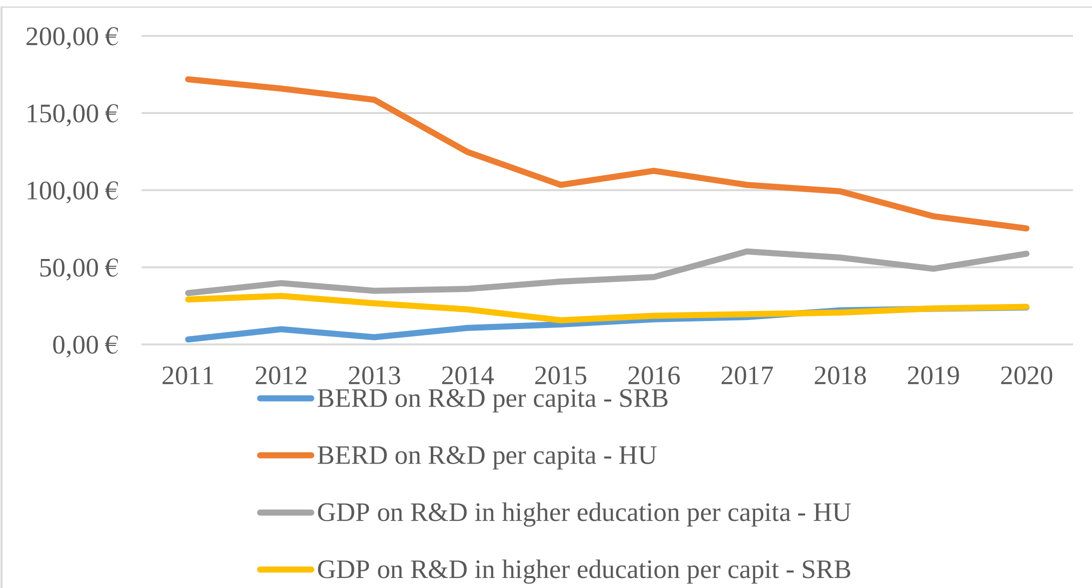

Figure 3: **BERD and GDP expenditures in the R&D sector in Hungary and Serbia, 2011-2020**

Source: Author's edition based on Eurostat, 2022

The development of the business enterprise sector is something that deserves more attention in Serbia. Although it shall be mentioned that, even though private incomes, capital, and investments are stronger in Hungary rather than in Serbia, the private business sector is stronger and seems more stable.

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When it comes to the GDP and its share in the higher education sector it can be seen that still Hungary is performing better. A slight increase had been recorded for both countries and in Hungary, public investments in higher education are three times higher. Knowledge resources and human capital are one of the drivers of regional development, especially in the knowledge-based economy.

The number of registered patents and trademarks are commonly used variables when it comes to evaluating innovation and research efficiency with the help of Data Envelopment Analysis. There are several researchers using patents or trademarks as input or output variables. Ekinci and On (2015) used them as an output indicator in their analysis of evaluating the research and development efficiency of the EU countries. The same can be found in the research of Chang (2011) on the topic of technological forecasting in Taiwan as patents are defined as technological outcomes. However, Lacka and Brzezicki (2021) defined patent applications, trademark applications, and design applications as intellectual assets and inputs. But in the case of research work conducted by Firsova and Chernysova (2020) they used patents as an intellectual activity outcome in the role of the input, while patents used and commercialized in the real business were defined as an output. Therefore, in this research paper, we considered them as input or assets as statistical data on the patents and trademarks utilized for commercialized business purposes are not available. As per Graph 4 below it can be noticed that number of patents did not change over the years but the number of trademarks increased and reached the number of patents. Still, their sum is much lower compared to Hungary. Anyhow, when it comes to the number of trademarks in Hungary, their declination over the last few years has been present, and the number of registered trademarks in 2011 and 2020 is very much similar. However, when it comes to the patents certain peaks have been noticed over years. But definitely in 2019, there was the highest peak but then already in 2020, the drop had been faced which equaled the same fall as in 2017-18.

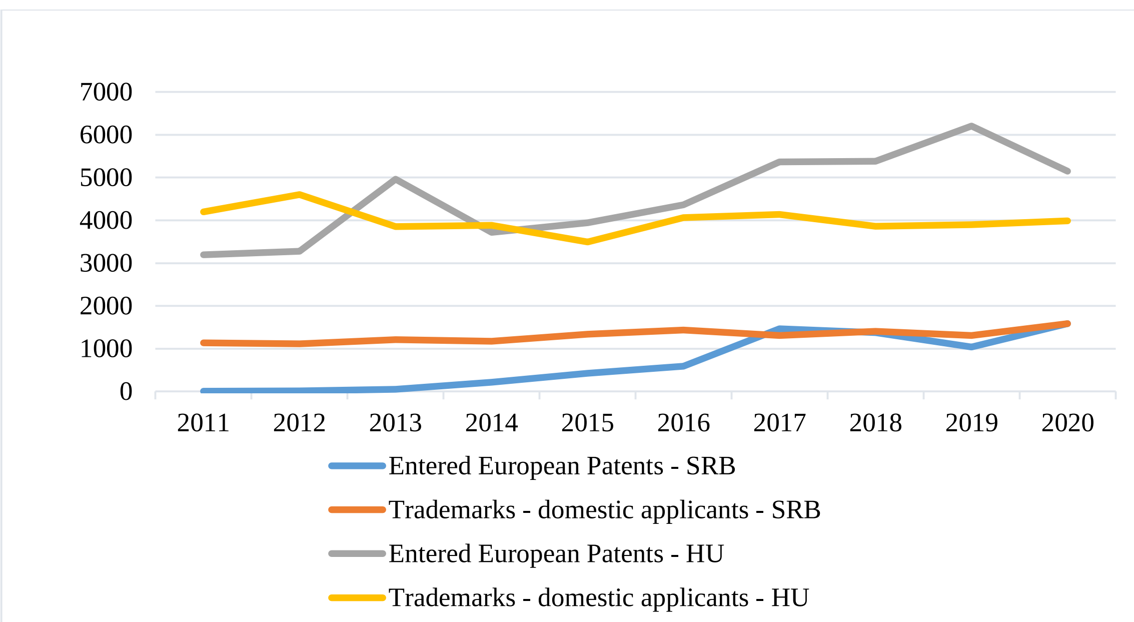

Figure 4: Registered patents and trademarks in Hungary and Serbia, 2011 - 2020

Source: Author's edition based on Eurostat & NSOS, 2022

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When it comes to the outputs, as mentioned above, two indicators have been selected, one of them is employment in the high-tech and knowledge sectors (Lacka and Brzezicki (2021) also employed the same indicator as an output); and a second indicator is several business entities conducting professional, scientific and technical activities. Both indicators express the size of the national innovation business market, consuming intellectual assets to deliver to the market an innovative product and/or services or activities that support the commercialization of the innovations. As per Figure 5 below, Hungary faced a continuous increase in the number of employees in the high-tech and knowledge-based sectors in the period since 2017 when it comes to the business sectors that are delivering professional, scientific, and technical services/products the increase was very stable, and by 2020 was increased by 50%. In the case of Serbia, the number of business entities stayed static, with no movements, while the number of employees increased by 50% in the last ten years with peaks in 2017 and 2020. In Serbia, the number of private enterprises conducting scientific research is very low and most of the organizations are in public ownership where financial resources and commercialization opportunities are limited. Definitely in Hungary, based on the presented figures, the private sector is emphasized distributing technical and scientific products and/or services.

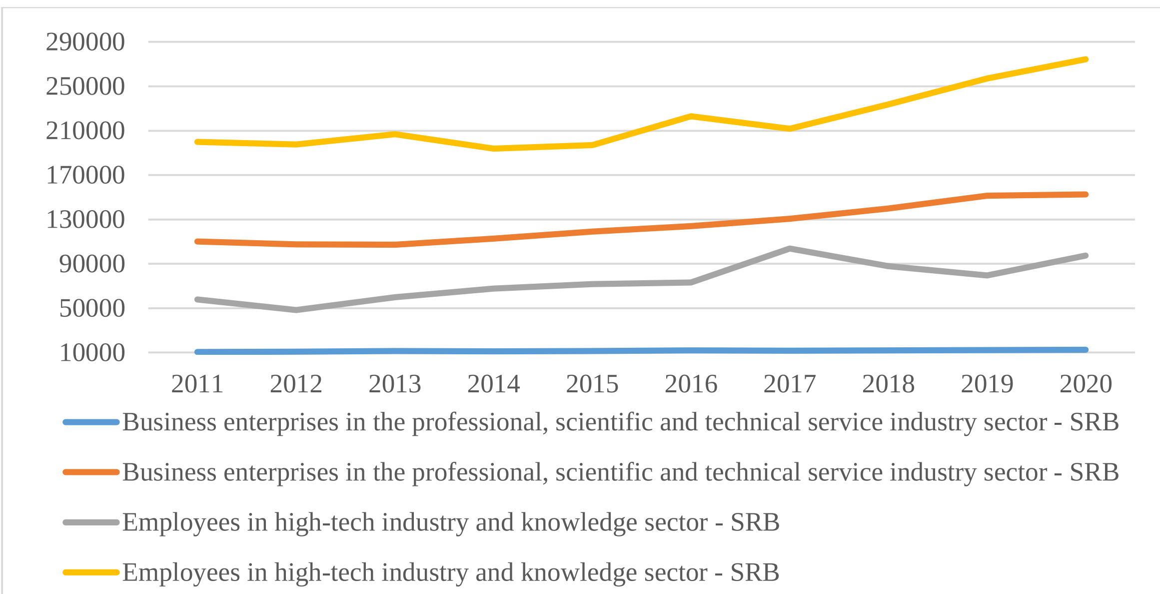

Figure 5: **Business entities in the professional, scientific, and technical service industry sector and employees in the high-tech and knowledge sector in Hungary and Serbia, 2011-2020.**

Source: Author's edition based on Eurostat & NSOS & HCST, 2022

Based on descriptive statistics it can be seen that Hungary has quite better figures and no significant falls, while Serbia has similar results but inputs are significantly lower which can send a picture that the innovation performance is quite lower. Therefore, to understand better how inputs reflect through outputs DEA Malmquist Productivity Index (MPI) was deployed in this research as the goal is to examine the innovation productivity efficiency as well as changes over time (from 2011 to 2020), and deliver an overview of indicators generating changes based on defined inputs and outputs that describe the utilization of the intellectual assets and R&D capital (financial investments, human capital). The Malmquist index can be input and output-oriented, in this case, the output-oriented index measuring changes comparing t period to t+1 was selected. MPI can be decomposed into two main indices, efficiency change, and technical change (TC). Efficiency change (EC) shows if productivity change is coming closer or further from the frontiers, while technical change (TC) represents whether the shift in technological change between two examined periods (t and t+1) happened based on the examination of the input-output correlation. If the value of TC is > 1, deterioration happens, while if the value is < 1 technical progress is ongoing (Heathfield, 1995, see Fare et.al., 1994). Technical efficiency shows the efficiency used to convert inputs into outputs; scale efficiency represents whether the parameter (indicator) is closed to its most efficient scale, and productivity growth shows the change in output without necessarily being caused by the growth of given input (Johnsen, 2006).

In Table 3 it can be seen that Hungary has a higher average value during this period of 10 years, meaning that it did better proportional allocation of inputs to ensure higher outputs.

Table 3: **Malmquist Index for the period between 2011-2020 for Serbia and Hungary, 2022.**

	Serbia	**Hungary**
Min	0.72	0.90
Max	1.17	1.15
Mean	0.92	1.045
Median	0.91	1.06

Source: Author's Calculation based on R-Studio, 2022.

When it comes to the productivity index for the whole examined period, it can be noticed - as presented below in Table 4 - that the mi index was always around 1, -0,1, or + 0.15 for both countries. While there was present regression in the value of 8-9 % in the case of Serbia, and progress of 15 % in the case of Hungary. Still, Serbia had experienced more significant fluctuations, as presented in Table 4. The regression was at one point 28 % in the year 2015-14 but a progression of 17 % was recorded in the earlier years, such as 2013-12 and since then, no significant positive results had been recorded. During the examined period it can be seen that Serbia was mainly performing a negative (mi) index. Anyhow, Hungary is showing stability over years, and it managed to obtain positive values. The most remarkable results are expressed in the early years - 2014-13 and in the recent years, 2019 and 2020.

The only year that draws attention was 2016-17 as both countries experienced a fall, Serbia with 21% and Hungary with 8%. Serbia for most of the years faced a drop but as well in 2013 proved that after a rapid fall of 17 % in 2012 it managed to achieve a growth of 17 %. We can see that data are quite as well sensitive, although those oscillations in Serbia are caused due to the BERD and GDP as inputs, they are increasing slightly year by year, but the number of patents and trademarks are not growing proportionally. There are investments when it comes to the innovation sector, but generated outputs are still at a low level, as the private sector does not get sufficient resources. Additionally, the current situation and major events that impacted Europe are COVID-19 and now political instability in the Eastern European countries will have an impact on the innovation progress, mostly in negative terms. With the current trend, Serbia cannot achieve more significant and stable progress when it comes to innovation advancements. Financial investments are present but still, investments in the knowledge and education sectors are lacking, although the number of patents and trademarks will be increased which can indicate that there is low support toward small-scaled business and a lack of collaboration between public educational and scientific institutions with the industry research.

Definitely for a better understanding of what affected oscillations to happen and why innovation progress in the case of Serbia is hard to be performed on a higher level more various and specific indicators shall be taken into account. This would help the national policymakers to drive regional innovation development.

Table 4: Malmquist index (mi): 2011-2020, 2022.

Year	**Serbia**	**Hungary**
2020/19	0.94	**1.12**
2019/18	**1.06**	**1.11**
2018/17	0.94	1.06
2017/16	**0.79**	0.93
2016/15	0.92	1.04
2015/14	0.82	1.1
2014/13	0.91	**1.14**
2013/12	**1.17**	0.92
2012/11	0.83	0.98

Source: *Author's Calculation, 2022.*

Conclusions

It is clear that the EU is placing a high accent on innovation progress and creation of the innovation leaders but not all countries are having the same level of resources and adequate environment for that. When it comes to Hungary and Serbia, based on the secondary data analysis it is evident that there are better inputs that can support outputs more efficiently as they are more coherent. Slight progress has been noticed in the case of Hungary and in overall it performed well over a decade, no significant crises have been noticed. The Malmquist index went down for the max 8% in 2013 and up by 12 % in 2020. While in the case of Serbia constant stagnation has been noticed, the Malmquist index over time was mainly negative for up 10 %. One time it went down by 21 % but that did not last for a long time. Slight progress of 6 % has been recorded in the year 2019 but, in general, the drop was present in the examined years. Some of the reasons are a low number of R&D units, not enough strong private sector that can generate research activities, low level of patents and trademarks, weak intellectual assets, as well as low financial investments, especially comparing the Serbian level to the Hungarian and EU. At the current speed, no progress regarding innovation capacities can be noticed in the coming future, and as well the question is how COVID-19 impacted the innovation environment in both countries.

The RIS results can be confirmed that Hungary is better performing than Serbia, but to understand what it is behind a better set of innovation indicators shall be designed, and as well more detailed database is needed which in the case of Serbia is very narrow. Increasing a country's innovation progress is important not just for its national development but also for the development of the EU in terms of socio-economic development. It is important to add that Serbia has potential chances to join the EU, but the current performance is not satisfying, therefore better measures regarding strengthening innovation capacities shall be reworked and implemented, as it can help the country to build its competitive advantage based on innovations. Therefore, Serbia shall find its way to proven management of innovation inputs (innovation resources) that can generate good outputs (an increase in business activities and employment).

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