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SCIENTIFIC REVIEW

Comparative Analysis of High Technology Exports and Selected Innovation Indicators for Serbia and CEE Countries

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ABSTRACT
The article reports on comparative analysis of high technology exports and selected innovation indicators for Serbia and three CEE countries – Hungary, Romania and Bulgaria for the 2011-2015 period, with an aim to provide an insight on the innovation potential of Serbia. The analysis is based on data publicly available at Eurostat and the Global Innovation Index rankings. The selection of countries for country comparison is based on many similarities such as historical circumstances and geographical position. HTP exports are exports of high technology products as a share of total exports. As for innovation indicators, the article considers the Global Innovation Index (GII) which provides metrics about innovation performance of countries and economies, as well as values of selected inputs contained in the innovation pillar of the GII such as costs, R&D investment (total by sector) and number of researchers (in total and by sector). The analysis shows that there are considerable differences between Serbia and the three CEE countries. The analysis results are divided into three groups according to impact on the HTP export. The first group refers to innovation indicators with significant impact on HTP exports such as GDP, number of researchers, the GII rank and R&D costs in the business enterprise sector. The second group are innovation indicators with significant impact on HTP export such as total R&D costs, and finally the third group are innovation indicators with little impact on HTP export.

Key words: *high technology products, export, global innovation index, Serbia, CEE countries*

JEL Classification: O32, Q55

INTRODUCTION

Many scientific studies discuss enterprise innovation potential, and thereby reveal that while some struggle to introduce new products through radical innovations, others tend to use the existing knowledge through cooperation as an effective tool for knowledge transfer, thus developing incremental innovations to improve performances of existing products. The innovation process and its results have characteristics of complexity, primarily referring to non-linearity and multi-level phenomena. (Hurmelinna-Laukkanen & Olander, 2014; Martinez-Ros & Orfila-Sintes, 2009; Fernandes Pacheco Dias et al., 2014).

As a result of social interactions, technological progress brings changes in technological processes (Eisenman, 2013; Domazet, 2018), new innovative production technologies are created from which certain categories of products are obtained, thus brining such innovations to new markets - innovative products market. This kind of radical innovations enable new

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products, and as such are difficult and expensive processes leading to break with obsolete knowledge and requiring new, more complex knowledge (Stošić et al., 2019). It is important to emphasize that risk associated with radical innovations is greater than risk associated with growth and promotion, but the problem refers to return on investment as early as possible (Kennedy et al., 2017). These trade risks come as a result of rapid development of technological innovations and decrease in high-tech products (HTP) sales prices, as well as increased competition and short life expectancy of new products, primarily HTP, for example, computers recorded a decline in sales prices by around 1% per week (Yang et al., 2011). Investments in research and development (R&D) are key factor in creating new knowledge, as well as creativity and ideas for design, production and commercialization of HTP. It is clear that the level of GDP determines the level of state allocation in R&D activities, but often countries that have the same or similar GDP realize different innovation results and capacities, and they achieve more significant growth, than expected, with regard to resources and potentials (Ahlstrom, 2010).

By analyzing the data related to Serbia and the countries of the region, the question is also raised about the degree to which the CEE countries depend on foreign investors to increase their innovation potentials (Allen & Aldred, 2011). Much of the literature gives a pessimistic picture of the ability of the CEE countries to emerge from the dependence of being able to achieve economic growth and development with their own radical innovations.

The main research objective of the paper is to provide a comparative analysis of HTP exports and selected innovation indicators for Serbia and the CEE countries with an aim to provide an insight on the innovation potential of Serbia. The analysis is based on data publicly available at Eurostat.

LITERATURE REVIEW

Most authors point out that in new products development (NPDs) process, the strategy and the effect of duration of new products implementation depend on the company's absorption capacity (Kiss & Barr, 2014). This means that the high-tech CEE countries will need to have a far higher level of knowledge and skills in their companies for which an adequate absorption capacity is required between companies in the region (Allen & Aldred, 2011; Domazet & Marjanović, 2017).

A country's innovation growth depends to a large extent on how innovation activity is realized and on effectiveness of national innovation system (NIS.). A National Innovation System (NIS) refers to a set of organizations, institutions and their relationships directed towards generation, diffusion and application of scientific and technological knowledge in a country. More precisely, NIS is a complex network of enterprises, universities, research and development (IR) institutes, professional societies, financial institutions, educational and information infrastructure, government agencies and public resources aimed at producing, distributing and applying different types of knowledge (Kutlača & Semenčenko, 2015). Lundvall (1992) defines a national system of innovation as the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state. NIS largely determines the innovation potential of a country and its economy.

For innovative technologies, special knowledge flow is needed between different actors in networks. In these networks, for example, the newly created knowledge is supplemented between two potential partners (firms) (Caminati, 2016; Chiou et al., 2016) and their knowledge bases serve as an incentive factor for cooperation intensity in realizing innovation activities and radical R&D projects. Individual competence of partners in the complex R&D cooperation process determine the level, scope and scenarios of their specialized activities in developing several products (Bondarev, 2016).

There are several concepts and measurements of national innovation capacity through various indicators. "Innovation Score Board" and "Global innovation index - GII" are among the world's most renowned innovation bases of innovation performance (Babić et al., 2015). In this article, we can use GII as a measure of national innovation capacity of the country, that is, its innovation level. This indicator (GII) consists of 7 pillars of various activities, the first five are dedicated to innovative inputs (Institutions, Human Resources, Infrastructure, Market Sophistication, and Sophistication of Business Processes), and the next two relate to innovation autopsies (scientific outputs and creative outputs). Competitiveness of an economy or national competitiveness is a complex concept which depends on several factors on both micro and macro levels. In addition to several methodologies for measuring competitiveness of enterprises and economy, the Global Competitiveness Index (GCI), defined by the World Economic Forum, is based on company surveys (Cvetanović & Sredojević, 2012; Tošović-Stevanović, 2011). The GCI index has many pillars of competitiveness including institutions, infrastructure, education, enterprise sophistication, market efficiency, etc. Interpretation of GCI has to consider a county's development level. By analyzing 7 pillars of innovation (GII) and 12 pillars of competitiveness (GCI), we found structural similarities.

Innovation is a prerequisite for increased competitiveness. According to the World Economic Forum methodology, there is a direct correlation between quality of national innovation system and competitiveness of economy (Cvetanović & Sredojević 2012). The basic issues of theoretical discussions on competitiveness are between the theory of comparative advantage and the framework of competitive advantage with the first paragraph relating to Ricardo and the other to Porter (Croes & Kubickova, 2013; Marjanović, 2018; Paraušić et al., 2017). The manifestation of national competitiveness is reflected in capability to supply customers with competitive products (Igor Gurkov, 2005), as competition is pushing for continuous search for new products, and that requires new knowledge growth coming from different sides in the communications between companies in the global world market. (Golebiovski & Lewandovska, 2015; Domazet & Marjanović, 2018). Creativity should be encouraged within companies.

Also, countries have different innovation potentials (Marjanović & Domazet 2018). As a result of creativity, knowledge is transformed into new products, services or processes. However, creativity is necessary but not a sufficient condition. To be complete it must be achieved through innovations that use new or existing ideas transforming them into actions (Stošić et al., 2013). Unlike creativity which is often defined as an individual cognitive process, innovations arise from complex inter-individual and social processes that occur within a company (Anderson et al., 2014). Creativity is a complex process and phenomenon which involves not only new ideas generation, but different ways of thinking at different organizational level in a company. However, innovation is achieved by studying, processing and applying an idea for a product or service (Adam & Clelland, 2002). There is no creativity without new knowledge, and new knowledge is gained through research, individual and team activities.

New knowledge creation occurs from interactions in various fields of activities, and most obviously in new products development (De Massis et al., 2016). New knowledge that is created from different activities must be adequately managed and targeted. This is particularly important in terms of new products development (NPDs). Considering NPDs, if various functional knowledge is inadequately used and combined within a company, then the acquired experience and resources which could be useful for further new products creation, will be inadequately stored, and will reduce the possibility of knowledge acquisition, accumulation and transfer and that is critical for NPD as it is dynamic and rapidly repeating process (Ordanina et al., 2008). A company must be capable to acquire new knowledge from recombining and applying the existing one to new products development along with new knowledge (Enkel & Heil, 2014), and its reaction to the perception of a competitive company with high absorption capacity can be withdrawal from further innovation in the area where a competitive company of higher absorption capacity is located or, more importantly, to increase its own research and

innovation efforts and activities by continuously acquiring new knowledge in order to find themselves in front of a market competitor (Cuerro-Cazurra et al., 2018).

In terms of innovation performance, Serbia is lagging behind the new EU member states i.e. Hungary, Romania and Bulgaria, and it is even more emphasized in comparison with more developed EU countries. Abandoning planned economy, not being followed by qualitative shifts in organization, management, entrepreneurship, innovation culture, politics, legislation, etc., has not and will not introduce the CEE countries directly into the market economy as predicted by the neoclassical transitional theory (Mikl-Horke, 2004). Consequently, many problems have arisen in these countries' economies and societies. The CEE countries, and particularly the private sector, have experienced a strong influence of principles and practices from the West. However, the question arises as to the extent to which the individual CEE countries are in capitalism, how innovative the absorption capacities of knowledge and skills firms are necessary for the HTP production (Allen & Aldred, 2011). Without an adequate absorption capacity of the CEE countries, and Serbia, they will not be able to produce and export high-end products, regardless of their access to a relatively cheap labor force. Competitiveness is the key factor driving faster economic growth and higher living standards.

The question is how companies can practically increase their innovations through major investments in R&D activities. Research findings show (Anderson et al., 2014) that high level of innovation is provided by companies that carry out innovative employee trainings, apply salary system based on performance, foster employee independence and creativity, have flexible working hours and fluctuations, etc.

DATA AND METHODOLOGY

In order to achieve the stated objective of the paper, a comparative analysis of HTP exports and selected innovation indicators for Serbia and the CEE countries is conducted. The analysis is based on data publicly available at Eurostat and the Global Innovation Index rankings.

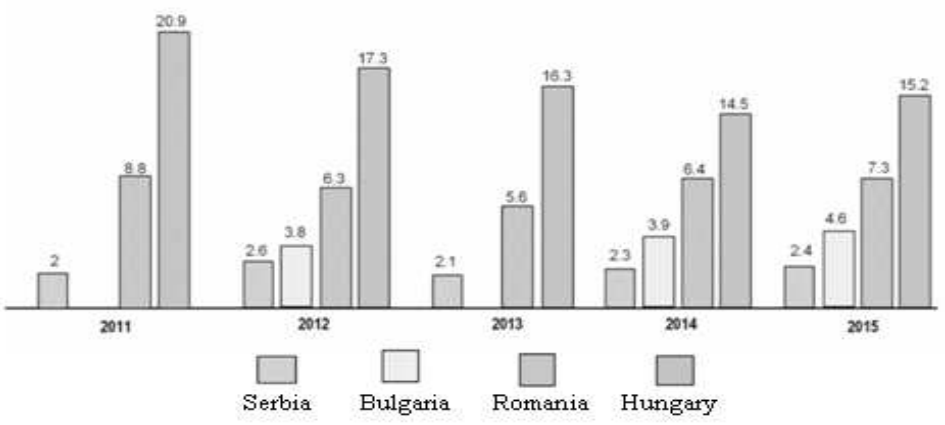
HTP exports are exports of high technology products as a share of total exports. As for innovation indicators, we considered the Global Innovation Index (GII) which provides metrics about the innovation performance of countries and economies, as well as values of the following inputs contained in the innovation pillar of the GII: costs, R&D investment (total by sector) and number of researchers (in total and by sector).

A comparative analysis is conducted to provide an insight and better understanding of innovation potentials and particularly of Serbia based on the value of HTP exports, the Global Innovation Index, R&D investments and number of researchers.

RESEARCH RESULTS

Based on the Eurostat database, the fair value of HTP export, the values of Global Innovation Index (GII) and values of inputs such as costs, R&D investments and number of researchers are presented.

The data presented in Graph 1 shows the share of exports of high-tech products (HTP) for Serbia and the selected CEE countries. In the observed period 2011-2015, the average value of HTP exports for Serbia was 2.3%, while the same indicator for Bulgaria, Romania and Hungary was 4.1%, 6.9% and 16.8% respectively.

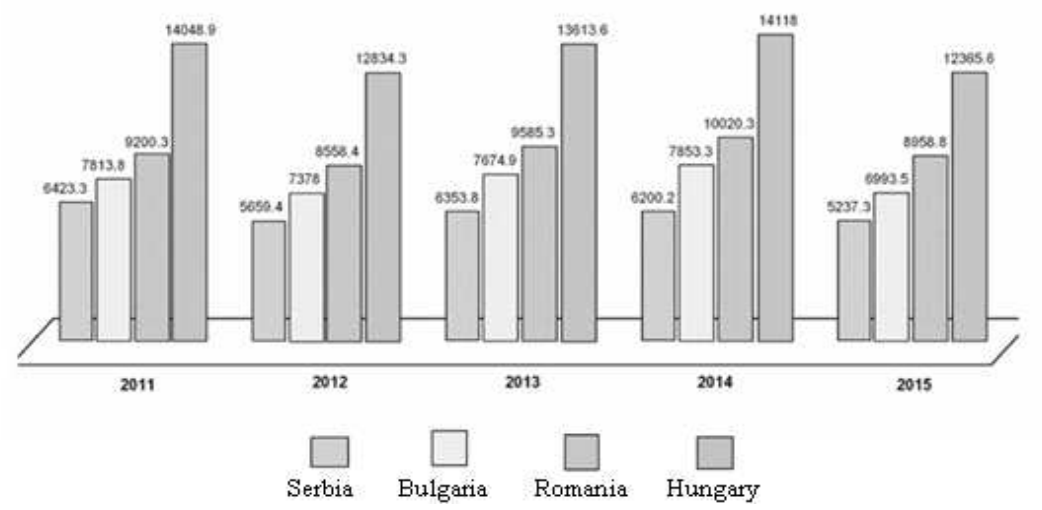


Graph 1. Share of exports of high-tech products (HTP)

Source: Eurostat

Considering the value of export of HTP as a share of country's total export, Serbia significantly legs behind the CEE countries. In 2015, the export of HTP in Bulgaria accounted for 4.6% of country's total exports, in Romania it accounted for 7.3%, while in Hungary it accounted for 15.2% of country's total export which is more than six times larger than the value for Serbia. Gaining competitiveness of HTP on the world market is more significant than competitiveness of products of middle or lower level of technology.

Considering the value of GDP per capita as a potential source of funding for R&D, there is a notable oscillation in the figures for Serbia. Serbia's GDP for 2015 was 5,237 USD and for 2011 was 6,423 USD, the last being the highest recorded level in the observed period. When comparing the GDP figures of Serbia and the CEE countries, the findings show that Hungary recorded the highest average GDP per capita in the observed period. Hungary recorded the average GDP per capita of 13,396.1 USD, Romania of 9,264.6 USD, Bulgaria of 7,542.7 USD, and Serbia of 5,874.8 USD. The data shows that Serbia is falling behind the CEE countries whereas its GDP per capita was twice as lower than in Hungary.



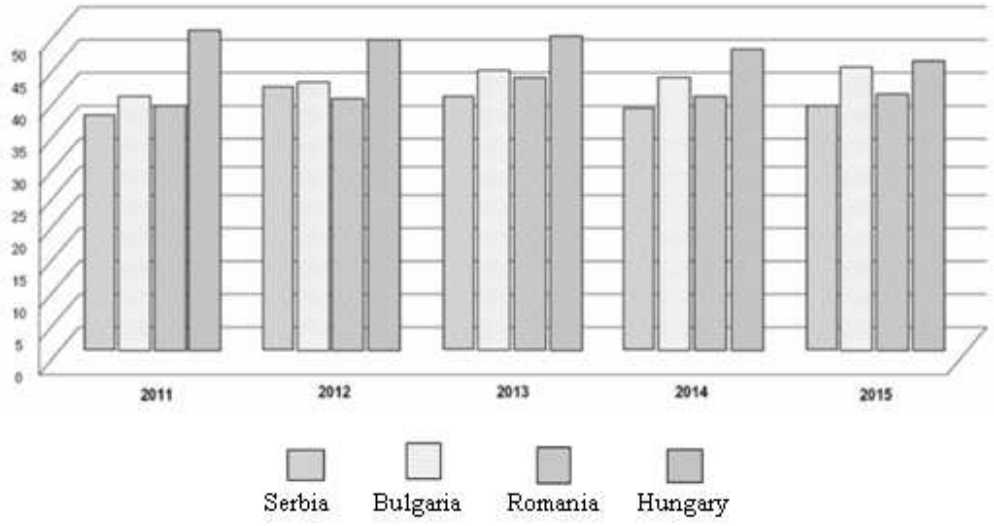
Graph 2. GDP per capita (US$)

Source: Eurostat

Also, the findings indicate a significant lagging of Serbia in terms of R&D expenditure. In 2011-2015 period, Serbia's average R&D expenditure as a percentage of GDP was 1.34%. Additionally,

the innovation activity of the Serbia's non-profit sector is rather insufficient. The Serbia's lowest recorded value of GDP per capita in comparison with other analyzed countries is a limiting factor for R&D activity. These allocations also determine the number of actors in innovation process and their allocation by sector. When analyzing high-tech products, their specific characteristics must be considered (Yang et al., 2011), such as: shorter product life, need for rapid response as prices fall, demand for global co-operation and ability of firms to adapt to new market demands in a flexible or rapid manner.

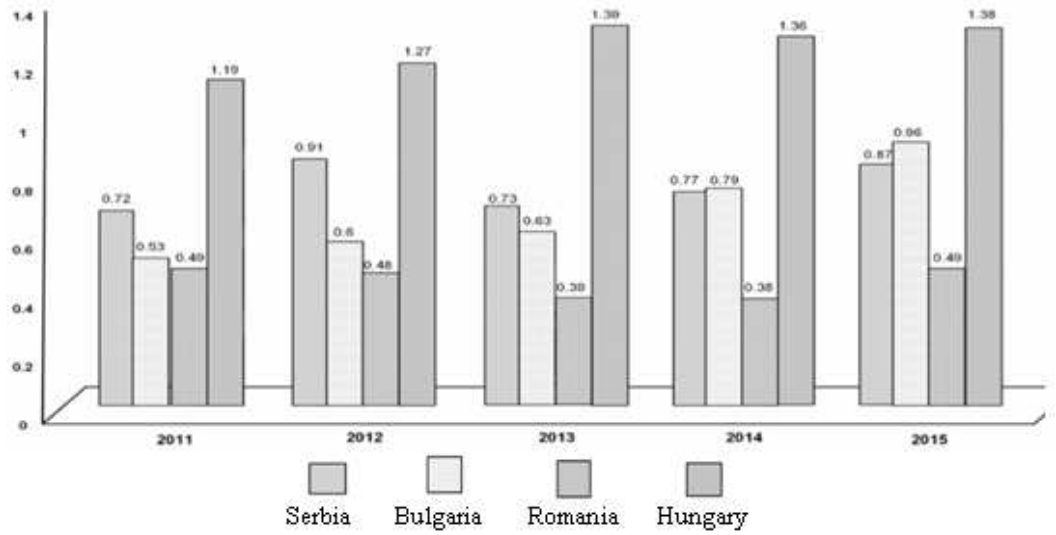
The Global Innovation Index (GII) for Serbia, Bulgaria, Romania and Hungary is presented in Graph 3. The GII ranking for the surveyed countries show that Hungary recorded the highest values during the five-year period, while Serbia holds the worst position. Also, when looking at the average value of GII as an indicator of a country's innovation capabilities, Serbia is ranked the lowest (37.31), while Hungary, Bulgaria and Romania recorded higher values (45.83, 40.67, 38.25 respectively).



Graph 3. Global Innovation Index Rankings
Source: GII report

The average recorded R&D investment as a percentage of GDP in the observed period was 1.32 for Hungary, 0.78 for Serbia, 0.70 for Bulgaria and 0.45 for Romania. The findings show significant oscillations in terms of R&D investments of the business enterprise sector by countries and by years. The highest average value was recorded for Hungary (0.91%), while Bulgaria recorded 0.45%, Romania 0.17% and Serbia 0.16%. The sector's costs in Serbia are three times lower than in Bulgaria, and five times lower than in Hungary.

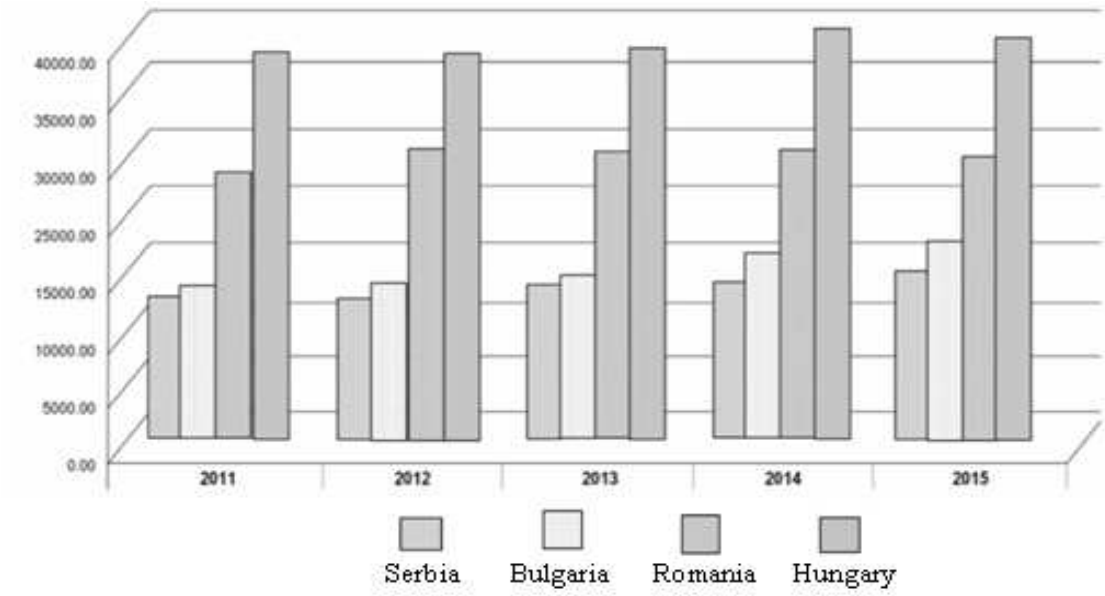
The R&D spending of the public sector ranges between 0.16% and 0.24%, as shown in Graph 4. Serbia recorded the average R&D investment as a percentage of GDP of approximately 0.23%, while the other three countries recorded an average of 0.19%. The data indicates the public sector records higher investments in Serbia comparing to other observed countries. Higher education expenditure on R&D varies greatly across concerned countries. Serbia recorded the most considerable spending (0.39%), while Bulgaria, Romania and Hungary recorded significantly lower expenditures (0.05%, 0.09%, and 0.20% respectively). The sector's costs are two times higher in Serbia in comparison with Hungary, and notably higher than in Romania and Bulgaria. The R&D costs of the private non-profit sector are negligible, and the data are incomplete.



Graph 4. R & D costs

Source: Eurostat

Graph 5 shows the total number of researchers in 2011-2015 period for all four considered countries. The average number of researchers in Hungary was 37,739, in Romania 26,865, in Bulgaria 15,976, and in Serbia 14,166. The figures show that Serbia has approximately the same number of researchers as Bulgaria, but that number is significantly higher in Romania, and especially notably higher in Hungary.



Graph 5. Total number of researchers

Source: Eurostat

The number of researchers engaged in the business enterprise sector in Serbia increased greatly over the observed period (165 in 2011 and 1,467 in 2014). However, this number is still significantly lower for Serbia comparing to three other observed CEE countries. An increase in the number of researchers engaged in the business enterprise sector in Serbia is still insufficient, particularly considering the figures for Bulgaria (3.969), Romania (5.848), and Hungary

(17.008) recorded in 2014). The number of researchers in this sector in Serbia accounts for less than 10% of the number of researchers in Hungary.

CONCLUSION

The analysis shows that there are considerable differences between Serbia and the three CEE countries. Serbia recorded almost two times lower export of HTP comparing to Bulgaria, and notably lower export comparing to Romania. Hungary's export of HTP is larger than those of Serbia, Romania and Bulgaria all together.

Because all three CEE countries recorded significantly higher exports of HTP in comparison with Serbia, an analysis of innovation indicators having considerable positive impact on the increase in HTP export was conducted. The analysis results are divided into three groups according to the impact on HTP export. The first group refers to innovation indicators with significant impact on HTP exports such as GDP, number of researchers, the GII rank and R&D costs in the business enterprise sector. The second group are innovation indicators with significant impact on HTP export such as total R&D cost, and finally the third group are innovation indicators with little impact on export of HTP.

The analysis indicates that the impact of GDP on HTP export is the largest. This particularly provides valuable insight for Serbia since it records significantly lower figures of GDP comparing to the CEE countries. Also, the GII ranks as a measure of innovation capabilities are higher for Hungary, Bulgaria and Romania comparing to Serbia. Considering that GDP is a basis for R&D expenditures of a country, major improvements are necessary for Serbia to provide financial and general conditions for increased investments in R&D. Also, the structure of R&D investments within the existing level of R&D cost allocation is rather challenging issue for the Serbian policy makers.

The data show that Serbia recorded an average R&D investment in the business enterprise sectors of 0.16%, Romania 0.17%, Bulgaria 0.45% and Hungary 0.91%. Accordingly, the figure for Bulgaria is more than two times higher and the figure for Hungary is more than five times higher comparing to Serbia. Also, the data analysis of the number of researchers point out that Serbia recorded the highest number of researchers in the higher education sector (70%) but with no positive impact on HTP exports. Serbia recorded the least number of researches in the business enterprise sector (10%) which significantly negatively affected the export of HTP. The analysis of the GII ranking considering a very complex set of indicators on innovation capabilities showed that Serbia holds the worst position among surveyed countries.

Based on the conducted data analysis, significant changes in the Serbian innovation policy are necessary particularly concerning the expanding role of human resources at universities and research institutes, more rational management of existing R&D capacities and infrastructure, as well as increased co-operation and coordination of institutions and different actors in the innovation ecosystem. Increasing public and private R&D investments would positively influence scientific and creative outputs contained in the HTP exports. The Serbia's share of R&D investment indicates that there is potential for improvements since the figures are not the lowest in comparison with other surveyed countries. Serbia recorded two times larger R&D investment than Romania, almost the same as Bulgaria, and significantly lower than Hungary. The GDP as an indicator of economic strength and the basis for R&D activity is a limiting factor for Serbia. According to the World Bank data for 2015, Serbia's GDP was 37.16 billion USD, Bulgaria's 50.20 billion USD, Romania's 177.50 billion USD, and Hungary's 121.70 billion USD. The size and strength of an economy measured by its GDP indicates that Serbia is behind the observed CEE countries. Serbia's GDP is 35% lower than that of Bulgaria, more than four times than of Romania and more than three times than GDP of Hungary.

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