

EFFICIENCY OF THE ROMANIAN RDI SYSTEM IN GLOBAL CONTEXT

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***Abstract:** Research, development and innovation play an important role in ensuring sustainable economic growth. By producing new knowledge, research is essential to the development of new and innovative products, processes and services that contribute to increased productivity, industrial competitiveness and ultimately prosperity. For this reason, the encouragement of the research-development and innovation activities has become now an extremely important imperative of the modern socio-economic and technological policies in developed and less developed countries. The present paper tries to present an overview of the efficiency of the research, development and innovation system in Romania in a global context. The analysis of the Global Innovation Index shows that the existing research-development-innovation system in Romania is not able to ensure overcoming the condition of being a modest innovator, due to some of its weaknesses. Thus, Romania is in a not exactly favourable situation, a fact that influence in a negative way the country's competitiveness and long-term growth prospects.*

***Keywords:** innovation, research, development, innovation performance.*

***JEL Classification:** O10, O30, O39.*

1. Introduction

By producing new knowledge, research is essential to the development of new and innovative products, processes and services that enable increased productivity, industrial competitiveness and ultimately prosperity. For this reason, research and innovation plays an important role in generating sustainable economic growth and job creation.

Following the crisis caused by the Covid-19 pandemic, economic growth was, and continues to be, a primary government strategies objective, both at the European Union countries and international level. Given that, in the new context of global competitiveness, technological progress is recognized as one of the sustainable economic development key elements, a central place in this equation being the research, development and innovation sector. It is well known that supporting the research, development and innovation sector is achieved through a mix of policies and varied instruments, many of them complementary.

2. The efficiency of the Romanian research, development and innovation sector

The Global Innovation Index (GII) report is made by the World Intellectual Property Organization, "Cornell" American University and the French School of Management "INSEAD" and is published annually from 2007. The aim of the Global Innovation Index report is to familiarize interested persons and institutions with all the new aspects in the field of innovations that appear in society and to approach this field beyond traditional innovation mechanisms (Saharneau, 2019). The reasons behind the creation of this report are multiple. Because many governments place innovation at the heart of their economic growth strategies, the first reason is determined by the importance of innovation in driving economic progress and competitiveness – for both developed and developing economies,. The second reason is determined by the expansion of the definition of innovation, which now is not limited to only theoretical research. Nowadays innovation is much more general and includes social, technical and business model aspects. The last, but not the least, reason is determined by the fact that in emerging markets innovation is a key element in inspiring the next generations of entrepreneurs and innovators.

The Global Innovation Index report adopts a broad definition of innovation, originally introduced in the Oslo Manual developed by the European Communities and Organization for Economic Co-operation and Development (OECD) - "An innovation is the implementation of a new or significantly improved product (a good or service), or a process, or a new marketing method, or of a new organizational method in business practice, in the organization of workplaces or in external relations" (Maier, 2014) This definition reflects the evolution of the way in which innovation has been perceived and understood in recent decades. Previously, economists and policy makers focused on research, development and product technological innovation, today innovation capacity is seen more as the ability to exploit new technological combinations.

The GII do not intend to realize a final and definitive ranking of economies in the field of innovation, but aims to improve innovation by measuring it as accurately as possible and by identifying policies, best practices and other levers that encourage innovation. It helps to create an environment where the influencing factors of innovation are under continuous evaluation and provides a key tool and a rich database that can contribute to the development of innovation policies.

Over the past decade, GII has established itself as a leading reference in the field of innovation. Better understanding of the human aspects behind innovation is essential for developing policies that help promote economic development. Recognizing the key role of innovation as a driver of economic growth and prosperity and the need for a broad overview of innovation applicable to developed and emerging economies, the GII includes indicators that go beyond traditional measures of innovation, such as the level of research and development and the amount of investment allocated in innovation (Saharneau, 2019).

The global innovation index is built on the basis of two sub-indices – the input innovation sub-index and the output innovation sub-index. The first targets at the elements that influence innovative activities, such as research and development – while the output innovation sub-index targets at the results of these activities (Cristina, 2020). Each sub-index is divided into pillars, pillars into sub-pillars and each sub-pillar is composed of individual indicators. The scores for each sub-pillar are calculated as the weighted average of the individual indicators, and the pillar scores are calculated as the weighted average of the sub-pillar scores. The overall global innovation index is calculated as the simple average of the input and output sub-indices. The innovation efficiency ratio is the ratio of the output sub-index to the input sub-index.

The innovation input sub-index is built on the basis of five sub-pillars that assess the factors that enable and favour innovative activities: institutions, human capital and research, infrastructure, market sophistication, business sophistication.

The output sub-index for innovation is built on the basis of two pillars that assess the results of innovative activities within economies - Knowledge and technology outputs, creative outputs. Although it includes only two pillars it has the same weight in calculating the value of the Global Innovation Index as the inputs sub-index (Cristina, 2020).

The Global Innovation Index 2022 provides a detailed picture of the innovation performance of 132 countries and economies around the world. Its 81 indicators explore a wide area of innovation, including politics, education and business. From year to year the number of innovation performance indicators and the countries participating in the study differed. For example, in 2013 the GII used 84 indicators for the comparative evaluation of the innovation capacities of 142 countries (which included 94.9% of the world's population and constituted 98.7% of the world's GDP). The framework is reviewed every year in a transparent exercise to improve how innovation is measured (Saharneau, 2019).

As can be seen in Table 1 .Switzerland and the USA are the innovative leaders of the high-income countries group, occupying the first and second places. Surprisingly, Bulgaria occupies the second place as an innovative leader of the upper middle-income countries group, alongside China and Malaysia, Romania placing on the 8th rank in this group.

Table 1. Innovation leaders by income group according to GII 2022

High-income		Upper middle-income		Lower middle-income		Low-income	
Switzerland	64.6	China	55.9	India	36.6	Rwanda	18.7
USA	61.8	Bulgaria	39.5	Vietnam	34.2	Madagascar	18.6
Sweden	61.6	Malaysia	38.7	Iran	32.9	Ethiopia	16.3

Source: Own processing based on the Global Innovation Index 2022

In 2022, Romania occupied the 49th place among the 132 economies included in the GII 2022. It should be noted that the availability of data and the changes made in the GII methodology influence comparisons from one year to another. The statistical confidence interval for Romania's GII 2022 ranking is between 48th and 52nd places. As it can be observed in the Table 2, in 2022 the general position of the Romania descended with one place comparing with 2021 and three places comparing with 2020. However the position occupied in 2022 was superior to the position occupied in 2019.

Table 2. Romania's position in the Global Innovation Index (2019-2022)

Description	Position			
	2019	2020	2021	2022
Innovation input sub-index	53	46	50	56
Innovation output sub-index	54	51	54	43
Global Innovation Index	50	46	48	49

Source: Own processing based on the Global Innovation Index 2019-2022

In 2022, Romania obtained better results in terms of innovation outputs than innovation inputs. It ranks 43th place in terms of innovation outputs, occupying a better place comparing with the previous years. In terms of innovation inputs, Romania ranks 56th place, this position being lower than the previous years. At the same time, Romania ranks 40th among the 51 economies with high incomes and 31st among the 39 economies in Europe.

Table 3. Romania's position within the GII pillars (2019-2022)

Description	Position			
	2019	2020	2021	2022
Institutions	50	53	53	75
Human capital and research	69	76	76	74
Infrastructure	35	37	36	33
Market sophistication	92	83	76	63
Business sophistication	51	53	54	51
Knowledge and technology outputs	41	28	35	31
Creative outputs	71	67	72	57

Source: Own processing based on the Global Innovation Index 2019-2022

In the analysis period 2019-2022, the best positions occupied by Romania are within the pillars Infrastructure and Knowledge and technology outputs. Thus, in the 2022 ranking, within the Knowledge and technology outputs pillar Romania occupied the 31st place (inferior compared to 2021 when it occupied the 34th position, but superior to 2020 when it occupied the 28th position). Within the Infrastructure pillar Romania occupied in 2022 the 33rd place (superior to the previous years- 2019, 2020, and 2021- when it occupied the 35th, 37th and 36th position). The weakest performance recorded by Romania was registered at human capital and institutions pillar, where it occupied the 74th and 75th place.

Closely related to the human capital dimension, it is important to mention that Romania has the lowest number of researchers in the EU 27. As can be seen in table 4, the total research and development staff has decreased substantially since 1993 from over 73,611 to 33,892 in 2000. Since then the number of researchers has stabilized around 30,000, reaching 33,189 in 2020. However, the number of research and development staff in higher education has increased over the past two decades from 3,780 in 2000 to 8,862 in 2020, peaking at 9,000 in 2015.

Table 4. The evolution of the researchers number

	1993	2000	2007	2014	2015	2016	2017	2018	2019	2020
RDI	73.61	33.89	28.97	31.39	31.33	32.23	32.58	31.93	31.66	33.18
staff	1	2	7	1	1	2	6	3	5	9

Source: EC, 2021, PSF review of the Romanian R&I System, available online at <https://op.europa.eu/en/publication-detail/-/publication/8a4a2522-eac3-11ec-a534-01aa75ed71a1/language-en/format-PDF/source-259353375>

The low attractiveness of the research system in Romania is also determined by the small number of foreign PhD students. According to the Report on the state of higher education in Romania in the academic year 2020-2021, a number of 34,447 students studied, and of these only 3%, respectively 970, followed doctoral study programs (Ministry of Education, 2022)

The sub-pillars that positively influenced Romania's position were the Knowledge Impact and Knowledge diffusion. The indicators that positively influenced Knowledge Impact sub-pillar were Labour productivity growth and ISO 9001 quality certificates. The indicators that positively influenced Knowledge diffusion sub-pillar were ICT services exports (% total trade) and production and export complexity. The Infrastructure pillar was favourably influenced by the ecological sustainability sub-pillar. The indicator that positively influenced ecological sustainability sub-pillar was ISO 14001 environmental certificates

Table 5. Romania's Strengths and Weaknesses

Strengths	Position in GII 2022	Weaknesses	Position in GII 2022
1.2.3 Cost of redundancy dismissal	1	1.1.2 Government effectiveness*	84
3.3.3 ISO 14001 environmental certificates	10	1.3.1 Policies for doing business	114
3.3.1 GDP/unit of energy use	19	2.2.1 Expenditure on education, % GDP	99
4.1.3 Loans from microfinance institutions, % GDP	9	2.3.2 Gross expenditure on R&D, % GDP	64
4.3.1 Applied tariff rate, weighted avg., %	20	2.3.4 QS university ranking, top 3*	72
5.1.4 GERD financed by business, %	21	4.1.2 Domestic credit to private sector, % GDP	105
5.3.3 ICT services imports, % total trade	14	4.2.1 Market capitalization, % GDP	74
6.2.1 Labor productivity growth, %	4	4.2.3 Venture capital recipients, deals/bn PPP\$ GDP	81
6.2.4 ISO 9001 quality certificates/bn PPP\$ GDP	17	4.2.4 Venture capital received, value, % GDP	95
6.2.5 High-tech manufacturing, %	23	5.2.1 University-industry R&D collaboration†	82
6.3.4 ICT services exports, % total trade	11	5.2.4 Joint venture/strategic alliance deals/bn PPP\$ GDP	93
7.2.1 Cultural and creative services exports, % total trade	15	6.1.2 PCT patents by origin/bn PPP\$ GDP	79

Source: Own processing based on the Global Innovation Index 2022

The positions occupied by the European countries, including Romania, at the global level in Global Innovation Index are correlated with the positions occupied at the European level in the European Innovation Scoreboard.

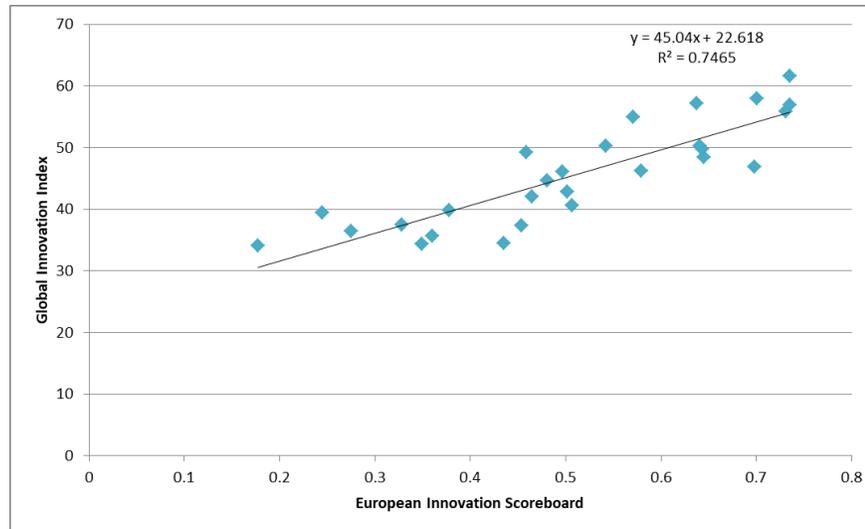


Figure 1. The relationship between the European Innovation Scoreboard and Global Innovation Index 2022

Source: Own processing based on Global Innovation Index and European Innovation Scoreboard 2022

Based on the calculations, was obtained a coefficient of 0.74, which indicates a correlation between the European Innovation Scoreboard and the Global Innovation Index. This positive relationship is determined by the use of common indicators within the EIS and GII, as well as by the common purpose of the two tools to analyse innovation performance.

3. Conclusions

Romania is an emerging innovative country, with an innovation performance well below the EU average. The existing research-development-innovation system in Romania is not able to ensure overcoming the condition of a modest innovator, due to some of its weaknesses, among which the most important are: extremely low research and development expenses, under-financing, decreasing of the researchers number, the excessive priority given to fundamental research to the detriment of applied research, the lack of adequate incentives in favour of research and development, the lack of a periodic analysis of the real correlation between the needs of Romanian society and the priority programs as research direction within the national programs.

The position occupied by Romania in the Global Innovation Index is complemented by the position occupied in other world and European rankings, as follows:

- Romania ranks 19/133 in the list of the most complex countries in the world in the Economic Complexity Index ranking (Harvard, 2020).
- The 2019 Global Competitiveness Index of the World Economic Forum places Romania in 51st place out of 141 countries. The country ranks best in ICT adoption (32nd) and market size (41st), and worst in financial systems (86th), health (83rd), skills (72nd) and business dynamism (World Bank, 2020).
- Romania ranks 55th in the World Bank's Doing Business ranking, which evaluates the ease of doing business in 190 countries around the world. The country has gone through many reforms to make it easier to do business and is now closer to other EU member states in terms of scores for starting a business (EBRD, 2019).
- Romania has a below-average performance on all dimensions of the eco-innovation index (it ranks 25th out of the 27 member states). Eco-innovative

outputs and activities are relatively at half of the EU average; the country is closer to the EU average in socio-economic outcomes (93%) and resource efficiency outcomes (81%) (European Commission, 2019).

- Romania ranks 26th out of 28 countries in the Digital Economy and Society Index (DESI) 2021. The country scores best in the Connectivity dimension and is well positioned in terms of ICT graduates (Human Capital), but digitization the economy lags far behind. Regarding digital public services and the use of internet services, Romania has the worst performance in the EU (European Commission, 2021).

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