

# AN ASSESSMENT OF REGIONAL INNOVATION CAPACITY AS A FACTOR OF ECONOMIC GROWTH OF ROMANIAN REGIONS

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DOI: 10.2478/tjeb-2019-0012

## Publication history

Received: 1 October 2019 | Accepted: 2 December 2019 | Last revision: 23 December 2019

## ABSTRACT

According to Regional Innovation Scoreboard 2016, Romania's regions, including the Bucharest-Ilfov region, are classified as modest innovators. This paper's objective is to identify certain potential ways of economic growth of the Romanian regions through its innovation absorptive capacity and innovation development capacity, according to the AC/DC model of the National Endowment for Science, Technology and the Arts (NESTA), UK. Using the 2016 pillar scores of the Regional Competitiveness Index (RCI) - Innovation sub-index, we analyze their compatibility with the NESTA model and assess the potential of Romanian regions to absorb external innovation. The paper proposes a qualitative and quantitative approach based on empirical evidence. The poor performances of the Romanian regions regarding innovation, as they were analyzed in this paper, draw attention to Romania's need to exploit innovation brought in from abroad. The main conclusion of our analysis is that Romania has failed to reach the absorption threshold of innovation that would allow it to accelerate the value-creating processes. The ability to innovate completes the ability to absorb. A detailed analysis of the causes of the reduced absorption capacity could also provide solutions for accelerating economic growth. We also formulate policy recommendations to increase Romania's regional competitiveness through the development of innovation capacity.

**Keywords:** Innovation, Regions, Romania, Economic growth.

**JEL Classification:** O00, R11, R58.

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## 1. Introduction

The sources of the wealth of nations and the causes of the differences in terms of the welfare between individuals in diverse countries have been concerns of the economists since the beginning of the economic science. The comparisons between diverse states are most often made in terms of economic growth, productivity and competitiveness, sometimes even confusing as a result of the interchangeable use of these terms. According to the World Economic Forum, competitiveness is the set of institutions, policies and factors that determine the level of a country's productivity (Schwab, 2017: ix). A competitive economy is a productive economy and a productive economy enjoys economic growth and high standards of living of its citizens. It remains to be seen why some nations are more competitive than others and to what extent there would be a formula for economic growth that could be replicated. The analysis of the institutions, the infrastructure, the education, the macroeconomic environment, the market size or the technological readiness offers numerous perspectives that make differences in the economic performance of diverse countries. The competitiveness of the regions is estimated, considering the quality of the institutions, the infrastructure, the education, the workforce skills, the technology and the innovation (Clipa & Ifrim, 2016).

Our study tries to focus on only one of the aspects of this picture, namely the role of innovation in the equation of the economic growth. The innovation is a determinant of the growth that gives birth to multiple challenges, both when it comes to its measurement (OECD, 2010), but also through the dual structure of innovation: the absorption capacity and the development capacity. The pillars of competitiveness indices treat the innovation in the broad sense, regardless of whether the knowledge used to increase productivity is gained within borders or adopted from outside (Schwab, 2017).

The contribution of innovation to the regional economic growth is one of the issues that are taken into account when measuring the regional competitiveness of EU countries. This is done by using Regional Competitiveness Index (RCI), launched in 2010 by European Commission and published every three years. The RCI is a weighted composite measure of multiple dimensions. Each dimension, that cannot be directly observed, is indirectly quantified by a set of indicators, statistically assessed and aggregated. There are eleven dimensions which are aggregated into three sub-indices of competitiveness and an overall composite index. One of the sub-indices, the innovation, indicates the highest level of heterogeneity across the EU. Its distribution is characterized by 'islands' of highly innovative territories surrounded by lower performers. Also, it can be observed the widest variations across regions in Western Europe (Annoni & Dijkstra, 2013).

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This paper starts from the study conducted by Mahroum et al. (2008), which considers that the innovation capacity of a region may substantially increase by adopting new knowledge created in other places (AC/DC model, NESTA). The development of a region increasingly depends on its ability to use the knowledge available abroad and to a lesser extent to the development of new knowledge. Searching in the literature, we notice the paucity of studies of the Romanian regional innovation capacity. The existing studies are more concerned with the role of innovation in the regional development (Talmaciu, 2012; Dan, 2012; Goschin, 2014) or the relationship between innovation and one of its enhancing factors, such as the academic-business environment cooperation (Șerbanica et al., 2015; Nastase & Kajanus, 2008; Marques & Morgan, 2018). We fill the gap in the literature trying to find out the potential path of economic growth of the Romanian regions through their capacity to innovate and use the innovation coming from abroad. For that purpose, considering the lack of data for conducting our own analysis of the absorption capacity of the innovation, we focus our research on the innovation sub-index as it was first presented in the Regional Competitiveness Index (RCI) 2010 (Dijkstra, Annoni & Kozovska, 2011) and developed later in RCI 2013 (Annoni & Dijkstra, 2013) and RCI 2016 (Annoni, Dijkstra & Gargano, 2016). We tried to identify which variables of the RCI Innovation sub-index are compatible with those used in the NESTA model, in order to assess the capacity of Romania to absorb the available innovation and achieve economic growth.

The research proposes a qualitative and quantitative approach based on empirical evidence. The pillars of the innovation sub-index are analysed, highlighting their strengths and weaknesses, and both the innovation development and absorption capacities are considered. The indicators used to estimate the Regional Competitiveness Index are compared with the indicators used to develop the NESTA model and the potential of Romania's regions to absorb the foreign innovation is assessed. In the end, certain recommendations are made on how to increase the regional competitiveness of Romania based on innovation.

## 2. Literature review

Since the 1950s, the developing economies have begun to be concerned about the capital formation as a source for development, knowledge being an important component of this factor. The literature in this field has focused on understanding the success or failure of diverse nations in stimulating the economic development through technological development. There are two theories on the role of innovation in the economic development: the first argues that high rates of investment in human and physical capital lead to innovation and high growth rates at national level (Young, 1993; Kim & Lau, 1996),

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and the second argues that the entrepreneurship, the effective learning and the innovation are different variables but, at the same time, have equal importance in development (OECD, 1971; Freeman & Soete, 2003 Kim & Nelson, 2000). Common to both approaches is, without doubt, the recognition of the huge role of innovation and knowledge on the economic development.

At the same time, the spatial economics literature has much to say about the contribution of innovation to the regional economic growth. Theories that refer to regions as knowledge hubs, based on the Schumpeterian theory and the evolutionary economy, place the innovation and the interactive learning process at the heart of the economic development process (Bottazzi & Peri, 2003; De Propriis & Hamdouch, 2013). The literature on the systems of innovation conceptualizes the innovation as an evolutionary and social process of collective learning (Cooke, Uranga & Etxebarria, 1998). However, the learning processes require a high number of actors, being rather a form of orchestration of the entire economic system (Narula, 2003). The accumulation of knowledge and the exploitation of the advantage of staying behind are not obvious processes, with clear results regarding the adoption of innovation existing abroad. These are conditioned by the ability of formal and informal institutions to capture and use available knowledge. All the factors favouring innovation in a region - partners, competition, human capital, regional knowledge infrastructure, institutions, regulations, legislation - form the regional innovation system. The regional presence of the competitive industrial agglomerations is proof that the regional innovation system is viable and gives sustainable competitive advantages to the economic actors. The advantages of the agglomeration economies are well known for increasing productivity (Henderson, 1986; Ciccone & Hall, 1996; Moomaw, 1981; Beeson, 2017; McCann & Van Oort, 2019).

However, the proximity advantages in agglomerations that increase the productivity and the economic development of cities and regions can be eroded during the final stages of the industry's life cycle (Potter & Watts, 2011). A recent study (Martin et al., 2018), looking at the various productivity growth paths from 85 British cities over the last 45 years, observed the slowdown in almost all the cities, and the decomposed analyses of the relative contribution of the effects of structural changes on the productivity of cities showed that structural changes, especially the shift from manufactures to services, had a negative impact. It is obvious why the productive advantage of large cities is constantly eroded and must be sustained by new job creation and innovation (Duranton, 2014).

The sources of agglomeration economies must be identified and boosted. One of these sources is innovation, both created within the city based on its own resources, and attracted from outside the agglomeration. A NESTA study (Mahroum et al., 2008) revealed that innovation capacity of a city or region may substantially increase by adopting new

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knowledge created in other places. Different specialization of places in particular industries or economic sectors may affect their capacity to develop innovations. This is because, according to the NESTA study, the decision-makers focus on the ability of cities and regions to create their own new knowledge and on their ability to trade it, the development of innovation absorption capacity is a challenge for these regions' performance. The development of a region is increasingly dependent on its ability to use the knowledge available abroad and to a lesser extent to the development of new knowledge. This makes the discussion on regional development increasingly obvious from the focus on creating innovation towards its absorption. Borenzstein et al. (1998) and Xu (2000) argue that the positive impact of Foreign Direct Investment (FDI) on economic growth only occurs in those developing countries that have achieved a certain minimum level of absorptive capacity. Dahlman and Nelson (1995:88) describe this absorptive capacity as "the ability to learn and implement the technologies and associated practices of already developed countries". The developing countries "must possess the ability to absorb, internalize and utilize the knowledge potentially made available to them" (Narula, 2004).

A detailed scheme of the absorption capacity is made by Narula (2004) and includes components grouped into four broad categories - basic and advanced infrastructure, firm, and institutions. The same study identifies 4 stages of absorptive capacities (pre catching-up, catching up, pre frontier-sharing and frontier-sharing), showing that after a certain level of knowledge is reached, the absorptive capacity of a country increases rapidly (Narula, 2004: 27). Reaching a certain threshold in terms of the absorption capacity of the innovation is equivalent to a more alert accumulation of knowledge. The economic growth relies on the ability of these countries to acquire and internalize knowledge developed elsewhere if they are to catch up.

### **3. Compatibilities between RCI Innovation sub-index and NESTA AC/DC model's dimensions**

According to the NESTA study, the ability of a region / city to innovate depends on both internal and external sources of knowledge. Perhaps the second component is more important, since most innovations take place abroad, without being particularly identified with a company, university, cluster or city-region (Mahroum et al., 2008). However, new ideas and innovations coming from outside through commercial networks, foreign investments, university collaborations or even migrants cannot be fully captured and exploited if the receiving location does not possess the ability to attract external knowledge - ability called absorption capacity of innovation (AC), along with the ability to use it indoors to create added value - this last one being called innovation development capacity (DC).

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Together, AC and DC in the NESTA model form the innovation system. The ability of the knowledge gained from abroad to contribute to economic growth in the recipient countries is conditioned by the human capital and the ability of the domestic firms to absorb them.

**Table 1.** The components of absorptive capacity

Basic infrastructure	Advanced infrastructure	Firms	Formal and informal institutions
Roads, railways, etc.	Universities	Domestic firms with appropriate human and physical capital to internalize technology flows	Intellectual property rights regime
Telephones	Advanced skilled human capital (tertiary education)	MNE affiliates (acting both as users and creators of technology flows)	Technical standards, weights and measures
Electricity	Research institutes		Incentives and subsidies to promote adoption and creation of new technologies
Basic skilled human capital (primary and secondary education)	Banks, insurance firms		Taxation Competition policy Investment promotion and targeting schemes.
Primary and secondary schools			Promotion of collaboration between economic actors (domestic)
Hospitals			Promotion of collaboration between economic actors (foreign)  Promotion of collaboration between economic actors (foreign) Promoting entrepreneurship

Source: Narula, 2004, p.18.

AC allows a region / city to identify, appreciate and assimilate new knowledge. AC is based on three components: the 'access capacity', which is the ability to connect to international knowledge and innovation networks, the 'anchor capacity', which means to identify and attract (anchor) external knowledge from people, institutions and firms; and the ability to 'diffuse knowledge', which means the ability to assimilate and spread knowledge in the economy. The DC comprises two components: knowledge creation and knowledge exploitation (Mahroumet *al.*, 2008).

More popular for European countries statistics, the Regional Competitiveness Index (RCI) is the only measure to provide a perspective on the competitiveness of all NUTS-2 regions. Through

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its 11 pillars, it assesses not only aggregate competitiveness but also the strengths and weaknesses of a region. The RCI has three dimensions, Basic, Efficiency and Innovation. However, some components of these dimensions can be found both in the structure proposed by Narula (2004) for the absorption capacity component, as well as in the AC / DC model. Thus, institutions, infrastructure or education, although not included in the Innovation dimension, are closely related to the absorption capacity of the knowledge brought in from outside. Accessing, anchoring and disseminating knowledge obtained abroad also depends on education, formal and informal institutions, labour market efficiency and macroeconomic stability, dimensions that the RC index accounts for outside the Innovation sub-index.

The Innovation sub-index is built on 23 indicators, grouped into three pillars: 'technological readiness' (regional and national), 'business sophistication' (regional) and 'innovation' (regional). The indicators that are part of 'technological readiness' relate to the access to the Internet of households and the use of the internet by individuals for online purchases, availability of latest technologies, firm-level technology absorption, technological adoption, FDI and technology transfer, enterprises having purchased and received online orders (at least 1%) and enterprises with fixed broadband access. Regarding 'business sophistication', the innovation sub-index uses: employment and Gross Value Added (GVA) in the 'Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities' sectors (K-N) and innovative SMEs collaborating with others. The third pillar, 'innovation' includes indicators such as: total patent applications, core creativity class employment, knowledge workers, scientific publications, total intramural R&D expenditure, human resources in science and technology (HRST), employment in technology and knowledge-intensive, high -tech, ICT and biotechnology patents and exports in medium-high / high-tech manufacturing. A first aspect related to the compatibility between the two models concerns the national character of the AC / DC approach, while the RCI has a number of regional components, which make aggregation difficult. If we refer only to the Innovation component of RCI, we obtain an insufficiently wide angle on the absorption-development binomial of innovation, proposed in the NESTA study. The absorption capacity is limited to technologies adopted at firm-level, while the availability of latest technologies gives no information about their use. Business sophistication dimension of RCI Innovation sub-index is composed of *Innovative SMEs collaborating with others*, but it is very hard to guess the linkage that could promote a network interactive learning as NESTA estimates. The global business network connectivity measured by NESTA means both inward streams of knowledge through firm networks and research networks. This could provide the information about how connected a region/country is and could satisfy the first condition for absorptive capacity. The access to broadband and the number of individuals and enterprises having transactions over internet, as included in RCI *Technological readiness* could indicate the international flow capacity of a country, being compatible with the communications and international transport networks component of the AC/DC "knowledge access" capacity. The knowledge "anchoring capacity" could have as corresponding component in RCI the FDI and technology transfer. There is no other information in RCI Innovation sub index about the density of international firms or the depth of foreign investment in the region or the retention of skilled people, as AC/DC model assumes, but Gross Value Added (GVA) from *Business sophistication* could estimate the knowledge "anchoring capacity" of the analyzed regions. As for knowledge "dissemination capacity", NESTA research focuses on populations and workforce learning capacity; knowledge sharing capacity and knowledge disseminated in firms. The ability to use and disseminate

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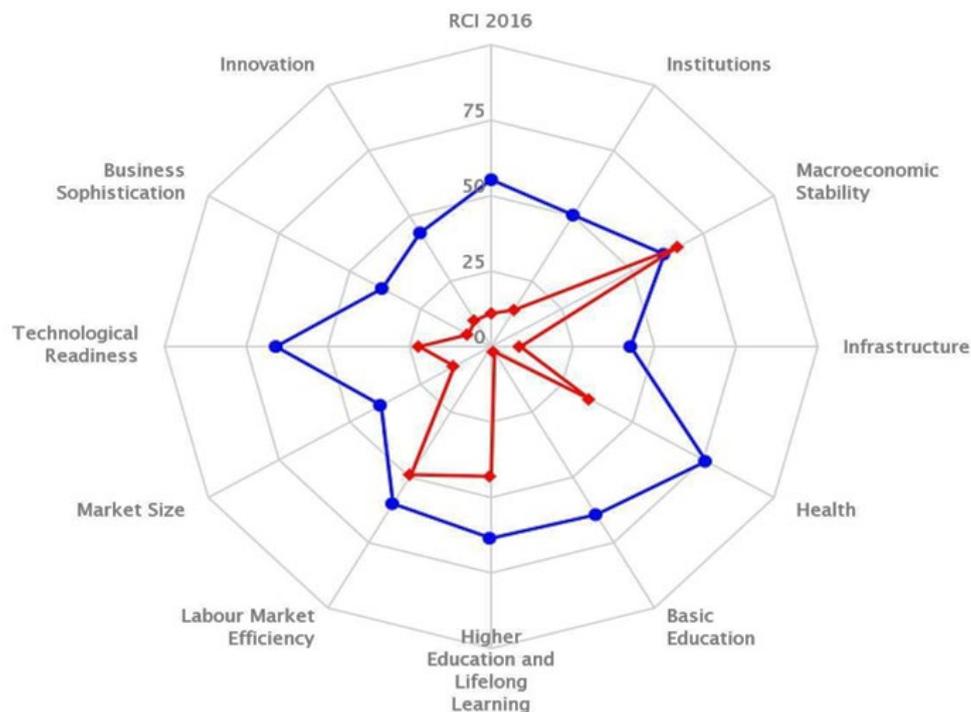
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knowledge depends on human capital. The Knowledge workers, Core Creativity Class employment and Employment in technology could provide the measure for this capacity.

The absorptive capacity of a region is an important channel for the development capacity of knowledge (Mahroumet *et al.*, 2008). As long as a region has the capacity to access and disseminate knowledge, it has the resources to create knowledge. All the patents included in measuring *Innovation* are, in fact, the result of a region ability to absorb and multiply knowledge, to create value.

#### 4. Regional performances and discussion

The regions of Romania have low scores of the indicators that are part of the pillars of the Innovation sub-index and there were not seen changes if compared to previous editions of the RCI (2013 and 2010). Romania has by far the most modest performance in the EU, both in terms of competitiveness, and when it comes to innovation (Figure 1). Innovation, Business Sophistication, Technological Readiness, together with Institutions, Basic Education, and Infrastructure seem to be far from the EU average.



Source: European Regional Competitiveness Index 2016

Legend: Romania – red, EU average – blue

**Figure 1.** Romania vs. EU average RCI 2016 – Spider-graph

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RCI 2016 for Center and West regions are placed in the second stage of development, placement that means an improvement in performance comparing to 2013, when these regions were included in the first stage. Compared to 15 other regions with a similar level of GDP per capita, RCI 2016 characterizes the Romanian regions according to the three pillars of the Innovation, either weaker, or at a similar level (neither better, nor worse).

Regional analysis revealed that in Romania, like most European countries (Austria, Belgium, Bulgaria, the Czech Republic, Hungary, Ireland), there is limited variation in regional performance groups, suggesting that regional and national innovation performance are connected.

As table 2 shows, there are three Romanian regions that have performed better at Technological readiness: North - West, Bucharest - Ilfov and West, while North - East is the weakest in the ranking at this pillar of Innovation.

**Table 2. Technological readiness (regional) – Romania**

	Households access to broadband	Individuals buying over internet	Households access to internet
North - West	65.0	11.5	67.5
Center	59.0	8.0	61.5
North - East	54.0	8.0	58.0
South - East	57.0	7.5	59.0
South - Muntenia	56.0	9.0	57.0
Bucharest - Ilfov	79.5	22.0	83.0
South - West Oltenia	57.0	8.5	59.0
West	69.0	9.5	72.0

Source: European Regional Competitiveness Index 2016

Regarding *Business sophistication* pillar, Bucharest - Ilfov, North - East and West present the best performance for GVA, Bucharest - Ilfov being the only region well positioned in terms of employment (table 3).

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*An assessment of regional innovation capacity as a factor of economic growth of Romanian regions***Table 3. Business sophistication pillar (regional) – Romania**

	Employment, K-N sector	GVA, K-N sector	Innovative SMEs collaborating with others
North - West	3.9	16.8	0.0
Center	4.7	16.1	0.0
North - East	2.9	17.7	0.0
South - East	3.6	14.8	0.1
South - Muntenia	4.6	14.2	0.0
Bucharest - Ilfov	15.2	28.9	0.0
South - West Oltenia	3.4	13.2	0.0
West	4.5	17.4	0.0

*Source: European Regional Competitiveness Index 2016*

The gap between the capital region and the other regions is quite large. It persists when analyzing *Innovation* pillar of innovation sub-index (table 4). Even if North - East or West are better than other regions in terms of scientific publications, employment in technology and knowledge-intensive sectors or exports in medium-high/high tech manufacturing, Bucharest - Ilfov still remains at the top of the ranking.

**Table 4. Innovation pillar (regional) – Romania**

	Total patent applications	Core creative class employment	Knowledge workers	Scientific publications	Total intramural R&D expenditure
North - West	2	6.0	21	762	0.38
Center	2	6.0	25	241	0.18
North - East	1	4.9	16	465	0.35
South - East	1	4.7	20	138	0.07
South - Muntenia	1	4.6	18	101	0.41
Bucharest - Ilfov	14	10.4	39	1887	0.91
South - West Oltenia	0	5.8	20	203	0.16
West	5	5.7	20	632	0.27
	Human Resources in Science and Technology	Employment in technology and knowledge-intensive sectors	High-tech inventors	ICT inventors	Exports in medium-high/high tech manufacturing
North - West	22	2.4	1	1	0.24
Center	26	1.8	1	0	0.34
North - East	17	1.2	0	1	0.07
South - East	20		0	0	0.21
South - Muntenia	18	1.1	0	1	0.41
Bucharest - Ilfov	47	7.0	3	5	0.59
South - West Oltenia	20	1.0		0	0.18
West	21	5.3	1	1	

*Source: European Regional Competitiveness Index 2016*

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Even if in previous editions of Regional Innovation Scoreboard, Bucharest - Ilfov and South - East were listed as moderate inventors, in European Regional Competitiveness Index (2016) all the Romanian regions are classified as a modest inventor. The poor performances of the Romanian regions regarding innovation, as they were analyzed previously, draw attention to Romania's need to exploit the innovation from abroad. Unfortunately, an infrastructure that allows the absorption of innovation from the outside can precarious be found in three regions (Bucharest - Ilfov, West and North - West).

Romania is far from being an innovative country, but it also fails to sufficiently use the innovation from outside. The low score in terms of the Innovation dimension of competitiveness does not offer a clear picture of the causes behind it. The number of scientific publications, closely linked to the presence of the most important Romanian universities in the leading regions, is not sufficient to give the image of their impact on innovation. Moreover, if the publications in the North - West region are on the second place in the national ranking, not the same can be said about the GVA in this region. It is obvious that Romania has failed to reach the absorption threshold of innovation that will allow it to accelerate the value-creating processes. The ability to innovate completes the ability to absorb. A detailed analysis of the causes of reduced absorption capacity could also offer solutions for accelerating economic growth. Co-authorships of scientific publications, business network connectivity, broadband infrastructure and international flights and travels could provide access to global streams of knowledge. FDI inflows and a high density of international firms mean access to knowledge and a good foundation for growth. Higher education qualifications and the retention of graduates should provide the human capital necessary for the capture and dissemination of knowledge. As NESTA study asserts, "a culture of openness and learning is particularly important" (Mahroumet *et al.*, 2008:15).

Romania could gain comparative advantages especially from improving its capacity to absorb innovation, benefiting from the catching up advantage. Romania's regional competitiveness can be improved by developing a viable innovation system. Unfortunately, Romania is a weak generator of new ideas and knowledge. Therefore, one way to achieve economic growth is to reduce the technological gap to the countries better positioned from this point of view. For this, Romania must focus on the absorption of knowledge coming from the outside, to a greater extent and before exploiting them internally, by creating an innovation infrastructure. The extent to which regions cause AC and/or DC to create new knowledge differs, both across sectors and inter across regions. The challenge is to identify the weakness and strengths of innovation capacity for each region, in order to provide real support to regional development policies by stimulating innovation.

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## 5. Conclusions

The paper brings up a topic of great importance, i.e. the major role of innovation in the equation of economic growth, filling a gap in the literature regarding the assessment of regional innovation capacity in Romania. Trying to find out the potential path of economic growth of the Romanian regions through their capacity to innovate, our research started from the AC/DC model (Mahroum et al., 2008), which considers that innovation capacity of a region may substantially increase by adopting new knowledge created in other places. Considering the lack of regional data that would support an analysis of the innovation capacity, our research was focused on Innovation sub-index of RCI (2016) performing an assessment of the Romanian regions in order to capture the aspects related to the absorption of innovation and those regarding the development of innovation, as well as the way forward for developing the innovation capacity of the regions.

By comparing the indicators used to estimate the Regional Competitiveness Index with the indicators used to develop the NESTA model can be revealed that both approaches to the regional innovation attach greater importance to the absorption capacity of new technologies, both at the firm level and in the whole economy. If the NESTA model makes a clear delimitation between innovation absorption and innovation development capacities, in the Regional Competitiveness Index these are only implied from the Technological readiness pillar, including rather absorption components, while the Innovation pillar focuses on creating knowledge (patents, publications). One region may have innovation potential measured by technological readiness, business sophistication and the level of innovation, or may attract innovation from external sources. Although absorption capacity and development capacity of innovation may be distinctly identified in theory, in practice the indicators that fall within the two sides of innovation capacity may overlap or power mutually. This could stimulate the innovation, but it hinders the actions of measuring the innovation capacity of a region in order to improve the policy to support the development of regional competitiveness.

Three points summarize the outcome of the data presented in the paper. Firstly, an infrastructure that allows the absorption of innovation from the outside can precariously be found in three regions (Bucharest - Ilfov, West and North - West). Secondly, Romania has failed to reach the absorption threshold of innovation that will allow it to accelerate the value-creating processes. Thirdly, a detailed analysis of the causes of reduced absorption capacity could also offer solutions for accelerating economic growth. Starting from the last

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point, the potential path of economic growth of Romanian regions through their capacity to innovate and use the innovation from abroad can be drawn by the following: co-authorships of scientific publications, business network connectivity, broadband infrastructure and international flights and travels that could provide access to global streams of knowledge; FDI inflows and a high density of international firms, which means access to knowledge and a good foundation for growth; higher education qualifications and the retention of graduates who should provide the human capital necessary for bringing in and disseminating knowledge. This way, Romania could gain competitive advantages especially from improving its capacity to absorb innovation, benefiting from the catching up advantage. Cities and regions need to collaborate and be part of networks in order to capture new ideas and external knowledge. Universities and other agents such as regional and national policy makers and multinational companies have a huge role in the efficiency of these networks. Growth could be achieved by creating an internal environment favourable to openness to external sources of innovation, enabling increased flows of knowledge, technologies, managerial practices and business models, by minimizing bureaucracy and cutting down on cultural barriers.

The main limit of our approach is the lack of available data regarding the absorption of innovation capacity of Romania, deficiency that we tried to fill in through interpreting the variables of the RCI Innovation index. Future research perspectives may consider statistical analyses in order to identify the impact of the factors that enhance innovation, as main support of regional competitiveness. Such analyses would allow the decision makers to develop more efficiently the policy measures by taking into account the factors of enhancing the regional innovation, with a positive impact on regional development.

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