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COMPARATIVE ANALYSIS OF CLUSTERS CONTRIBUTION TO REGIONAL COMPETITIVENESS

Komparativna analiza uloge klastera u razvoju regionalne konkurentnosti

Abstract

Objective of this paper is to determine how clusters contribute to regional competitiveness in the following five South-East Europe countries (hereinafter referred to as G5): Hungary, Bulgaria, Greece, Romania and Serbia. In order to test the hypothesis that strong clusters contribute to regional competitiveness we analyzed correlation between the strength and specialization of clusters in the regions (using the methodology of the European Cluster Observatory – ECO) and GDP *per capita*, as an indicator of productivity. The paper is based on various statistical data including Global Competitiveness Report, national statistical reports, and cluster mapping methodology developed by the ECO. Our analysis shows that, in observed G5, despite low ranks with respect to the state of cluster development, there is evidence of a strong cluster portfolio in more developed regions, mainly around the major cities. Also, determined positive correlation means that higher level of specialization in the G5 regions leads to a higher level of productivity, measured by GDPpc. Knowledge-intensive services, creative industries and life sciences segments are weak in G5, compared with developed EU countries. Nevertheless, in G5, there is a positive correlation between each of these segments and regional GDPpc, which brings us to the conclusion that they can be drivers of regional innovation and productivity.

Key words: *competitiveness, cluster, regional development, knowledge-intensive services, creative industries, life sciences*

Sažetak

Cilj ovog rada je da se utvrdi kako klasteri doprinose regionalnoj konkurentnosti u sledećih pet zemalja Jugoistočne Evrope (u daljem tekstu G5): Mađarska, Bugarska, Grčka, Rumunija i Srbija. Kako bi testirali hipotezu da jaki klasteri doprinose regionalnoj konkurentnosti, analizirali smo povezanost između snage i specijalizacije klastera u regionima (koristeći metodologiju Evropske opservatorije za klastere – *ECO*) sa BDP *per capita,* kao pokazateljem produktivnosti. Rad se bazira na različitim statističkim podacima, uključujući Globalni izvještaj o konkurentnosti, nacionalne statističke izveštaje i metodologiju mapiranja klastera koju je razvio *ECO*. Naša analiza pokazuje da, u državama G5, uprkos niskom nivou razvoja klastera, postoje jaki klasteri u razvijenijim regionima, uglavnom oko velikih gradova. Takođe, pozitivna korelacija dokazuje da viši nivo specijalizacije u G5 regionima vodi ka višem nivou produktivnosti, mereno BDP *per capita*. U poređenju sa razvijenim zemljama EU, segmenti privrede u znanjem intenzivnim uslugama, kreativnim industrijama i naukama o životu u G5 su slabi. Ipak, u G5 postoji pozitivna korelacija između svakog od ovih segmenata i regionalnog BDP*pc*, što nas dovodi do zaključka da ovi segmenti mogu biti pokretači regionalnih inovacija i produktivnosti.

Ključne reči: *konkurentnost, klasteri, regionalni razvoj, znanjem intenzivne usluge, kreativne industrije, nauke o životu*

Review of cluster literature

The attempts to use clusters as economic policy tools have increased since the early 20th century. Linking into clusters represents one of the key drivers of the competitiveness of regions and countries, and the basis for achieving competitive advantage under current conditions.

Clusters actually represent the balance of agglomeration and dispersion forces for specific economic activities [10, p. 8]. Starting from *Alfred Marshall*'s [11, p. 187] original observation that firms can enjoy benefits from locating close to others engaged in related activities that continues to hold true, in advanced as well as in developing countries, *Ketels* argued that the benefits have three main sources: (i) potential to attract more specialized suppliers and interact with them more efficiently, (ii) labor market that is deeper and provides more specialized skills, and (iii) knowledge spillovers through different channels [9, p. 8].

Organizing in clusters is one of the most efficient and most flexible ways to improve competitive position and exploit competitive advantages, on national and regional level. The role of clusters in linking business environment and company sophistication and establishing natural links among specialized knowledge, skills, infrastructure and supporting industries is significant. Clusters are geographical agglomerations of companies, suppliers, service providers and affiliated institutions, which are linked by the complementarities of industries and positive external effects [12, p. 1]. Cluster concept has become the central idea of competitiveness and economic development over the past few decades. The presence of complementary economic activity creates externalities that enhance incentives and reduce barriers to new business creation. Clusters are a particularly important way through which location-based complementarities are realized. Strong clusters are also associated with the formation of new establishments of existing firms, thus influencing the location decision of multi-establishment firms. Finally, strong clusters contribute to start-up firms' survival [1, pp. 495-518].

Recent research studies suggest that regional economic performance depends crucially on the cluster composition across nearby regions rather than within narrow political boundaries [2, p. 6]. Empirically, it is confirmed that strong clusters contribute to success of start-up firms and firms' survival. A few years ago, quantitative methodology was developed with the aim of determining the geographic concentration of specified cluster categories. As this is a relatively new area of research, it is necessary to define the key terms: cluster category, cluster sector, regional cluster, cluster initiative, and cluster mapping [16, p. 5].

Cluster categories are defined as a list of specific economy sectors for which it has been empirically proven that they tend to be geographically located close to each other. The Institute for Strategy and Competitiveness at Harvard University has identified 38 cluster categories using the US SIC industrial classification system, which has been translated into the European NACE system. Clusters encompass all sectors of the economy assigned to one of about 40 defined cluster categories. According to cluster mapping methodology, defined by the ECO, their geographic concentration is measured at the Nomenclature of Territorial Units for Statistics (NUTS) 2 level. NUTS classification is a hierarchical system for dividing the economic territory of the EU. The NUTS regulation defines minimum and maximum population thresholds for the size of the NUTS regions. For NUTS2 level, minimum population is 800,000, and maximum is 3 million habitants.

Cluster mapping methodology used by the ECO works with NUTS2 (which corresponds to our definition of regions) and the data we used are obtained using this methodology. At the level of NUTS3 (which corresponds to our definition of districts), facing difficulties in obtaining the data for the observed countries (considering particularly Serbia which is not recognized by NUTS3) authors realized that it would be of great interest for further research to proceed mapping for these countries at the NUTS3 level.

Cluster initiatives are defined as organized efforts to increase the competitiveness and growth of clusters within a region, encompassing firms, government institutions, and scientific research organizations. Clusters arise at the level of regions or economic areas, not entire nations, because of the importance of proximity to cluster benefits. This is why regional economies specialize and why regional economies are a crucial unit in understanding economic

performance. Cluster mapping contributes to better understanding of the economic performance of clusters. The use of the term "mapping" relates to two aspects of this research method: 1) determination of industrial classifications in clusters and 2) determination of clusters according to their geographic location [10, pp. 17-21].

The concept of clusters and cluster mapping methodology

We have used cluster mapping methodology developed by the ECO. It determines whether the level of employment in specified sectors of the economy, which belong to the cluster categories in a certain region, has achieved a critical mass needed for specialization in order to develop interlinking and networking effects that can generate positive economic effects. The relevant factors that indicate whether a cluster has reached 'specialized critical mass' are: cluster size, cluster specialization and cluster dominance.

Cluster size. If employment reached a sufficient absolute level, it is more probable that the economic effects of clusters will be significant. According to the methodology of the ECO, regional clusters with more than 15 thousand employees have a one-star rating.

Cluster specialization. It compares the share of economic activity in a particular industry on the regional level with the share of economic activity in the same industry on the national level, resulting in the degree of regional specialization in each industry. If a region is more specialized in a specific cluster category than the whole sector across all regions, it is more likely that the economic effects of the regional cluster will be strong enough to attract related economic activities from other regions to this location and that their links will be stronger. Regional clusters with the coefficient of specialization higher than 1.75 are also rated one star. This means that their level of employment is higher by 75% than the average in the whole region in a given cluster category. This figure again reflects top 10% of all clusters in the EU.

Cluster dominance. If a cluster has a higher share in total regional employment, it is more likely that networking effects will be generated, instead of being immersed into other parts of the local economy. The one-star rating is obtained by clusters which account for 7% or more of total employment in the region. This figure also reflects top 10% of all clusters in EU member countries.

The coefficient of specialization is obtained when the constant factor μ, which represents the total European employment in a particular category of clusters divided by the total employment in Europe, is multiplied by the employment within the cluster in the region divided by the total employment in the region:

$$SQ_{r,s} = \frac{e_{r,s}/E_r}{E_s/E} = \frac{e_{r,s}}{E_r} \cdot \frac{E}{E_s} = \mu \cdot \frac{e_{r,s}}{E_r}$$

$SQ_{r,s}$ – coefficient of specialization for the cluster category s in the region r;
$e_{r,s}$ – the number of employees within the cluster category s in the region r;
E_s – the total employment within the cluster category s in Europe;
E_r – the total employment in region r; and
E – the total employment in Europe.

The dominance of clusters in the region is calculated by the following formula:

$$D_{r,s} = \frac{e_{r,s}}{E_r}$$

$D_{r,s}$ – dominance of the cluster category s in region *r*;
$e_{r,s}$ – the number of employees within the cluster *s* in region *r*; and
E_r – the total employment in region *r*.

Each cluster can be rated up to three stars. Three-star clusters are clusters with the highest regional concentration and specialization compared to European clusters and such clusters have very good prospects [10, pp. 22-24].

Comparative analyses of clusters strength data in G5

This study focuses on available formal data on cluster mapping and aims to establish best practice benchmarks in clusters from observed G5: Hungary, Bulgaria, Greece, Romania and Serbia. If we observe the cluster-related criteria in the Table 1, we will find out that all five countries are ranked very low with respect to the state of cluster

Table 1: State of cluster development in G5 (among 144 countries)

Indexes of cluster development	Hungary	Romania	Bulgaria	Greece	Serbia
Country global competitiveness rank	60	59	54	81	94
State of cluster development	91	70	129	125	115

Source: [18, pp. 104-391], author's own selection of countries

development and hold the ranks that are far below those held on the competitiveness ranking list.

Research shows that the presence of a strong portfolio of clusters affects the level of productivity of the region in which they are located. The nature of these connections is represented in Table 2, comparing the top ten regions, measured by number of stars and level of GDPpc in 2011 in observed countries. Authors of this paper considered making this comparative analysis in a wider or more recent time framework, particularly using data for 2013, instead of 2011. Collecting inputs for the observed G5 for the year 2013 however resulted in insufficient data for all the countries. Authors therefore represent the findings for the year 2011 in this analysis.

We have chosen to use GDPpc as an indicator of productivity stating under assessment that it is broadly available indicator of productivity based on national statistics from all analyzed countries.

Table 2: Cluster strength in observed G5

Region	Number of stars	GDP per capita (in EUR)
Vest, Romania	22	7,100
Centru, Romania	22	6,200
Kozep-Magyarorszag, Hungary	21	17,600
Attiki, Greece	19	25,400
Sumadija and Western Serbia	19	3,100
Yuzhen tsentralen, Bulgaria	18	3,200
Sud-Muntenia, Romania	18	5,400
Nord-Vest, Romania	17	5,800
Eszak-Alfold, Hungary	16	6,600
Bucuresti-Ilfov, Romania	16	15,800

Source: Authors' calculation based on [6]

Romania is characterized by the highest degree of geographic specialization of its economy – clusters in eight statistical regions have a total of 138 stars. Clusters in the Central and West Region have 22 stars each, while the apparel cluster is the most frequent with 20 stars. Apart from the apparel cluster, strong clusters in Romania are mostly in the construction, furniture, footwear, heavy machinery and automotive industries as well as in the processed food and transportation & logistics. Clusters in six statistical regions in Bulgaria have a total of 75 stars. Clusters in the Central-Southern region have the greatest number of stars (18). According to the number of stars, the most frequent cluster category in Bulgaria is apparel. Strong clusters in the Bulgarian regions are also in farming & animal husbandry, processed food, and textile industries. Hungary has seven statistical regions whose clusters have obtained 96 stars. The region of Kozep-Magyarorszag has the greatest number of stars – 21. The cluster categories with the greatest number of stars are in processed food and farming & animal husbandry, then in education & knowledge creation, telecom, construction, and heavy machinery. Greece has the largest number of regions (13), but clusters in Greece have only 127 stars. Most stars have clusters in Attiki region, which is logical, considering the fact that major economic activities are located around capital of Greece. Cluster categories with the biggest number of stars in Greece are farming & animal husbandry, agricultural products, tourism & hospitality, and construction. Clusters in Serbia in total have 55 stars. The greatest number of stars has been obtained by clusters in the region of Sumadija and Western Serbia (19), then Eastern and Southern Serbia (14), Vojvodina (13), and Belgrade (9).

Dominance of the clusters in regions is measured by location quotient. It represents the share of certain cluster category in the overall strength of the cluster sector in the region where it operates. Thus, the location quotient represents a percentage of the total employment in a particular cluster category to the total employment in the region where it operates.

Table 3: Top 10 clusters in G5 region by value of location quotient

Region	Cluster	Location quotient
Notio Aigaio, Greece	Tourism and hospitality	29.18949865
Ionia Nisia, Greece	Tourism and hospitality	24.11097833
Sud-Est, Romania	Transportation and logistics	23.57404604
Ipeiros, Greece	Construction	22.98828029
Anatoliki Makedonia, Thraki, Greece	Farming and animal husbandry	22.65564607
Peloponnisos, Greece	Farming and animal husbandry	22.28544128
Vojvodina, Serbia	Processed food	21.1978881
Thessalia, Greece	Farming and animal husbandry	20.40165165
Sud-Vest Oltenia, Romania	Construction	20.09205946
Ipeiros, Greece	Farming and animal husbandry	19.56063355

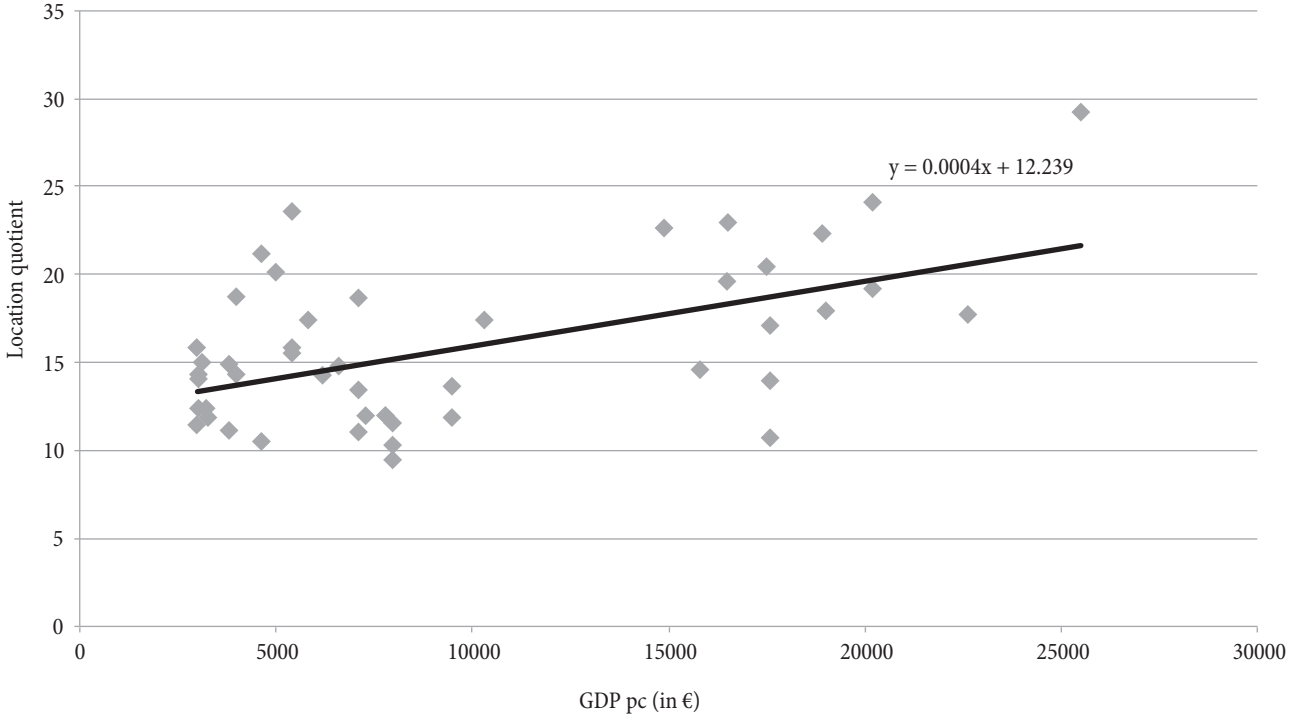
Source: Authors' calculation based on [6]

By the value of location quotient (see Table 3), the strongest clusters in G5 countries are in the area of tourism & hospitality, construction, farming & animal husbandry, and processed food. Processed food clusters in Serbia have strong dominance in the regions, measured by location quotient (all four are in top 10). They are followed by construction clusters (all four in top 12), and metals manufacturing (two in top 6).

Among top fifteen clusters in Greece, by the value of location quotient, seven are in construction, while six are in farming & animal husbandry, and two are tourism & hospitality. Construction clusters are also the strongest in Romania (seven in top 10), by the value of location quotient. Construction clusters in Bulgaria have also high values of location quotient (three in top seven), but the strongest clusters are in apparel sector (three in top five). Processed food clusters are also strong in Bulgaria (four in top 10). The strongest clusters in Hungary, by the value of location quotient, are processed food, automotive, transportation & logistics, and business services.

Figure 1 shows correlation between the top ten clusters in the each of G5 countries, measured by the value of location quotient and regional GDPpc. We calculated strong positive correlation (r = 0.545999). Therefore, we could conclude that cluster portfolio strength in the observed regions significantly influenced the level of GDPpc.

Figure 1: Cluster portfolio strength and prosperity



Source: Authors' calculation based on [6]

It is noticeable that these regions can be divided into two groups according to the level of GDPpc. This division can be understandable, considering countries' path of economic development. Hungary and Romania entered the transition of their economies from centrally planned to market economy in the early nineties. Regions in these countries are at a lower level of development than regions in Greece, which began earlier with the development of market economy. Only regions around capital cities in Hungary and Romania have the same level of development as regions in Greece. Bulgaria is struggling with transition process and its regions are in the lower developed group. On the other hand, Serbia is the last country in G5 that entered the transition process and its regions are the least developed. Only region around capital Belgrade is at the same level of development as less developed regions in Romania and Hungary. Broader aspects of Serbian competitiveness were analyzed in Comparative Analysis Based on New Competitiveness Index [15, pp. 105-115].

Ability to produce innovative products and services at global technology frontier and deliver products and processes with a unique value is dominant source of competitive advantage in innovation-driven economies [17, p. 69]. Efficiency innovations help company make and sale mature, established products or services to the same customer at lower prices. Efficiency innovations play two important roles: they increase productivity, which is essential for maintaining competitiveness, and they free up capital for more productive use [3, p. 245]. On the basis of empirical research the ECO has singled out three large segments of the economy as being knowledge-intensive and having a significant impact on an increase in innovation and development of new patents. Those three ECO segments are clusters in knowledge-intensive services (KIS), creative and cultural industries (CCI) and life sciences (LS).

KIS include business support services, education & knowledge creation, financial services, and IT (see Table 4). Hungary has the most developed KIS in G5 and its clusters in this segment obtained 13 stars. The region around Hungarian capital has the strongest KIS segment, while three regions in Hungary have two-star education & knowledge creation clusters. Regions in Bulgaria and Serbia have clusters with one star in KIS, while region around Romanian capital has strong, two-star IT cluster. Greece does not have any cluster star in IT, but in Attiki region there is strong, two-star financial services cluster. Research has shown that regions with strong KIS clusters have made the greatest progress in Europe. The presence of strong KIS clusters also has a positive impact on an increase in innovation and number of patents [5, p. 2].

Figure 2 shows the relationship between GDPpc and the location quotient for KIS clusters in the G5 regions. Location quotient represents the percentage of employees in KIS clusters to the total number of employees in the region and is the measure of the specialization of the region.

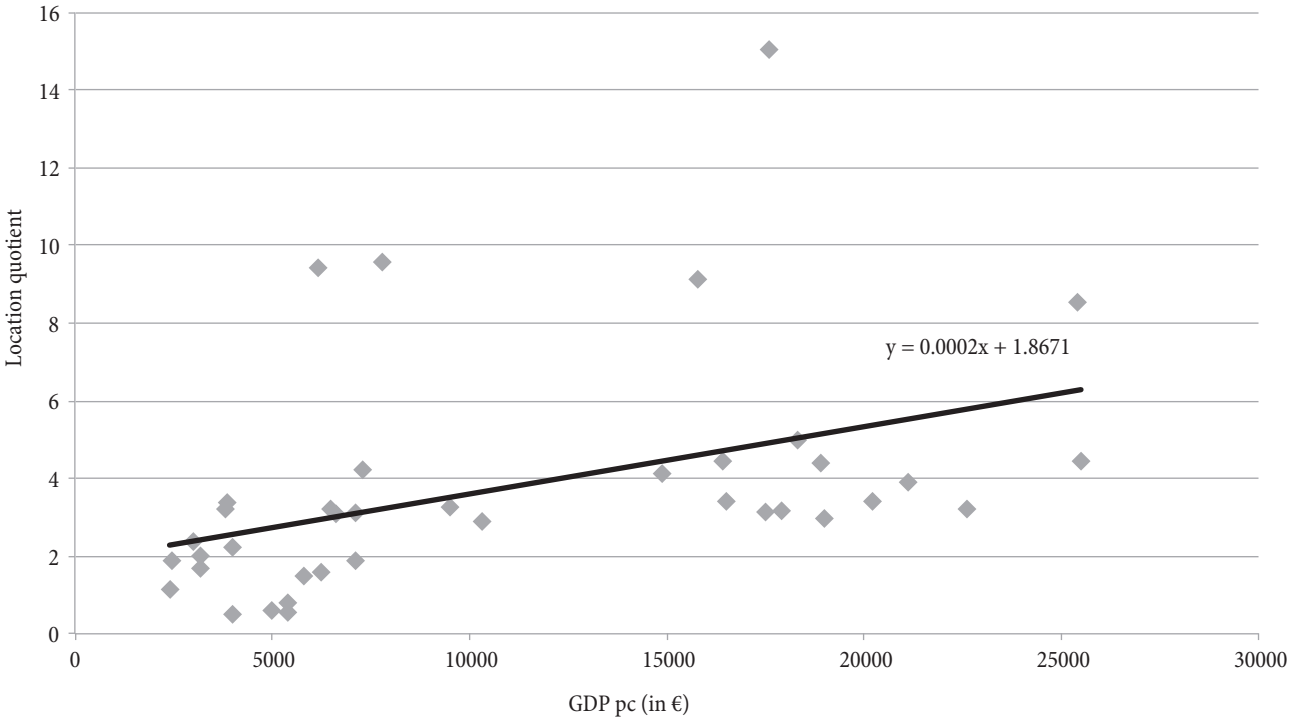
Figure 2 presents relationship between the specialization of the region in KIS and the level of GDPpc with minor fluctuations. Analyzed correlation is positive ($r = 0.422624$). The strongest concentration of KIS segment is in the region around Hungarian capital, while major exception is regions around capital of Bulgaria and Serbia, where despite a higher level of specialization in KIS, level of

Table 4: Cluster strength in KIS

	Business services	Education and knowledge creation	Financial services	IT
Kozep-Magyarorszag, Hungary	2	2	2	1
Del-Dunantul, Hungary	0	2	0	0
Del-Alfold, Hungary	0	2	0	0
Eszak-Magyarorszag, Hungary	0	0	0	1
Eszak-Alfold, Hungary	0	1	0	0
Bucuresti - Ilfov, Romania	1	0	0	2
Yugozapaden, Bulgaria	1	1	1	0
Belgrade, Serbia	0	0	1	0
Attiki, Greece	0	0	2	0

Source: Authors' calculation based on [6]

Figure 2: Location quotient for KIS and regional prosperity



Source: Authors' calculation based on [6]

GDPpc is relatively low. Other regions in Serbia have low level of specialization in KIS.

CCI are economic activities related to knowledge and information creation and exploitation. They can refer to culture or creative segments of the economy, such as advertising, architecture, arts, crafts, design, fashion, film, music, printing and publishing, R&D, software, video games, TV and radio. In Europe, creative and cultural industries represent a significant segment of the economy. In 2006, the total number of employed in creative and cultural industries in the EU was 6.5 million, thus accounting for about 2.75% of total employment. The regions with a high concentration of creative and cultural industries across Europe achieved the highest level of development. Creative industries are also the major generators of the creation of intellectual property, especially copyrights, while the regions with the highest concentration of CCI are the largest centers of employment in the copyright-based economic sectors. The presence of strong CCI clusters contributes to the development of other segments of the economy and exerts influence on the improvement of the competitiveness of the regions in which they are located [13, p. 5]. The similar situation is with respect to KIS. Regions Kozep-Magyarorszag and Del-Alfold in Hungary are the only ones in G5 where cluster mapping detected two-stars CCI clusters (see Table 5). Creative industry clusters in G5 are much weaker than those around large West European cities. For example, the region of London has three stars in the categories such as advertising, museums and preservation of historical sites and buildings, publishing and printing, and artistic and literary creation, and two stars in all other categories.

Table 5: Cluster strength in CCI

	Museums and preservation of historical sites and buildings	Advertsing	Printing and publishing	Software	Artistic creation and literary creation	Retail and distribution
Kozep-Magyarorszag	2	1	1	1	1	1
Del-Alfold	2	0	0	0	0	0
Eszak-Magyarorszag	0	0	0	1	0	0
Eszak-Alfold	1	0	0	0	0	0
Attiki	0	1	1	0	1	1
Yugozapaden	1	0	0	0	0	0

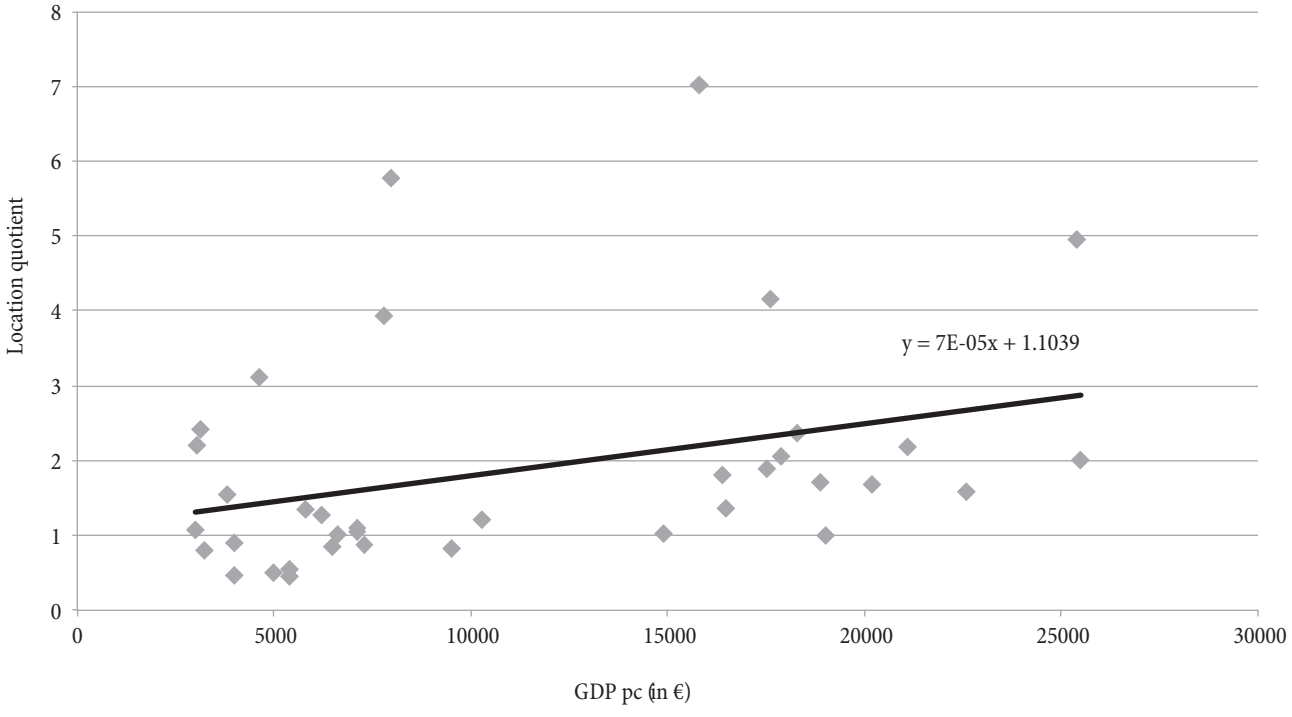
Source: Authors' calculation based on [6]

The cluster mapping results in observed countries show that the highest concentration of employment in creative industries is around the largest cities. Similar results are obtained across Europe, thus confirming that these sectors are industrialized and concentrated in large urban areas. Nevertheless, CCI employment and competitiveness are not directly related to the size of the labor market and cannot be simply regarded as the product of population concentration. CCI show that they represent drivers of the development of specialized labor force and clusters, as *Dominic Power* and *Tobias Nielsén* [13, pp. 5-6] registered for Europe.

Figure 3 indicates a solid relationship between level of GDPpc and regional specialization for CCI in the regions of G5, and positive correlation (r = 0.332885) is calculated. Region around capital of Romania has the strongest specialization in CCI, while regions around other capital cities in G5 also have strong clusters in this segment. Other regions in Serbia have solid specialization in CCI, above the trendline for G5. In Serbia, significant level of specialization is in the publishing & printing clusters, while clusters in museums & preservation of historical sites and buildings are less developed than in the other G5 countries.

According to the methodology of the ECO, LS clusters include three major cluster categories: biotechnology, pharmaceuticals and medical devices. Pharmaceuticals encompass three sectors: production of basic pharmaceutical products, production of pharmaceuticals, and production of perfumes and colognes. Medical devices clusters include the production of medical and surgical equipment, orthopedic devices, and production of conveyances for disabled persons. Biotechnology clusters are mainly focused on research and experimental development in this area. Cluster mapping shows that LS clusters are concentrated in the regions around capitals of Greece, Hungary, Romania, Bulgaria and Serbia (see Table 6). Hungary has long tradition in biotechnologies, and the biotechnology cluster in Kozep-Magyarorszag region includes both multinational and local companies. Most Hungarian biotechnology companies date back to the early 20th century. After surviving the communist regime, they have been privatized or integrated into large multinational groups. Another more interesting aspect is smaller biotechnology firms that emerged out of the academic excellence of Hungarian scientists, locally and abroad. These actors have shown interest in working as a cluster, since they are actually part of a much

Figure 3: Location quotient for CCI and regional prosperity



Source: Authors' calculation based on [6]

promising global value chain, which they need to reach from Hungary [4, pp. 29-31].

LS clusters in Serbia employ only 9,500 people. Production and employment in Serbia are mostly concentrated in large companies. There is no SME development arising from the need for the commercialization of scientific research results. The total number of enterprises in these clusters is 727. Employment in these clusters was almost three times higher in Greece and Hungary. In Germany, these clusters employ about 339,000, in Italy about 160,000, in Britain about 124,000 and in Switzerland about 66,000. As the most successful European country according to the number of enterprises, Italy has more than 22,000 enterprises in these clusters.

Table 6: Cluster strength in LS

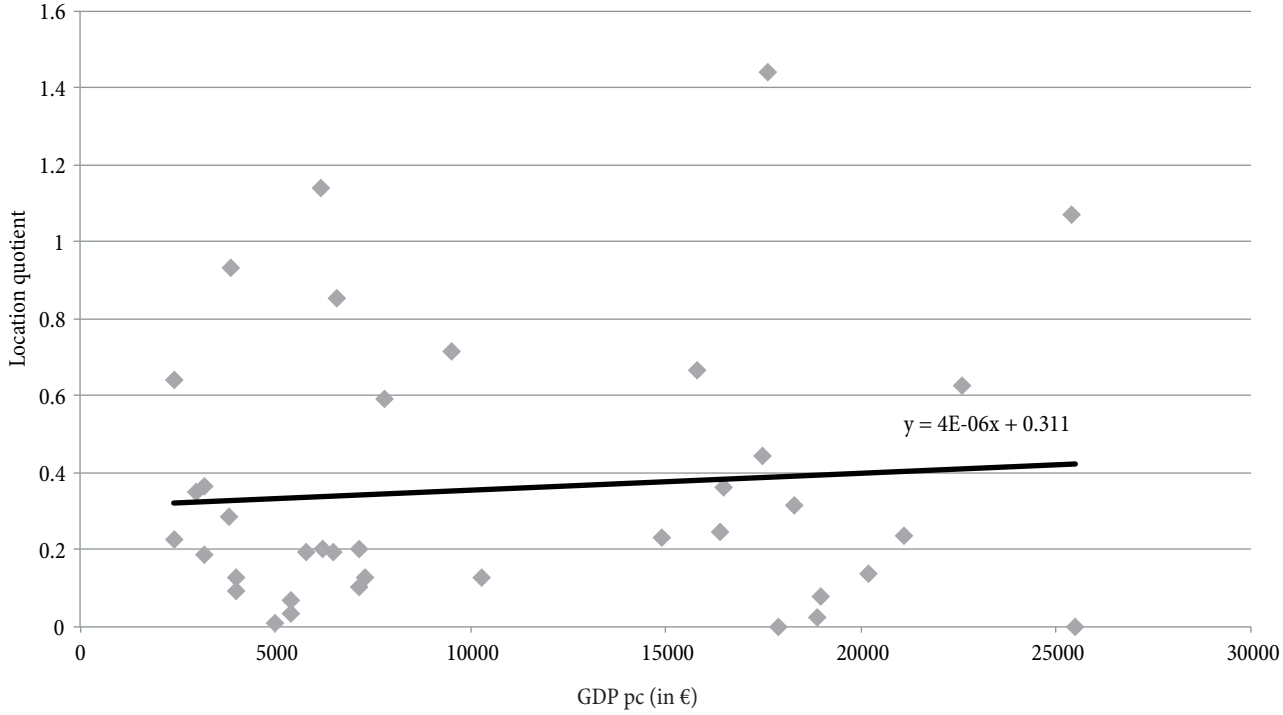
	Biotech	Medical devices	Pharmaceuticals
Kozep-Magyarorszag, Hungary	0	0	2
Kozep-Dunantul, Hungary	0	1	0
Eszak-Alfold, Hungary	0	0	1
Attiki, Greece	0	0	1

Source: Authors' calculation based on [6]

LS have become platforms with the great potential for a positive impact on many other industries. Apart from human and animal health, LS and biotechnology products also have a role in agriculture, aircraft industry, environmental improvement and information technologies. With such a great impact and an increase in global competition, LS have become an arena where many countries seek to realize innovations as their path to economic development [7, p. 3].

Figure 4 shows the relationship between regional specialization in LS and the level of economic development of the region, measured by GDPpc. We found a weak positive correlation (r = 0.09033) between location quotient of LS and the level of GDPpc. Major exceptions are regions in Serbia, Belgrade and Vojvodina, which, despite a higher level of specialization in the regions, lag behind other observed regions by the level of GDPpc. The highest concentrations in life sciences have regions around capital cities of Hungary, Serbia and Greece. Nevertheless, LS clusters in G5 are weak, compared with those in the developed EU countries.

Figure 4: Location quotient for LS and regional prosperity



Source: Authors' calculation based on [6]

Conclusion

We conducted a research to show how clusters, depending on their strength, affect the productivity of the region in which they are located. In attempt to determine the nature of these connections, we compared the strength of clusters per region in observed G5 with GDPpc level in 2011 (as previously explained, having in mind the research limitations due to insufficient data for more recent years as well as lacking optimal solution to be used as indicator of productivity). Removing current data limitations is crucial for future mapping of local and regional economies. These data represent inputs and powerful tools for developing regional development and innovation policies. Therefore, they should be expanded with the additional indicators, like regional exports, investments, innovation, patents, etc.

We calculated linear correlation coefficients to support the analysis and indicate validity of determined relationships. Based on the above-mentioned elements, we can draw the following conclusions from our research: despite the fact that observed G5 are ranked very low with respect to the state of cluster development, we determined the existence of strong cluster portfolio in the regions that are located mainly around the major cities. Moreover, there is high positive correlation between the regional specialization and productivity in the G5 regions. In addition, regions with strong KIS, CCI and LS clusters, as indicated in our analysis, are more developed than the ones that do not have dominant clusters in these segments. Our analysis indicated positive correlation between strength of clusters in these segments and regional productivity, measured by GDPpc. Considering the proven importance of strong clusters in regional economic development, our conclusion is that economic development policies should encourage development of strong clusters and stronger geographic specialization, and focus on increased productivity of those clusters that have an important regional position.

Knowledge-intensive services, creative industries and life sciences can play important role in boosting regional innovation and competitiveness. However, policy measures for strengthening these clusters should be carefully planned. These measures should be aimed solely at strengthening emerging and embryonic clusters, not at developing new ones.

The impact of clusters on productivity growth should be permanently monitored concurrently with methodology development. In further research, the authors will put forward expanded research domains and include other parameters in the analysis (such as the level of cluster development the NUTS3 level, the level of technological development of clusters, innovation, etc.)

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