

PATTERN OF EUROPEAN REGIONAL CREATIVITY: EXPLORING ENDOGENOUS SUSTAINABILITY

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ABSTRACT

During the latest decades, regional creativity has often been considered as the precondition for innovativeness and sustainability. However, quantitative indicators of creativity are the subject of discussion. The paper aims to analyse the patterns and causes of European regional creativity distribution, revealing the influence of endogenous determinants on regional innovative development. An empirical analysis of regional patenting activity and a selection of indicators of regional creativity is conducted. Among the indicators, we include the development of regional institutions that are assessed through the data of the European Quality of Government Index. Besides the learning ability of the region (indicators of higher education prevalence and digital skills), the abundance of the creative class, regional innovative infrastructure, and population agglomeration were taken into account. The paper concludes concerning the most crucial factors contributing to endogenous sustainability through the lenses of European regions. In general, the formed model turned out to be significant with an acceptable level of standard error and a high predictive value. The influence of most of the parameters (except for the intelligence) was positive and significant. It is especially worth highlighting the parameters of regional institutions' quality and volumes of private research and development expenditures, which exert the greatest positive influence on the resulting variable.

Keywords: *creativity, innovations, creative class, sustainable development, endogenous development, regional development, agglomeration*

1. INTRODUCTION

Starting from Florida's (2002) seminal work there were numerous attempts to expand and enhance the methodology of "creative class" definition and evaluation. Florida supposed that regions with concentrations of creative workers, including artists, designers, and professionals in technology and knowledge-based industries, tend to exhibit higher levels of economic growth and innovation. His research suggests that these creative individuals are attracted to places with diverse cultural amenities, tolerance, and a vibrant social scene. Such a hypothesis sparked an active discussion among researchers concerning its validity and relevance for European regions. There is evidence that creative industries could positively influence the pace of economic revitalization, increase property values, and enhance quality of life (Katlas et al, 2024). Other

papers indicate that creative agglomerations facilitate knowledge spillovers, collaboration, and innovation through face-to-face interactions and the exchange of ideas (Markusen & Schrock, 2006).

Typically, the researchers emphasized the sustainability and resilience of creative regions in the face of economic, social, and environmental challenges, as well as their ability to ensure long-term well-being (Pratt, 2008). In such a manner the accent is made on the endogenous nature of creative regions. Nevertheless, Hesmondhalgh (2007) explored the relationship between creative regions and globalization flows, concluding that globalization has led to the emergence of transnational creative networks, new market opportunities, and challenges related to cultural homogenization and intellectual property rights.

Current research continues the wide range of research papers dedicated to the analysis of European creative regions. Among others, we should mention the investigation of Słowagę & Boayardi (2014), which inspired us to reevaluate the parameters of regional creativity under the current conditions. Among the recent publications in the area, we should mention Lazzeretti, Oliva, et al. (2022) aiming to rethink culture and creativity in the period of digital transformation. Borseková, Vaňová, et al. (2021) propose the criteria matrix of creative actors' indicators and try to assess their impact on regional development in Slovakia.

2. LITERATURE REVIEW

In the research literature, different methodological approaches are used for identifying creative regions. Typically they involve a combination of quantitative and qualitative techniques. The pure quantitative analysis normally includes indicators to evaluate employment in creative occupations, patent filings, research and development spending, innovation indices, and cultural amenities. Cluster analysis involves grouping regions based on similarities in their creative industries, economic structures, innovation ecosystems, and cultural assets. However, the analysis could be made from the perspectives of the creative class parameters and concentration. Qualitative methods involve in-depth studies, interviews, surveys, and case studies to understand the dynamics of creativity within specific regions. This approach explores factors such as local culture, history, institutions, policies, networks, collaboration, and community engagement.

It should also be emphasized that today a certain mainstream among researchers has become the consideration of three manifestations of location creativity (entrepreneurship, innovation, and internationalization). All of them are largely determined by the above-mentioned parameters and are closely interconnected. Thus, empirical studies confirm the mutual influence of innovation and entrepreneurship (Gouvea et al., 2021; Roach et al, 2016; Wright et al, 2007) and internationalization (Ding et al, 2021; Papanastassiou et al, 2020; Lachenmaier & Wößmann, 2006) an increasing number of high-tech venture start-ups are international from the moment of creation (Gawel, 2021; Zahra, 2005).

Researchers quite actively analyze the issue of interstate and interregional institutional differences and their impact on regional creativity. For example, Hall & Soskais (2001) proposed the idea of comparative institutional advantages, arguing that different national institutional systems are acceptable for different types of economic activity. According to these scholars, coordinated market economies with significant government interventions better stimulate diversified high-quality production than liberal market economies, which are more favorable to competitive production on the principles of flexibility (and therefore the exploitation of economies of scale). Liberal institutions are revealed in high levels of labour mobility (including due to a relatively low level of protection against situational staff reductions), numerous corporate mergers and acquisitions, and a diversified structure of share capital, which is considered a

more suitable environment for generating radical innovations. A coordinated market environment is more suitable for an incremental type of innovation (gradual, but more thorough), which to some extent corresponds to the aspect of resistance of localities to the impulses of globalization. Alternative approaches to the role of regional institutes are presented in the papers of [Rodríguez-Pose \(2020\)](#) and [Audretsch \(2021\)](#).

The scope and quality of higher education play an important role in the development of innovative skills of personnel and conducting theoretical explorations, which in the future form the “building material” for the framework of enterprises in certain regions ([İlhan Ertuna & Gurel, 2011](#); [Clayman & Holbrook, 2003](#)) and conducting venture activities ([Venesaar et al, 2014](#)). In addition to higher education, the importance for innovative development is also shown through the measures of involvement in lifelong learning processes ([Rodríguez-Pose & Crescenzi, 2008](#)), and the state of development of the national and regional research environment, public administrations and universities ([Buesa et al., 2010](#)).

The role of universities in the development of “high-tech” regions has been repeatedly emphasized by researchers ([Lecocq et al., 2009](#); [O’Mara, 2015](#)), taking into account the aspects of the formation of the “triple helix” of science, business, and public power ([Gunasekara, 2006](#)) strengthening of ties with the private commercial sector ([German-Soto & Flores, 2013](#)), growth number of patents received by firms, the attraction of externally generated knowledge to the region ([Niosi & Bellon, 2002.](#)), etc.

Recent studies also indicate that creative sectors themselves are becoming important sources of economic activity ([Markusen & Schrock, 2006](#)) and facilitators of innovation ([Santoro et al, 2020](#)). However, the lines between the creative and traditional sectors are increasingly blurred. Thus, [Bakhshi H. & McVittie \(2009\)](#), comparing the innovative impact of firms in creative sectors with firms from other sectors, found that firms that spend more money on attracting creative resources are more innovative. [Potts \(2009\)](#) developed a model that details the role of creative sectors in an innovation trajectory consisting of three phases (emergence, adoption, and consolidation), during each of which creative sectors contribute to the further progress of the system.

We should highlight also that public spending on R&D is of key importance for the development of high-level technological infrastructure and the stimulation of cooperation within the “triple helix” ([Hinoul, 2005](#); [Argyriou, 2021](#)). It is also worth noting that the newly created infrastructure is increasingly associated with the emergence of science and technology parks ([Zhao, 2000](#)).

3. METHODOLOGY

One of the most important factors determining the region’s ability to generate new impulses of globalization (primarily based on the diffusion of innovations), as well as its resistance to such impulses and the formation of a system of localities, is the aspect of regional creativity. To analyze regional creativity, we will mainly use the methodological approach proposed by [Słowagę & Boayardi \(2014\)](#) taking into account the new conditions and statistical background. that identify four “i’s” of regional creativity (hereinafter referred to as the “4-I”): institutions, intelligence, inspiration, and infrastructure.

An important aspect of such a systemic approach is that the specified parameters are endogenous to the system (although they can be formed at the regional, national or supranational level), unlike, for example, the approaches based on the choice of location by firms (through FDI or another form of merger/acquisition), their types and numbers, ability to expand, which are generally exogenous parameters.

One of the basic drivers of regional creativity is the state of development of institutions (political, economic and social). In the context of the conducted analysis, we will rather understand the institutes as a certain environment of the functioning of the region, without considering the aspect of formal organizations. Thus, economic institutions include such aspects as the protection of property rights, the fulfilment of contractual obligations, compliance with laws and regulations regarding the implementation of economic transactions and the distribution of income. Political institutions provide restrictive instruments for the behavior of politicians and elites, determine the principles and incentives for the distribution of power. Social institutions (formal and informal) regulate the interaction between people in work and non-work environments.

To characterize regional institutions, we will use the values of the European Quality of Government Index (Charron et al., 2022) that is calculated within the traditional study by representatives of the University of Gothenburg for 2022 (data from 2021). The index is based on a survey of 129,000 respondents from 208 European regions. The investigation covered the assessment of levels of quality, accessibility and corruption in the areas of education, health care and law and order, as well as the “cleanliness” of the electoral process and the taxation system.

The second parameter of the creativity of the region according to L. Slovagen and P. Boayard (2014) is “Intelligence”, which is considered as the ability of the region to assimilate information, acquire and develop knowledge that solves a certain range of problems. In other words, in a broad sense, it is the learning ability of the region. In its essence, the “Intelligence” parameter we used is close to the “Talent” parameter in R. Florida’s (2002) flagship study on the formation of the creative class.

To analyze the parameter of regional intelligence, we will use a composite indicator that is arithmetic average of two components:

- the share of human resources with higher education and/or employed in the scientific and technical sphere in 2022 (“HRST” indicator of Eurostat);
- digital skills – an index within a broad framework of indicators proposed by the composers of the EU Regional Competitiveness Index 2.0 (2022 edition).

The third parameter of a creative region is “Inspiration”, which is perhaps the most “intangible” of the entire group and reflects the region’s ability to: promote the development and diffusion of new ideas, unique combinations of resources and non-traditional methods of work and lifestyles. In its essence, Inspiration is the embodiment of the characteristics characteristic of the creative class in the style of Florida (2002), that is, the desire for agglomeration with other representatives of the creative class and the avoidance of “working” districts. At the same time, researchers emphasize the significant role of creative individuals in the process of intersectoral spillovers (“spill-acrosses” as opposed to “spillovers”), that is, the interaction of artistic and traditional technological communities, and also point to the importance of artistic networks in spreading new knowledge ideas between firms and industries (Stolarick, Florida, 2006).

For the empirical assessment of the “Inspiration” parameter, we will use the aggregation of two indicators from the matrix of the EU Regional Competitiveness Index:

- the volume of the “core creative class employment”, which represents the share of the population that is considered to be a part of the core creative class according to the international standard classification of occupations;
- employment in technology and knowledge-intensive sectors (KIS).

The second indicator was added because the “core creative class employment” does not take into account technical personnel and managers in high-tech sectors.

The fourth parameter of the region's creativity is "Infrastructure" development. Various researchers include quite different characteristics in the "innovation infrastructure", in particular: all types of scientific institutions, pools of human capital, communication and transport networks, institutions of financial support, governments in general, etc. (Słowagę & Boayardi (2014)). In this form, the concept of "Infrastructure" is too extensive for empirical research and partially echoes the parameters of "Institutions" and "Intelligence" that we considered earlier. To avoid the overlap of categories, we adapt for the analysis the interpretation of the category as "technological infrastructure" as the aggregation of two indicators that are also the components of the EU Regional Competitiveness Index 2.0 (2022):

- the share of public expenditures on research and development in the structure of the region's GDP, a significant share of which is directed to universities, research laboratories and other entities of the innovation infrastructure (Yankovyi et al., 2022);
- the share of households with access to broadband Internet as a characteristic of the extent and quality of the communication network in the region;

In order to evaluate the values of the four parameters, the rate of each of the component sub-indicators was first normalized in the range from 0 to 1. Normalization was carried out according to the formula:

$$\text{Normalized value} = (\text{Indicator value} - \text{Minimum value}) / (\text{Maximum value} - \text{Minimum value})$$

after which the arithmetic mean was calculated values of sub-indicators.

In order to assess the impact of large urban centres on the creative potential of the region, we also introduced the parameter "Agglomeration", which denotes the relative size of the region in terms of population and covers the role of scale effect for innovative potential. The parameter values were also normalized to a range of 0–1.

To analyze the influence of the factors of the specified four groups of "4-I" parameters, we will use the recursive system of structural equations. Two indicators were selected as the resulting variables for assessing the impact of factors:

- regional private R&D expenditures;
- the number of registered patents in the region.

The first equation (1) will be used to analyze the influence of the parameters of creativity and polarized population agglomeration on the indicator of the share of private expenditures on R&D in the structure of regional GDP:

$$\begin{aligned} R\&D = \beta_{0R} + \beta_{1R} \text{ "Institutions" } + \beta_{2R} \text{ "Intelligence" } + \beta_{3R} \text{ "Inspiration" } + \\ &+ \beta_{4R} \text{ "Infrastructure" } + \beta_{5R} \text{ "Agglomeration" } + \varepsilon_R \end{aligned} \quad (1)$$

In equation (2), the R&D indicator is already used as a factor indicator, while the indicator of the number of patent applications submitted to the European Patent Office "PCT patent applications" was chosen as the resulting variable of innovative activities of the European Commission:

$$\begin{aligned} PAT = \beta_{0R} + \beta_{1R} \text{ "Institutions" } + \beta_{2R} \text{ "Intelligence" } + \beta_{3R} \text{ "Inspiration" } + \\ &+ \beta_{4R} \text{ "Infrastructure" } + \beta_{5R} \text{ "Agglomeration" } + \beta_{6P} R\&D + \varepsilon_R \end{aligned} \quad (2)$$

Delineating the impact of the "4-I" parameters on the volume of private R&D expenditures and the intensity of patent activity makes it possible to avoid some of the hidden effects typical of knowledge generation functions. The review and sources of the indicators used for the model elaboration are presented in Table 1.

Table 1. Components of 4-I indicators for the regional creativity model

Aggregate indicator	Component	Source
<i>Institutions</i>	Quality of Government in EU Regions, 3 rd edition	University of Gothenburg; European Commission, Directorate-General for Regional and Urban Policy
<i>Intelligence</i>	Human Resources in Science & Technology (HRST) by category and NUTS 2 regions	Eurostat/OECD
	Digital skills	EU Regional Competitiveness Index 2.0
<i>Inspiration</i>	Core creative class employment	EU Regional Competitiveness Index 2.0
	Employment in technology and knowledge-intensive sectors	EU Regional Competitiveness Index 2.0
<i>Infrastructure</i>	R&D expenditures public sector	EU Regional Competitiveness Index 2.0
	Households with broadband access (%)	EU Regional Competitiveness Index 2.0
<i>Agglomeration</i>	Population (regional level) (demopreg)	Eurostat. Population statistics at regional level
<i>R&D</i>	R&D expenditures business sector	EU Regional Competitiveness Index 2.0
<i>PAT</i>	PCT patent applications	EU Regional Competitiveness Index 2.0

Source: composed by authors based on the data of the matrix of the EU Regional Competitiveness Index, Eurostat, and Directorate-General for Regional and Urban Policy

The model is based on a sample of indicators of 223 regions of the EU states, mainly at the NUTS-2 level. Due to the lack of some statistical data, the sample did not include the regions of small states: Cyprus, Malta and Luxembourg.

4. RESULTS

Table 2 illustrates the correlation matrix between all sub-indicators and the synthetic parameters of creativity “4-I”. In general, the effect of most of the proposed 4s synthetic parameters on creativity and innovative activity is significantly greater than zero and exceeds the influence of individual sub-indicators (except “Intelligence” which is rather controversial). This may indicate the relevance of the proposed approach and the presence of a linear relationship between model parameters, and hence the feasibility of regression modeling.

The only exception is the “Population” parameter which doesn’t correlate notably with all selected indicators and sub-indicators. However, later we will see in regression models that population volume is among the significant parameters for regional creativity.

Analyzing the value of the correlation coefficients according to the proposed parameters of creativity, we emphasize the relatively greater importance of the parameters “Institutes” (especially for patent activity), “Inspiration” and “Infrastructure”.

Table 2. Correlation matrix between parameters of regional creativity and population agglomeration

	Institutions	HRST	Digital skills	Intelligence	Core creative class employment	Employment in technology and knowledge-intensive sectors	Inspiration	R&D expenditures public sector	Households with broadband access (%)	Infrastructure	Population	R&D expenditures business sector	PCT patent applications
Institutions													
HRST	0,61												
Digital skills	0,49	0,41											
Intelligence	0,65	0,83	0,85										
Core creative class employment	0,59	0,85	0,30	0,68									
Employment in technology and KIS	0,22	0,68	0,09	0,45	0,71								
Inspiration	0,44	0,83	0,21	0,61	0,92	0,93							
R&D expenditures public sector	0,36	0,44	0,21	0,38	0,49	0,31	0,43						
Households with broadband access (%)	0,39	0,48	0,57	0,63	0,41	0,31	0,39	0,03					
Infrastructure	0,52	0,64	0,54	0,70	0,63	0,43	0,57	0,74	0,69				
Population	-0,08	0,16	0,02	0,11	0,11	0,23	0,18	0,12	0,12	0,17			
R&D expenditures business sector	0,57	0,61	0,25	0,51	0,63	0,48	0,60	0,48	0,31	0,56	0,18		
PCT patent applications	0,75	0,53	0,30	0,49	0,59	0,33	0,50	0,49	0,24	0,51	0,17	0,78	

Source: own calculations based on the data of the matrix of the EU Regional Competitiveness Index, Eurostat, and Directorate-General for Regional and Urban Policy

The results of regression modeling of the influence of parameters of creativity and population agglomeration on the level of private expenditures on R&D are shown in Table 3 (column 1). In general, model (1) is significant with an acceptable level of standard error and an average predictive value (determination coefficient $R^2 = 0.517$). The influence of most parameters (except the “Intelligence” parameter) was positive, significant, and notably higher than zero. It is especially worth highlighting the “Inspiration” parameter, which exerts the greatest positive influence on the resulting variable. Conversely, the influence of the parameter “Infrastructure”, the value of which was strongly correlated with R&D, turned out to be not so intensive and statistically insignificant.

The influence of population agglomeration was positive and statistically significant, but not decisive. Although in general it is possible to talk about the presence of the effect of scale in creative and innovative activities.

Table 3. Results of the regression of regional creativity parameters according to models 1 and 2

Variable	R&D		PAT		PAT	
	(model 1)		(model 2)		(without R&D)	
	1		2		3	
	β	SE	β	SE	β	SE
R&D			0,575***	0,04		
Institutions	0.380***	0,06	0,622***	0,05	0,841***	0,06
Intelligence	-0,170*	0,09	-0,236***	0,08	-0,334***	0,09
Inspiration	0,462***	0,08	0,022	0,07	0,283***	0,08
Infrastructure	0,334	0,10	0,052	0,09	0,244**	0,10
Agglomeration	0,194**	0,08	0,252***	0,06	0,364***	0,08
Multiple R	0,719		0,877		0,806	
R Square	0,517		0,763		0,650	
Standard Error	0,156		0,125		0,154	
Observations	223		223		223	

Notes: *, **, *** – P-value is less than 0.1, 0.05, 0.01; SE – standard error.

Source: own calculations based on the data of the matrix of the EU Regional Competitiveness Index, Eurostat, and Directorate-General for Regional and Urban Policy

The results of calculating the β -coefficients of model (2) are given in column 2 of Table 3. Similarly to the previous one, model (2) is statistically significant with an acceptable level of statistical error and an even higher level of reliability ($R^2 = 0.763$). According to the simulation results, regional institutions and private spending on R&D are the most powerful factors in the generation of patent applications. Surprisingly, the impact of “Intelligence” is negative and significant, though the impact is not very high. Thus, the level of education and digital skills by themselves, do not have a positive impact on regional innovativeness. The role of the other two parameters of creativity turned out to be small and insignificant, so it can be assumed that the relationship of patent activity with the parameters, “Inspiration” and “Infrastructure” is traced through the intermediate channel of private R&D expenditures.

To check the degree of multicollinearity between the studied parameters, we used the variance inflationary factor (VIF) test, but the estimated values of the standard errors of the coefficients were not too high. The recursive principle of models (1) and (2) makes it possible to estimate the overall impact of the four parameters of creativity and agglomeration on patent activity without the mediation of indicators of private R&D expenditures. The results of the analysis are summarized in column 3 of the Table 3. Summarizing the above, we can conclude about the significant importance of the role of creativity parameters for the process of diffusion of innovations in the EU regions.

5. CONCLUSIONS

We can summarize that one of the most important factors that determines a region’s ability to generate new impulses of globalization (primarily through the diffusion of innovations) is the aspect of regional creativity. Regional creativity is typically considered as a key to endogenous sustainable development. It fuels solutions that are locally-driven and suited to specific environmental and cultural contexts. This approach empowers communities to leverage their existing knowledge and traditions, fostering innovation that’s sustainable in the long term.

To analyze regional creativity, we adjusted a methodological approach distinguishing four syn-

thetic parameters of regional creativity: institutions, intelligence, inspiration, and infrastructure. The impact of creativity parameters and population agglomeration on the indicator of the share of private R&D expenditures in the structure of regional GDP and the indicator of the number of patent applications filed to the European Patent Office was assessed. According to the modelling results, private R&D expenditures are among the most powerful factor in generating patent applications. The “Institutions” parameter (is assessed mainly via the indicator Quality of Government in EU Regions) is even more influential and statistically significant. While population agglomerations clearly boosted creative and innovative activities, their impact wasn’t the sole driver. The evidence suggests economies of scale are present, but other factors likely play a significant role.

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