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INCREASING DIVERGENCE OF PATENT ACTIVITY IN CERTAIN EUROPEAN REGIONS - SPACE-TIME ANALYSIS

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Abstract: The article attempts to analyse the impact of changes taking place within patent activity at the regional level. The study included regional data (NUTS1) for the years 2000-2012 from EUROSTAT. The space-time models used an error correction construction with fixed effects was proposed in research. Analysis of data at the regional level pointed to existing and deepening divergence. Countries but also some regions that have reached high ranks of innovation in the past, are leaving the other countries and regions behind. On the other hand weaker regions are not able to compete with the stronger ones. Research shows, that regions of Germany, Austria, France, the Netherlands, Luxembourg will be far ahead of the most of European countries in terms of innovation in the coming years. Coefficients obtained for Croatia, Cyprus, Lithuania and Malta, indicate a "waste" of expenditures under decidedly unfavourable development of innovation.

Key words: innovation activity, patents, regional analysis.

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Introduction

Main determinants indicated in the analysis of patent activity (Acs and Audretsch, 1989), often synonymous with innovation activity (Zaytsev et al., 2021), are usually financial outflows (in different terms) and the human factor (Furman et al., 2000). International comparisons are burdened with certain errors. Of course, it is difficult to avoid them when assessment of the economy is carried out at the state level. This is associated not only with existing rules and principles, but often with possible easy comparisons resulting from a certain generalization and collection of data in accordance with general guidelines - for example Eurostat. In the end, funds collected and distributed at the level of the European Union are based on schemes for entire countries (Sipa et al., 2016). Meanwhile, if possible, analysis of region may have much greater value (Niklewicz-Pijaczyńska, 2014). It should be remembered that countries (usually the larger ones) with an extensive administrative division (if natural) are characterized by different levels of development of individual regions in many areas of economy (Feldman and Kogler, 2010; Iammarino, Rodríguez-Pose and Storper, 2019). Therefore, due to averaging, data from the entire country may contain errors. The strongest regions overstate the average, the weak ones understate it. The results may have positive but also negative repercussions. On the one hand, the state (mistakenly) judged to be well developed,

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can be regarded as a better location for certain investments, on the other hand, due to its good indicators, it may lose the right for support from the EU institutions, and as a result less affluent regions may suffer.

The question of convergence, or even more postulating convergence is worth mentioning here (Górna et al., 2014). In the author's opinion postulating a similar way to achieve economic growth in different areas is not appropriate. Of course, we can expect (want) regions of the country to evolve in a similar - appropriately fast - pace. However, demands placed on similar paths and ways of development seem to be fundamentally misguided. The current situation of individual regions or countries is the result of a past accumulation of a variety of factors, not only economic but also cultural, social and administrative, independently of geographical locations and climatic conditions (Buesa et al., 2010). Such factors very often determine the development of these regions. Policy makers using the knowledge available to them today - also economic knowledge - may attempt to use these determinants to influence the development of regions in order to improve their attractiveness, competitiveness, and quality of life (Asheim et al., 2017). Of course you can use, or even require the latest techniques and technologies. Some of them allow to improve quality of life in a given area to an unavailable before level, due to lack of access to certain products or services (Evangelista et al., 2018.). On the other hand, opening market, to an increasing extent free of trade barriers, becomes a certain risk (Ermasova, 2016). The development of technology has led to unprecedented levels of labour mobility and the increase of market transparency postulated by classics. Universal access to information in a natural way, but often also intentional, alters societal behaviours with regards to the way of life and consumption. In light of these facts, it seems reasonable to attempt to identify some relations and attempt a comparative analysis at regional level of innovative activities treated by many as some of the main determinants of economic growth (Antonelli, 2009).

Patent activity and their determinants

Discussion on the legitimacy of the use of patent data (especially for the reported patents) seems to be well founded, but arguments for this approach have been presented in the literature (Acs et al., 2002; Dang and Motohashi, 2015, Andrijauskiene, Dumciuviene, and Stundziene, 2021). Overall, reporting activity itself is a picture of a kind of creativity in the field of new solutions (PCT mode in which it was approved gives credence to their quality). The granting of a patent is an administrative decision and its implementation is both a strategic and a business move (Griliches, 1990). Patents, even the best ones, may not reach the production phase because of the owner's/company's policy (Frietsch et al., 2010a). Sometimes, due to business reasons, the implementation of various patented solutions is postponed to a later date and sometimes owning a patent is regarded as a quality mark (Hottenrott et al., 2016). This can either be a result of a planned strategy, an unfavourable situation on the market, or a simultaneous appearance of other, not necessarily better but more common, and simpler solutions. The question of the place of application (and thus data acquisition) remains. In this case, due to spatial locations of surveyed administrative units, the competent office is the European Patent Office (Frietsch et al., 2010b). It is worth noting that this institution on the one hand is working closely with the United States Patent and Trademark Office (USPTO), on the other hand, is more "permeable" although not perfect, than its American counterpart (Kica and Groenendijk, 2011), for which the range of patenting in some cases, has nothing to do with novelty, intellectual contribution or real usability.

Finance is mentioned among main determinants of innovation (Shuba and Sotskyi, 2019). This includes funds directed to research, development, innovation, implementation, etc. From the point of view of this study, due to a kind of preliminary phase (pending patent) funds involved in creation of patents on research and concept stage are taken into account. They can be identified with those invested in R&D sector (Ostraszewska and Tylec, 2019). Any portion of these funds used "improperly" is in the author's opinion, offset by funds not included in records and used by innovative system in other ways. On the other hand, patents are applied not only by research units, but also enterprises and individuals (Wiśniewska and Janasz, 2018), which are entities that often do not provide information on the size of previous investments in development of new solutions. It seems to be natural that in this approach the source of funding is not important, what matters is the level of used funds. However, given the desire to carry out comparative analyses the comparison i.e. of the reference variables used in the study presents certain problems. Commonly used population does not seem to be too accurate, because a lot of these people are somehow excluded from the system, they are children - which are often the catalyst but not a creator, or an elderly people with whom, of course, part of it is still active, but most participate in the innovation process only on the demand side. In the author's opinion the above argument is well justified, therefore the number of economically active people (Eurostat data 15-64, population aged) is suggested as the correct reference variable. This is not an ideal solution, since due to different labor laws in force in individual countries, the retirement age, for example, ranges from 62 to 67 in Slovakia, Poland, and Denmark. Assuming, however, that the age range for which the data are available, is the population range most active in terms of R&D, it is possible to continue research with this information. In this study we have taken into account another reference variable, which is the number of people employed in the R&D sector. To a large extent these individuals are involved in innovative activities and receive funds transferred to the sector. It is a stronger specification of variable subject to a very large share of described sector in activities, which resulted in patents with a very large commitment of funds for this purpose.

The second determinant, considered to be crucial in creation of any business is the human factor (Hauser at al. 2018). From the point of view of the analysed innovation activity, employees of R&D and also research and human resources for science and technology are usually taken into account (Pater and Lewandowska, 2014). The latter are understood as a collection of people with a third degree education and/or people representing professions requiring higher education (Valinurova et al., 2022), as well

as employees who have completed their university degrees in the field of science and technology and work in these fields (Markowska, 2014). The last of these categories is considered more and more often because of both its demand and supply-side approach. Researchers in practice are seen as providers of innovation, and human resources for science and technology, next to the creative potential involve also possibility of absorption potential (Kowalik, 2008). This absorption is not less important especially in terms of demand factors. In turn, the demand determines the possibilities of payback for research and development and adaptation of innovations for utility purposes. Even the best solutions must find fertile - respectively competitively prepared – ground, so their utility values were appreciated and used. The study, therefore, takes into account two approaches, one purely from the point of view of the supply - if the process takes into account filed patents, we assume that they are the results of scientific research undertaken within the R&D sector and the second supply-demand, where human resources for science and techniques were used as a determinant of patent activity. In both cases with respect to the number of economically active people.
The aim of the study was to identify - with the use of econometric tools - the existing differences between the level of patent activity of the regions of the European Union. The models - taking into account the set of variables described in various terms - were to confirm / contradict the assumptions of a similar innovation policy of European regions raised in the literature.

Methodology

Data from the EUROSTAT database have been used in this study. In primary terms the database contains information on all NUTS 2 EU regions (276). Because of some missing data, the number of regions actually used in the study consisted of 185 units. The lack of data is related mainly to regions of which territorial range (or their appearance, as in the case of Denmark) has changed in recent years, making it impossible to conduct comparative analysis with the use of time series for all variables with a length of 13 years (2000-2012). At the time of the publication, Eurostat has not published more recent data on research.
Despite the general guidelines adopted for the study, it cannot be clearly stated that areas with the largest investments in R&D and employment in this sector will achieve the best results. The situation is much more complicated. Information on the R&D activities expenditures does not contain details. There is no information on whether the money has been spent on building of hard infrastructure (buildings) purchase of equipment or what quality it was, whether the funds were passed on salaries, bonuses, license fees etc. Therefore, it can be assumed that the general added effect should be the result of this expenditure (Torrecillas et al., 2017) while the time of its implementation - occurrence and intensity, duration continuity and strength of the impulse may be different. Similar questions are related to employment in the R&D sector. A situation in which employees do not fully use their knowledge in the workplace is possible, or there is over-employment. Use of human resources

in science and technology which can be more often noticed is another approach, more general, but enables to eliminate such errors. People which are included even if they are not involved in the creation, unintentionally represent potential of creating a critical mass responsible for absorption of innovation. The conclusions were based on econometric studies. The models used an error correction construction with fixed effects. An estimate was made for a balanced space-time trial was proposed.

Model concept

Before estimation, time series properties of the following variables were tested:
PAT – number of patent applications filed by residents in terms of one thousand labour force,
GLF – gross expenditures on R&D activity in terms of one thousand labour force,
GPR – gross expenditures on R&D activity in terms of one thousand personnel R&D,
RLF - number of researchers in R&D sector in terms of thousand labour force,
HLF - Human resources in science and technology in terms of one thousand labour force.

The tables below present the results of a few unit root tests (Choi and Bhum Suk 1995), which indicate the existence of unit root.

Table 1. The results of unit root tests

Variable	Estimator: Method:	levels I~(0)		first difference I~(1)	
		Statistic	Prob.*	Statistic	Prob.*
PAT	Levin, Lin & Chu t*	11.175	1.000	-7.928	0.000
	Im, Pesaran and Shin W-stat	6.293	1.000	-1.616	0.053
	ADF - Fisher Chi-square	275.224	1.000	522.858	0.000
	PP - Fisher Chi-square	378.027	0.376	996.613	0.000
GLF	Levin, Lin & Chu t*	-5.819	0.000	-31.526	0.000
	Im, Pesaran and Shin W-stat	4.192	1.000	-8.390	0.000
	ADF - Fisher Chi-square	330.184	0.933	711.547	0.000
	PP - Fisher Chi-square	298.643	0.997	830.108	0.000
GPR	Levin, Lin & Chu t*	-18.444	0.000	-41.195	0.000
	Im, Pesaran and Shin W-stat	-5.366	0.000	-11.696	0.000
	ADF - Fisher Chi-square	598.666	0.000	830.841	0.000
	PP - Fisher Chi-square	597.313	0.000	981.448	0.000
HLF	Levin, Lin & Chu t*	-7.059	0.000	-14.835	0.000
	Im, Pesaran and Shin W-stat	3.569	1.000	-8.293	0.000
	ADF - Fisher Chi-square	311.795	0.987	675.349	0.000

	PP - Fisher Chi-square	582.609	0.000	1 613.630	0.000
RLF	Levin, Lin & Chu t*	-6.907	0.000	-49.844	0.000
	Im, Pesaran and Shin W-stat	4.241	1.000	-10.717	0.000
	ADF - Fisher Chi-square	307.312	0.992	719.940	0.000
	PP - Fisher Chi-square	330.158	0.933	1 027.420	0.000
* Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.					

All variables (excluding GPR) are integrated on order 1, ~ I (1). Next, we attempted to test the existence of cointegration in the assumed system, i.e. equation with PET as dependent variable and GLF, GPR, RLF, HLF as independent variables.

Table 2. The results of cointegration test for Pedroni residuals in the models

Model type	*GLF RLF*		*GLF HLF*		*GPR RLF*		*GPR HLF*	
Test type	Alternative hypothesis: common AR coefficients (within-dimension)							
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	12,283	0,000	13,936	0,000	14,182	0,000	16,374	0,000
Panel rho-Statistic	3,203	0,999	3,252	0,999	3,898	1,000	5,879	1,000
Panel PP-Statistic	5,031	1,000	-2,974	0,002	7,706	1,000	8,890	1,000
Panel ADF-statistic	-5,773	0,000	-5,616	0,000	-6,118	0,000	-0,260	0,397
Test type	Alternative hypothesis: individual AR coefficients (between-dimension)							
Group rho-Statistic	9.098	1.000	8.056	1.000	9.177	1.000	7.969	1.000
Group PP-Statistic	-10.090	0.000	-11.059	0.000	-10.662	0.000	-11.913	0.000
Group ADF-Statistic	-9.152	0.000	-5.148	0.000	-7.565	0.000	-4.706	0.000

The results based on "ADF" tests and Group PP, recognized as being more powerful than "panel" tests when conducting a research on smaller samples (Pedroni 1995), indicate the existence of cointegration. In connection with potential doubts (due to the results of other tests) concerning the existence of cointegrating relations, the error correction models were proposed. Such solution is often used in cases of uncertainty as to the existence of a uniform row of integrating. Its additional advantage is the fact that it takes into account both short- and long-term relationships.
One of the objectives of the study was the selection of a pair of variables, which would describe tested innovative activity in the best possible way. Using available variables four space-time models (see: Baltagi, 2009) of general form have been developed:

$$\Delta \log PAT_{it} = \alpha^{*}_{i1} + (\alpha_1 - 1)(\log PAT_{it-1} - \delta_1 \log GERD_{it-1} - \delta_2 \log RECH_{it-1}) + \beta_1 \Delta \log GERD_{it} + \beta_2 \Delta \log RECH_{it} + \varepsilon_{it}$$

where:
PAT_{it} – number of patent applications filed by residents in terms of one thousand labour force in a given period t for a given region i,
$GERD_{it}$ – gross expenditures on R&D activity in a given period t for i-th region in terms of:
- one thousand labour force (*GLF*);
- one thousand personnel R&D (*GPR*),
$RECH_{it}$ - number of researchers in R&D sector in terms of thousand labour force in a given period t for i-th region (*RLF*) or Human Resources in Science And Technology in terms of one thousand labour force (*HLF*).

Results and Discussion

In accordance with the accepted assumptions the estimated model (with the full decomposition of intercept) has showed dependence for logarithms of variables (Szajt, 2006).

Table 3. The values of structural parameter assessments in estimated models

Model type: Variable	Parameter	*GLF RLF*		*GLF HLF*		*GPR RLF*		*GPR HLF*	
constant	α_0	0.347	<0.001	3.651	0,1134	0,483	0,002	34,638	<0,001
PAT_{-1}	α_1-1	0.225	<0.001	0.276	<0,0001	0,227	<0,001	0,231	<0,001
Δ *HLF*	β_1			-1.013	0,0014			-1,141	<0,001
HLF_{-1}	δ_1			-0.982	<0,0001			-1,178	<0,001
Δ *GLF*	β_2	0.411	0.001	0.267	0,0415				

GLF_{-1}	δ_2	0.440	<0.001	0.119	0,109				
Δ GPR	β_3					0,284	0,034	0,437	0,001
GPR_{-1}	δ_3					0,449	<0,001	0,667	<0,001
Δ RLF	β_4	-0.690	<0.001			-0,405	0,008		
RLF_{-1}	δ_4	-0.859	<0.001			-0,484	<0,001		
Within R^2		0,350		0.325		0.348		0.346	
LSDV R^2		0,377		0.353		0.375		0.373	
LSDV $F_{(189, 1475)}$		4,717		4.256		4.689		4.652	
p – value (F)		0,000		0.000		0.000		0.000	
r_{ho1}		-0,022		-0.033		-0.020		-0.025	

Obtained results, particularly the assessment of structural parameters, only apparently seem to be surprising. Minus signs which appear, do not show negative impact of human resources on innovation activity. Interpretation assumptions should be remembered. With "zero" expenditure on R&D, employment growth will result in a decrease in patent activity. First, an application, like research, is associated with certain expenditures. Assumption of their absence is purely theoretical. Second issue is the negative patent activity. In this study we accept, that we are dealing with some level of patent activity at the regional level. With the right approach, we can assume that the negative patent activity is, in fact, associated with the use of research implemented in one region in the application submitted by the other region. The transfer of knowledge which we experienced for instance in the '80s in Poland, where many graduates emigrated abroad, can be treated as unauthorized (illegal, caused by economic reasons). Today, the role of technology and knowledge transfer as the main source of growth is being raised (Simmie, 2003; Androniceanu et al., 2021). Currently, migration for work purposes, for self-realization, career development, etc. is still very common (Groutsis et al., 2015), however there are no records of costs (although some attempts are being made in that direction) and associated profits. In simple terms, one can say that in the absence of activity on the innovation expenditures front, employment growth in R&D sector will decrease the efficiency (which is logical) and certainly worsen the competitive situation of this area in comparison to others (Teslenko, Melnikov and Bazin, 2021).
As for the impact of financial resources on patent activity, it is stronger in the long term, as expected. The difference between short and long-term elasticity is not large, but it must be remembered that in the case of the former, we deal with point, incidental impact, and in the case of the latter, the impact is often spread over many years, and the resulting parameter is only an approximation of the size of the effect only from that direction. In fact, the provision of funding for R&D is the catalyst for

the multitude of processes which also indirectly stimulate the development of innovation.

The main task of the model developed in the course of the estimation, was to identify the differences/similarities among the level of patent activity in the regions -which is not surprising (Škrinjarić, 2020). The very functioning in the region may not have an impact on the innovativeness for example of the university (Acosta, Coronado and Ángeles Martínez, 2012), but at the same time it may affect the innovativeness of other units, and thus the entire system (Corradini and De Propris, 2015). While the parameters of the model, which stand by the variables that identify main determinants should be treated as universal, due to decomposition of the intercept in space we obtain activity indicators for each region. These precisely defined individual elements indicate differences in results, which are not included in the model of individual regional circumstances to change of the level of patent activity. If generally accepted determinants are relatively similar in their impact, other - individual characteristics - determine the current level of activity.

Because of the multiplicative nature of obtained intercepts, their power of impact is perceived as an indicator strengthening or weakening the effect of the main determinants of innovation.

Table 4. Number of innovation indicators (weakening, neutral, strengthening) estimated in model for the surveyed countries

Country	number of regions in sample	min	weakening	neutral	strengthening	max
Germany	35	0,44	3	14	18	3,24
Austria	9	0,49	1	3	5	2,64
France	21	0,49	12	6	3	1,93
Netherlands	14	0,34	6	6	2	2,79
Spain	17	0,06	12	4	1	17,57
Italy	18	0,10	13	5	0	1,00
Belgium	1	1,00	0	1	0	1,00
Luxembourg	1	1,00	0	1	0	1,00
Poland	16	0,05	16	0	0	0,38
Greece	9	0,07	9	0	0	0,27
Romania	8	0,02	8	0	0	0,22
Czech Rep.	8	0,09	8	0	0	0,52
Hungary	7	0,13	7	0	0	0,61
Portugal	5	0,10	5	0	0	0,26
Bulgaria	4	0,08	4	0	0	0,22

Slovakia	4	0,10	4	0	0	0,63
Ireland	2	0,62	2	0	0	0,69
Croatia	1	0,13	1	0	0	0,13
Lietuva	1	0,15	1	0	0	0,15
Kypros	1	0,16	1	0	0	0,16
Malta	1	0,19	1	0	0	0,19
Latvija	1	0,27	1	0	0	0,27
Eesti	1	0,36	1	0	0	0,36

Even in the case of Germany perceived as a state characterized by a very strong level of innovation, there are areas with worse conditions for its development. The hypothetical lack of cooperation between regions - or its ineffective results - is no surprise (Broekel et al., 2015). In the region of Trier innovation index is 0.77 and in Mecklenburg-Vorpommern and Saxony-Anhalt it does not exceed 0.50. In this case, we can even talk about the divergence in relation to the majority (18) of other regions. This also applies to "neutral" regions because among the strongest innovation rate exceeds 2 for four and 3 for three consecutive regions. For the 18 out of the 23 surveyed countries there were no indicated regions of strengthening impact of conditions for innovation. In Spain, the region with the highest (the only one) strengthening index - Comunidad de Madrid – it is a value incomparably superior to all others in Europe - 17.57. A colossal accumulation of patent applications in the capital city can be assumed and it could be perceived as a centralization of science at the expense of other regions, of which as many as 12 have a weakening impact on innovation.

In general, assuming further development on a diagnosed level, regions of Germany, Austria, France, the Netherlands, Luxembourg and possibly also Belgium (too small a representation) will be far ahead of the rest of Europe in terms of innovation in the coming years (excluding Denmark, Finland, Sweden, Great Britain and Slovenia, which were not taken into account). Coefficients obtained for Croatia, Cyprus, Lithuania and Malta, not exceeding 0.20, indicate a "waste" of expenditures under decidedly unfavorable development of innovation. In the other countries admitted to the Union after the year 2000, the situation is not much better, which is also confirmed by other regional studies (Lewandowska, Švihlíková, 2020). The highest rate of innovation has been noted in Slovak region Bratislavský kraj and is only 0.63. Given the wealth of these countries, a result close to the "old EU" - that is, de facto catching up - is actually impossible in the existing conditions. In practice, these conclusions are part of the discussion on the use of outlays (especially financial ones) for innovative activities in the countries admitted to the European Union in 2004 and later (Prokop, Kotkova Striteska and Stejskal, 2021; Androniceanu, 2020).

Conclusions

The results received in the course of the research clearly indicate a need to coordinate expenditures on R&D in relation to human resources involved in this activity. It can be assumed that certain mechanisms that regulate this kind of relationship operate in many enterprises. Unfortunately, in many economic systems, R&D sector is financed largely by the government institutions, and therefore its economic efficiency is not monitored. Inadequate capital in relation to employment can cause adverse (even pathological) circumstances, affecting the competitiveness of the economy overall.

The analysis of data at the regional level pointed to an existing and deepening divergence. Countries but also regions that have reached high ranks of innovation in the past, move away from the other ones. On the other hand weaker regions are not able to establish a competitive struggle with stronger. While at the country level we can assume that there is some kind of division of tasks between different regions, which shapes their involvement in specific sectors of the economy (not necessarily innovative), at the state level such division presents a problem. Mono-industry economy is not a good option for any country, because it is too exposed to potential turbulence within this particular specialization.

Proposals presented in the Lisbon Strategy have not been put into practice yet by the European countries. The dynamic economic development in terms of global turmoil associated with financial crisis of 2008-2009 and the current political turmoil (eg. embargo to Russia) does not help in normalization of the European economy. Therefore, a change in assumptions should be considered. They should be adjusted to a turbulent economy, which is an environment of innovative systems of individual countries and the EU as a whole.

Taking into account the structure of financing R&D activities in the countries - leaders and the effectiveness of systems financed in this way, changes are proposed in the remaining ones. It is necessary - through all kinds of organizational, fiscal and financial incentives - to transform innovative systems towards financing R&D activities (especially in the field of applied research and development) by the industry. At the same time, it is not allowed to reduce the level (not share) of R&D funding by the state, and these funds should be directed to research with a slower translation into direct profits (basic research).

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ROSNĄCA DYWERGENCJA AKTYWNOŚCI PATENTOWEJ W WYBRANYCH REGIONACH EUROPY – ANALIZA PRZESTRZENNO-CZASOWA

Abstrakt: W artykule podjęto próbę analizy wpływu zmian zachodzących w obrębie aktywności patentowej na poziomie regionów. Badanie obejmowało dane regionalne (NUTS1) za lata 2000-2012 pozyskane z bazy EUROSTAT. W badaniu zaproponowano model przestrzenno-czasowy z efektami stałymi, zawierający konstrukcję korekty błędem. Analiza danych na poziomie regionalnym wskazała na istniejącą i pogłębiającą się dywergencję. Państwa, ale także niektóre regiony, które osiągnęły wysokie stopnie innowacyjności w przeszłości, pozostawiają inne kraje i regiony w tyle. Z drugiej strony słabsze regiony nie są w stanie konkurować z silniejszymi. Badania pokazują, że regiony Niemiec, Austrii, Francji, Holandii, Luksemburga będą w najbliższych latach znacznie wyprzedzać większość krajów europejskich pod względem innowacyjności. Współczynniki uzyskane dla Chorwacji, Cypru, Litwy i Malty wskazują na "marnotrawstwo" wydatków w ramach zdecydowanie niezadowalającego rozwoju innowacyjności.

Słowa kluczowe: aktywność innowacyjna, patenty, analizy regionalne

某些欧洲地区专利活动的差异越来越大——时空分析

摘要：本文试图分析区域层面专利活动中发生的变化的影响。该研究包括 EUROSTAT 2000-2012 年的区域数据 (NUTS1)。研究中提出了使用具有固定效应的纠错结构的时空模型。区域层面的数据分析表明，分歧存在且正在加深。国家以及一些过去曾达到高创新水平的地区，正在将其他国家和地区甩在后面。另一方面，较弱的地区无法与较强的地区竞争。研究表明，未来几年，德国、奥地利、法国、荷兰、卢森堡等地区在创新方面将遥遥领先于大多数欧洲国家。克罗地亚、塞浦路斯、立陶宛和马耳他的系数表明，在创新发展明显不利的情况下，支出是“浪费”。

关键词：创新活动，专利，区域分析