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European Capital Cities and Their Surroundings – Innovativeness Convergence or Divergence?

Abstract

The study presents an attempt to answer the question of whether the closest surroundings of European capital cities are becoming as innovative as the capital cities themselves. The value of an aggregate index of innovation was defined for the EU NUTS 2 level regions based on eight characteristics.

Against the background of changes occurring in the values of the Innovation Index in the European regional space, the study assesses the effects of capital cities on their closest surroundings in the context of trends observed in terms of innovation. The analysis covered countries in which the capital city is at the same time the NUTS 2 level region. It also discusses the variables determining the differences in the Innovation Index values between capital cities and the areas that surround them.

Keywords: EU capital cities, surroundings, innovativeness, convergence, NUTS 2.

1. Introduction

The importance of innovativeness for economic development constitutes an important reason to investigate the sources, factors and determinants of facilitating the creation of innovation and its dissemination. The problems of innovativeness analysed in their territorial context were the research area conducted in relation to companies, their clusters, cities, regions, countries and also in a global

perspective. Innovativeness constitutes the basis for the construction of the power that is ingrained in cities and metropolises, and enhanced by the leading role of cities in the development of science and techniques and also in creating inventions and innovation.

The problems involved in convergence processes, including convergence in terms of innovativeness, are an area of interest investigated by researchers in analyses related to international, national and regional comparisons, as well as their assessments of cities and the relationship they have with their surroundings.

The objective of the present study is to assess the pace of changes in the level of innovativeness with reference to selected EU capital cities as compared to their "surroundings". The paper also seeks to determine if the areas most closely surrounding capital cities are keeping pace with capital cities in terms of innovation.

2. A City and Its Surroundings

Cities constitute poles of growth by attracting investment and creating the most modern workplaces. They are the centres of change and initiate innovative projects. They also play an important role for economic competitiveness on the global market. At the same time, however, they play host to diverse social problems such as social exclusion, spatial and ethnic segregation, and unemployment. The development of a metropolis is associated with the formation of ecological problems such as the pollution of industrial areas, noise, and urban sprawl beyond the administrative borders. The importance of cities for the development of the EU is manifested by the conditions of territorial cohesion as complementary to economic and social cohesion. Achieving such cohesion represents an enormous challenge since it refers, on the one hand, to the reconciliation of dynamic economic growth in cities along with the mobilisation of developmental processes covering entire regions (Pięta-Kanurska 2010).

Large cities, as Gaczek (2010b) emphasises, can be responsible for the advantage resulting from internal resources, while in the global economy they can facilitate interregional cooperation. In the course of analysing the significance of a metropolis, the answer is sought to the questions of whether, and if so, why a metropolis serves as the springboard for innovative and modernisation processes in a region, and whether after the phase of growth impulses wash out from the surrounding areas, it is possible for a metropolis to undergo a phase in which it positively impacts a regional economy. A crucial component of such research is the identification of conditions for the emergence of positive effects resulting from growth in a metropolis' surroundings.

Along with the development of the global economy, the dynamic development of large cities performing international functions is observed. Metropolises take over both the leading and managerial functions and become the vital centres of the global economy (Taylor 2007).

Researchers offer numerous theoretical concepts which help explain both the process of a city's growth and the influence it has on the surrounding region (Hołowiecka 2004). They emphasise, among other things, the socio-economic and spatial effects that accompany the development of metropolises, placing particular emphasis on metropolitan processes occurring in space, and which are crucial to the functioning of the contemporary global economy[1].

Tying city and regional growth to an innovation paradigm seems an indispensable component for maintaining competitive advantage, requires specific knowledge that absorbs the economic structure, an absorbent market for new technologies and an innovative environment. The system of innovation is a supporting factor which facilitates the creation and implementation of innovation. Intellectual capital generated by the leading scientific and research entities and universities networking with industry is indispensable. These networks stimulate the transfer of technology and the implementation of modern technologies in the economy. The leading entities locate mainly in the metropolitan centre of a region or an agglomeration, where there is sufficient demand for knowledge-intensive services and knowledge as such (Gaczek 2010a).

3. Convergence – Theoretical Concepts and Empirical Studies

Convergence (lat. *convergere* – coming together) is a process which in economy results in the disappearance of inequalities in a group of entities that initially has a diversified level of development. These differences, from an economic perspective, can include the conditions and quality of life, costs and prices, the level of unemployment, income, employment and work performance, innovation.

The regulation of the Council of Europe (Proposal… 2004) defines economic convergence as the process of reducing differences between the countries of the European Union as well as the assimilation of socio-economic structures.

Convergence is defined in economics as the process of economies converging towards a state of balance; this is also referred to as β-convergence. Two types of β-convergence are distinguished: Absolute β-convergence assumes that economies aim at the same state of balance while relative β-convergence follows the assumption that economies converge towards their own balance states. Still another

[1] See Myrdal (1957), Friedmann (1966), Jałowiecki (2000), Smętkowski (2001, 2010), Domański (2008), Pięta-Kanurska (2010), Gaczek (2010a).

approach highlights σ-convergence, where the dispersion of economic phenomena in a given time and for a given group of countries or regions are analysed.

The following types of convergence can be named: beta convergence (which can be understood as eqalising economic levels and faster growth of economies of lower initial leve;es of variables such as GDP per capita, prices, costs, exchange rates etc.), sigma convergence (decreasing diversification of variable values among regions or countries), and gamma diversification (improving object position in wealth ranking) (Wolszczak-Derlacz 2007).

The research on convergence applies diverse empirical strategies (Markowska & Strahl 2012) including sector-based, time series analysis-based, and panel data--based ones, as well as approaches that combine the three.

Also possible is a "descriptive" approach, which often distinguishes the convergence of issues, interests, solutions and convergent business models (Bulloch, Lacy & Jurgens 2011).

The research on convergence is mainly carried out at three spatial levels: international (national, global), regional and local. In recent years a lot of research on convergence in its diverse aspects has been conducted at the level of European regions (Quah 1996, Fischer & Stribock 2006).

Numerous issues are also present in domestic research – referring to different levels of territorial division, such as NUTS 1, NUTS 2 or even cities.

Convergence analyses refer to many aspects of economy, and are conducted using diverse methods while spatial units at different levels are selected as research objects. The interesting ones are those related to a city as a research object, while assessment refers to innovation or similar problems.

We would do well to examine research done by Kliber (2007), who analysed problems of regional disproportions in Poland in terms of such wealth growth factors in regions as capital and technical advancement. Bal-Domańska (2011) analysed sigma and beta conditional convergence in the classes of regions at NUTS 2 level of the European Union countries in the context of innovation. Markowska and Strahl (2012) did research in order to assess sigma convergence processes in the groups of regions distinguished, first, with reference to the EU integration process covering the group of EU-15 countries and the group of 2004 EU accession countries and, second, by distinguishing homogenous groups of regions in terms of tendencies characterising measures of regional innovation indicators. Hussler (2004) discussed the problems of innovation and convergence in the context of provisions in EU policies.

4. Innovativeness in the Territorial Context – Theories and Empirical Studies

For many years innovativeness has been a popular research field in many scientific areas, starting with technology, economics and political science. Apart from macro scale research examining, among other things, innovative countries whose competitiveness has led to economic growth, numerous studies are carried out on entrepreneurial behaviours and attitudes in terms of innovation. In theory the diversity of innovative effects is mainly studied at the level of the organisation; however, the urban context is more and more often taken into consideration (Berliant & Fujita 2009). The spatial configuration of innovation is a research area of regional economics and geography (Nijkamp & Reggiani 2000).

In his book *The Economy of Cities*, Jacobs (1969) defines innovation as the process by which new work is added to old divisions of labour, thus creating new products, processes, or ideas, and therefore also new divisions of labour. Feldman (2000, p. 373) adds that "innovation is the novel application of economically valuable knowledge". Bunnell and Coe (2001) analyse "spaces of innovation" and indicate relations and interdependencies across spatial scales. Bathelt, Malmberg and Maskell in 2004 wrote that "innovation and new knowledge is best understood as a combination of local and global interactions" (Bathelt, Malmberg & Maskell 2004, p. 40). Glaeser (2000, p. 83) observes cities as the centers for creating and transferring ideas: "cities will grow when they are producing new ideas or when their role as intellectual centers is increasing". Innovation occurs when individuals with high degrees of existing creativity or knowledge make new and novel combinations of this knowledge with new insights observed or learned through spillovers (Knudsen *at al*. 2007).

Innovation is a vital factor responsible for the long-term economic growth of a country, and is also an important objective of policy intervention (Romer 1990, Schumpeter 1962). Cities and urban areas, by virtue of their economic diversity, facilitate innovation activities (Duranton & Puga 2001). More and more evidence suggests that, in fact, culturally diversified cities are more innovative, take more extensive advantage of international knowledge relations and diverse decision-making, and are able to attract more innovative people (Hunt 2008).

The location of innovation in its geographical sense has been, for many years, a subject of interest for scientists. One of the approaches related to inventions in the US takes us 150 years back (Feller 1971), while others are based on much more current data (Breschi 1997). Cooke (2006) discusses the role of space analysed in terms of growth and the significance of spatial specialisation and diversification of urban areas with reference to innovation. Boschma (2005) presented a theoretical

analysis of the relationship between innovation capacity and different aspects of proximity.

Research on innovation in cities has been carried out for many years (Florida 2004, *Eurocities…* 2010) and is mainly focused on analyses resulting in assessments referring to such aspects as:

– city innovation and competitiveness (Simmie & Wood 2002);

– city size vs. innovation (Orlando & Verba 2005);

– population density vs. innovation (Knudsen *at al*. 2007) covering the density of "creative capital";

– innovation levels referring to a city or a group of cities such as e.g. Amsterdam, London, Milan, Paris and Stuttgart (Capello 2001b) or Barcelona, Stockholm, Vienna (Fischer, Revilla Diez & Snickars 2001). Nijkamp and Reggiani (2000) also discussed this phenomenon;

– diversification, specialisation and location (*Innovation…* 1999, Nathan & Lee 2011);

– factors and sources of innovation such as knowledge-intensive services (Capello, Caragliu & Lenzi 2012), and patents and R&D activities (Jaffe & Trajtenberg 2002).

Innovation is now recognised as the key to constructing metropolitan power and also as its determinant. Metropolises, the traditional birthplaces of innovation, represent an absorptive sales market for innovative products. They have innovation potential at their disposal, which creates civilisation in a political, cultural, economic, technical and social respect. The unique nature of these places draw large numbers of people who bring in their creative potential. Such diversification implies better quality of services, institutions and technical facilities, which allow for the remaining centres of social and economic life to be "overtaken" (Drabińska 2012).

Metropolises today concentrate both research and innovative activities, endowing them with great importance to economic growth and development. Their concentration in metropolises is also growing along with the knowledge-based economy and high-tech development (Asheim & Gertler 2006). The Fifth Report on Economic, Social and Territorial Cohesion (*European…* 2010) informs us that, in 2007, 60% of the EU population resided in metropolitan areas, and produced 68% of the Community's GDP.

The size and compactness of urban centres, their population density and human interactions open up opportunities for the increased flow of information. This is another reason cities create innovation. The leading role cities play in the development of science and techniques and the creation of inventions and innovation (intellectual and material, cultural and political, institutional and organisational) has been documented by researchers including historians, town-planners, geo-

graphers, anthropologists and regional economists (Mumford 1968, Mokyr 2002, *Innovation…* 1999, Spufford 2003, Algaze 2005).

Research on the type of innovation and its geographical context emphasises the spatial concentration of innovative activities which result from the nature of innovative processes. Looking at the process of innovation presented by Dosi (1988), Feldman (1994) points out five stylised facts:

– the uncertainty of the innovation process,
– the reliance on advances in scientific knowledge,
– the complexity of the innovation process,
– the importance of learning-by-doing and learning-by-using, and
– the cumulativeness of innovative activity.

In his discussion of the creation of innovation, Capello (2001a) lists two approaches:

– the first refers to economists dealing with the economics of industry who define the determinants of innovation, especially in knowledge acquisition, and seek to test whether the processes of knowledge acquisition are facilitated by spatial proximity and sectorial specialisation;

– the second originates from regional economists, who try to envisage the role of spatial effects like synergies, cooperation, and collective learning in the innovation activities developed at the local level.

Both approaches towards gaining knowledge seek to explain whether differences in learning are influenced by the characteristics of the area in which this process occurs, i.e. whether specialised or diversified knowledge spillovers are more effective. The conclusion offers far-reaching results: because if gaining knowledge is facilitated by the diversified urban environment, then the following statement is true: "since innovation becomes increasingly based on scientific and technological knowledge combined with creativity, only cities, and especially large cities, where these new resources are disproportionately concentrated will be able to compete successfully in the global economy" (Capello 2001a). This would complement the idea that cities represent "innovation islands" (*Innovative…* 2001). However, if expert knowledge guarantees intense innovation activities, then a city, where sectorial spillovers take place, does not have to offer the best location.

The role of cities as human capital integration centres, as well as incubators for inventions, is emphasised in the "new" theory of economic growth, which assumes that knowledge transfer among natural persons and businesses is fundamental for such growth (Romer 1986, Lucas 1988). Glaeser (1996) points to the fact that the idea of growth dependence on innovation results in recognising both the social and economic role of urban centres in the promotion of intellectual cross-fertilisation. In this case none of the additional incentives are necessary since the creation and concentration of knowledge in towns enhances their attractiveness and therefore

attracts educated, well-qualified, entrepreneurial and creative individuals. This subsequently results in the occurrence of further knowledge flows (Feldman & Florida 1994, Glaeser 1999, Florida 2004). The process in the course of which knowledge enhances growth and development, which in turn attracts new knowledge functions, is the "engine" that maintains growth by creating innovation. We would therefore do well to enquire about the incentives and obstacles for inventiveness and innovativeness. The measurement underlying explanation of the relationship between the characteristics of a town and innovation constitutes the problem. It has to be emphasised that some knowledge flows can be documented, such as patented inventions (Jaffe & Trajtenberg 2002).

5. Research Method and Results

The capital cities – Berlin, Brussels, Lisbon, London, Madrid, Prague, Stockholm, Vienna – were chosen for the study for the following reasons. My objective was to assess whether convergence in innovation occurs in the surroundings and in the country capitals analysed as comparable groups. These capitals were selected for the study which, following the criterion of resources excluding Eurostat databases and domestic statistical offices in terms of innovation, simultaneously constitute a statistical unit at the NUTS 2 level. While sources such as Urban Audit offer extensive data on capitals, only some data is useful in the assessment of innovation. Urban Audit does not offer data about the cities' surroundings, and the time range is highly limited (in many cases mid-term values of a few years are quoted). The resources of domestic offices are much richer. Unfortunately, data on a par with that available for cities are not available for the surrounding territories. An additional challenge for the analysis was handling innovation convergence, which requires dynamic data.

Another reason these particular capital cities were chosen was that each is surrounded by an area that directly borders them, and belongs to the same country. Prague (marked by the symbol CZ01) is surrounded by the Střední Cechy (CZ02) region, while the area around Brussels (BE10) is the region of Prov. Vlaams Brabant (BE24). The list of capital cities and their surroundings is presented in Table 1.

The sets of information used to assess the innovation at the national and regional (NUTS 2) levels in the research referring to the EU territories have been evolving for years. The analyses and expertise prepared for the European Commission usually use highly delayed data, while gaps in the data result in reports that cover only slightly more than 70% of the EU area and rarely cover longer time spans. The list of applied variables I present results from a compromise between

the desire to conduct an analysis for as many regions as possible (constituting a comparative group for calculations) based on data whose completeness is relatively high (where there were gaps in the data, it was possible to complete them), and to introduce variables for which data could be obtained for a relatively small number of regions.

Table 1. Capital Cities and Their Surroundings – The Study's Objects

Capital City	Surroundings
Région de Bruxelles-Capitale	Prov. Vlaams Brabant
Prague	Střední Čechy
Berlin[a]	1) Brandenburg – Nordost, 2) Brandenburg – Südwest
Comunidad de Madrid	1) Castilla y León, 2) Castilla-la Mancha
Vienna	Niederösterreich
Lisbon	1) Centro, 2) Alentejo
Stockholm	Östra Mellansverige
Inner London Outer London	1) Bedfordshire, Hertfordshire, 2) Berkshire, Bucks and Oxfordshire, 3) Surrey, East and West Sussex, 4) Essex, 5) Kent

[a] due to the system of presented data the change in nomenclature used by Eurostat (*Regions…* 2011) from 2011 was not taken into account, following which both regions surrounding Berlin were combined.

Source: the author's compilation.

The integration of the *Regional Innovation Scoreboard* proposal and other research approaches with database resources allows the following characteristics to be gathered (Markowska 2012):

– share of the tertiary education graduates among workforce to the total workforce number in a region (EDUC),

– share of the population aged 25–64 participating in life-long learning in a region (LLL),

– workforce employed in knowledge-intensive services as a percentage of the workforce (KIS),

– workforce employed in knowledge-intensive services as a share of the workforce employed in services (KIS 2),

– human resources in science and technology, i.e. the total number of population actually employed in science and technology-intensive professions in relation to the professionally active population (HRST),

– workforce in high- and mid-tech industry (as a percentage of the total workforce) (HIT),

– the number of patents registered in a given year in the European Patent Office per 1 million of workforce (EPO),

– share of the workforce in high- and mid-tech industry to the total number of workforce employed in industry (HIT2).

The study's timeframe was adopted for the following reasons: 1) the beginning of the period is a year from which Eurostat provides statistical data for the majority of the variables analysed; 2) data on the workforce in knowledge-intensive services and the workforce in high- and mid-tech industry after 2008, due to changes in NACE classification, are not comparable at the regional level because of the need to perform the indispensable calculations.

The initial stage of research was the construction of an innovation aggregate indicator based on the seven characteristics listed above. They were made comparable by transforming them to a [0,1] range, subtracting from the observed value the minimum one for a particular characteristic in the entire studied period (1999–2008) in the set of almost all NUTS 2 level regions following the division of 2008 (265 from 271 regions[2] – i.e. 97.8%) and next dividing by the range also calculated for the entire area. All of the characteristics represent stimulants whose high values confirm a high level of innovation.

The procedure applied for making data comparable is referred to as global unitarisation. Accepting reference points as minimum and maximum values from the entire period made it possible to carry out the subsequent analysis of the dynamics. Considering, simultaneously, all NUTS 2 level regions in the unitarisation process facilitated referencing the innovation dynamics of capital cities and their surroundings to an overall EU context. The value of the aggregate Innovation Index was calculated as an arithmetic mean of the characteristics after unitarisation with equal weights assigned to all characteristics. The scale coefficient used for the analysis equals 100.

The developmental tendencies using the innovation indicators for the selected capital cities and their surrounding regions were analysed in the first stage. If the capital city was adjacent to more than one region, then one common trend function was estimated for its surroundings. Because the period under consideration covered 10 years only, only linear trend functions were used. Their parameters were estimated by Ordinary Least Squares method. The significance of the slope was tested using the significance test for the trend parameter. These simple methods enabled the following analyses to be performed (the results may be found in Table 2):

– comparison of the baseline situation in the studied capital cities by comparing trend intercepts,

[2] Due to a lack of data, the study does not cover four French overseas regions (Guadeloupe, Martinique, Guyane, Réunion) and two Spanish ones (Ciudad Autónoma de Ceuta and Ciudad Autónoma de Melilla).

– objective (by means of statistical testing) statement in which capitals and in which surroundings the significant innovation changes occurred in the course of the studied period,

– analysing relations between the baseline innovation level in a capital city and its surroundings distance to it – this approach offered the possibility of assessing the difference in the initial moment of the analysis and, at the same time, an opportunity for the certain assessment of effects resulting from long-term changes,

– comparing the rate of innovation level changes in capital cities and their surroundings by comparing (calculating the difference) the slopes. This allowed for the convergence processes (divergence) in the period under consideration to be identified.

Table 2. Trend Parameters

Capital City	Capital City			Surroundings			Slope difference
	Intercept	Slope	*p*	Intercept	Slope	*p*	
Brussels	45.84	0.24	0.1832	33.99	0.39	0.0040	–0.15
Prague	37.19	0.65	0.0018	24.10	0.80	0.0007	–0.15
Berlin	45.23	0.81	0.0000	31.79	0.57	0.0072	0.24
Madrid	36.58	0.55	0.0005	19.63	0.88	0.0240	–0.33
Vienna	36.51	0.89	0.0017	24.24	1.15	0.0016	–0.26
Lisbon	23.44	0.62	0.0000	9.68	0.76	0.0000	–0.14
Stockholm	62.91	–0.54	0.0943	53.66	–0.01	0.9449	–0.53
London	50.03	0.34	0.0000	48.44	–0.02	0.9360	0.36

Source: the author's calculations.

The intercept makes it possible to assess the starting point. This can be done using a group of capitals and by comparing the performance of capital cities against their surroundings. Among the capitals, Stockholm was distinguished by an excellent baseline. It is a bit surprising to find Vienna grouped with Prague, Madrid and Lisbon, which initially were characterised by a relatively low level of innovation. The *p* value refers to the slope and indicates the significance of innovation changes in time. In this case stability was observed for Brussels, while a surprising drop was recorded in Stockholm (significant at the level of 0.10). In the remaining capitals the Innovation Index was seen to increase significantly. Vienna and Berlin were the definite leaders in pace of improvement.

In terms of a comparison of the capital city baseline level, a certain regularity was observed. The lower the city capital innovation level, the more the city differed from its surroundings. Hence it may be concluded that the higher the innovation level in the capital, the relatively less it stands out from its surround-

ings. Fig. 1 shows the correlation diagramme, with the coordinates X – trend intercept, Y – capital city trend intercept ratio versus its surroundings trend intercept. A significant negative correlation is observed between the baseline capital city level and its advantage over the surroundings. The linear correlation coefficient is –0,8667 ($p = 0.0053$).

The last column of Table 2 gives the differences in slopes of capital cities and their surroundings. A negative difference means that convergence was observed and the level of innovation in its surroundings was growing faster than in the capital (in the case of Stockholm and its surroundings, it did not decrease, while the Swedish capital itself experienced worsening innovation). The opposite relationship held only for Berlin and London. It seems that these conclusions do not counteract the situation presented in Fig. 1 – since it illustrates a certain initial moment of the analysis in which the position of particular capitals and their relations with their surroundings resulted from long-term historical, political, economic and administrative processes.

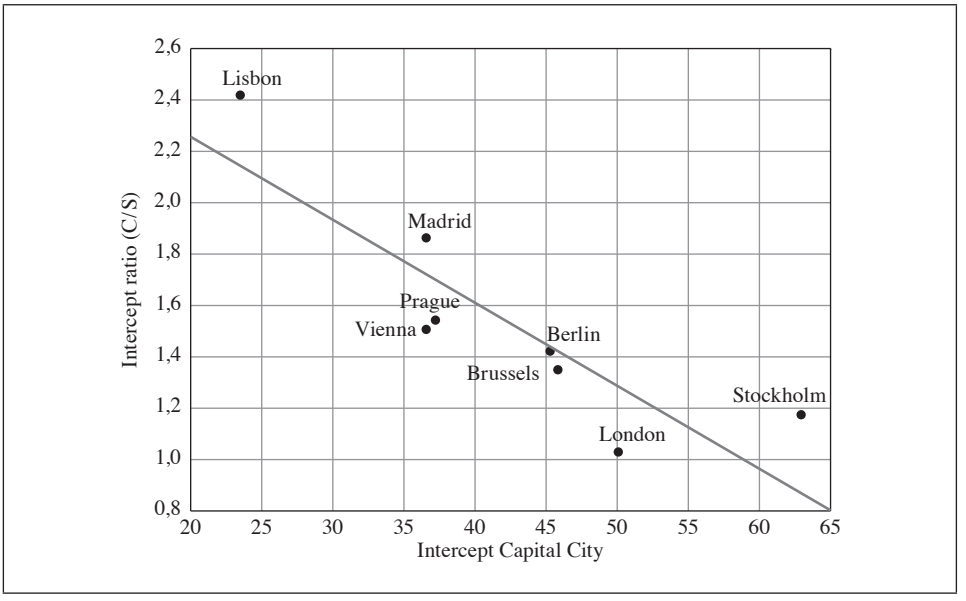

Fig. 1. Correlation Diagramme: Intercept Capital City versus Ratio Intercept Capital City / Intercept Surroundings

Source: the author's calculations.

Though the constructed trends covered a relatively short time, convergence in innovation occurred for the majority of the capitals and their surrounding areas. The following diagrammes (Fig. 2–9) illustrate trends in the Innovation Index

for capital cities and their surrounding areas, which is a positive feature of the described relations. One common trend was always calculated for the surroundings. While some effects of convergence are hard to notice, the trend lines seem parallel even despite the difference in slopes.

A separate comment is needed to address London's situation. Here the trend referring to surroundings has to be approached carefully. Essex and Kent are so distant in their innovation levels from the other counties surrounding London that they require a separate trend to be specified for them (one would, of course, prefer to stick to the methodology common for all countries – calculating a common trend for the surrounding regions regardless of their homogeneity level). The next stage focuses on an assessment of the impact of particular variables on the difference in the aggregated Innovation Indexes between capital cities and their surroundings.

To do so, a linear regression model was applied. Because the analysed variables, de facto, create (after certain transformations) this index, if the difference in a given year between the indicator for a capital city and the indicator for its surrounding region is the dependent variable, then the selection of variables for the model by applying backward stepwise-regression should have been performed separately for capital variables and the surrounding variables. Thus the null value of matrix determinant in the ordinary least squares method was avoided. Initially, the variables selected following this method were combined in a joint model. Also, a time variable was added, eliminating the general innovation increase effect in the European Union regardless of the occurrence of convergence effect. Again the procedure of stepwise-regression was applied and the final model, in which all structural parameters accompanying explanatory variables were statistically significant, was found. Because the explanatory variables are expressed in different units their impact can be evaluated by comparing the assessments of standardised regression coefficients (see Table 3).

Coefficients referring to capital cities (CC) are positive since the higher values of these variables increase the differences in the level of innovation between the capital and its surroundings. In this case the KIS variables (workforce employed in knowledge-intensive services as the percentage of workforce) and LLL (share of population aged 25–64 participating in life-long learning in a region) are of the greatest significance. The former is also the most important one from the perspective of its surroundings. Its improvement allows the difference of surroundings to the capital city to be reduced the fastest. The signs of regression coefficients for the variables characterising the environment are negative since the increase in these variables' values results in smaller differences. It may be said that KIS (workforce employed in knowledge-intensive services as the percentage of workforce) is the

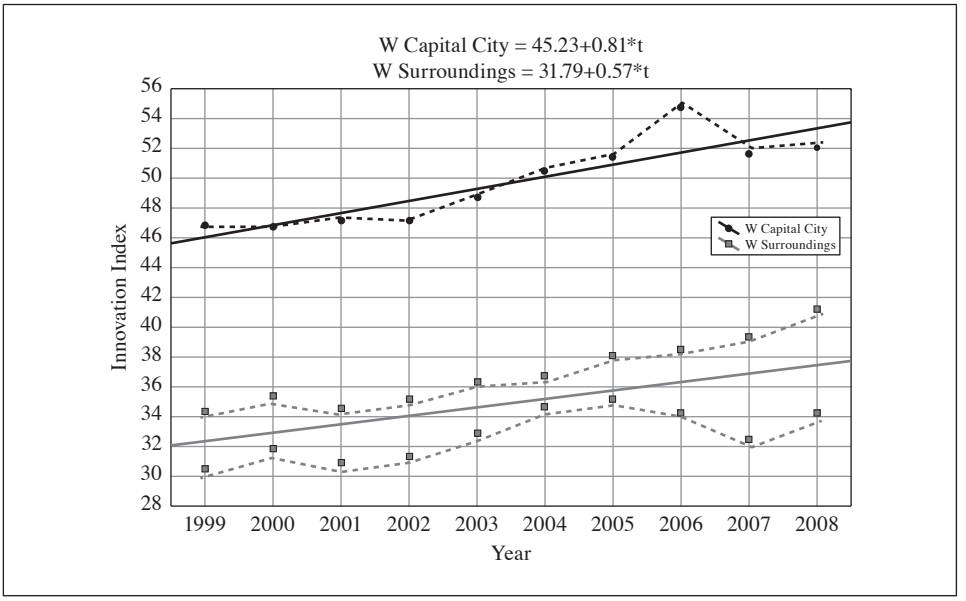

Fig. 2. Trends in Innovation Indexes for Berlin and Its Surroundings
Source: the author's compilation.

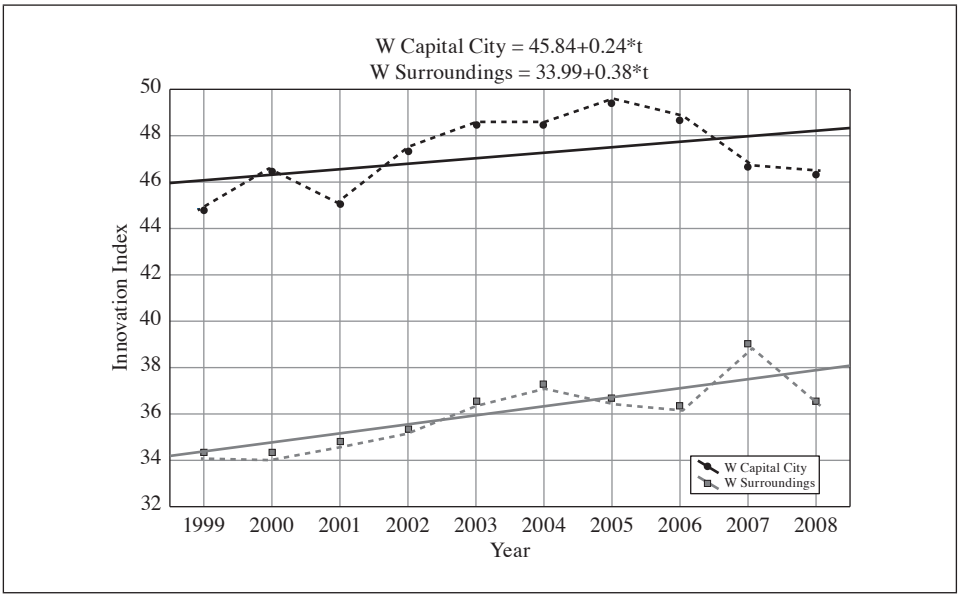

Fig. 3. Trends in Innovation Indexes for Brussels and Its Surroundings
Source: the author's compilation.

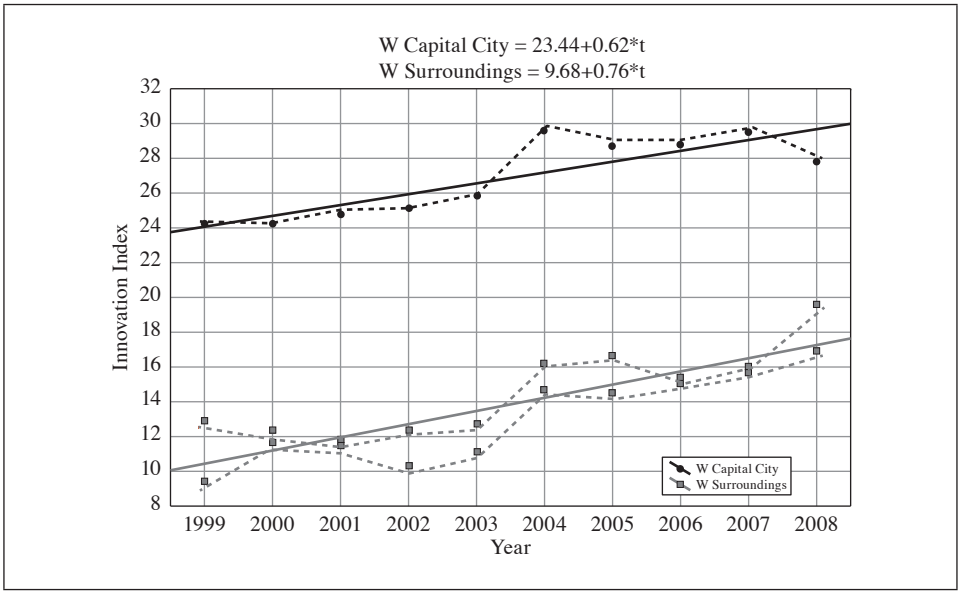

Fig. 4. Trends in Innovation Indexes for Lisbon and Its Surroundings
Source: the author's compilation.

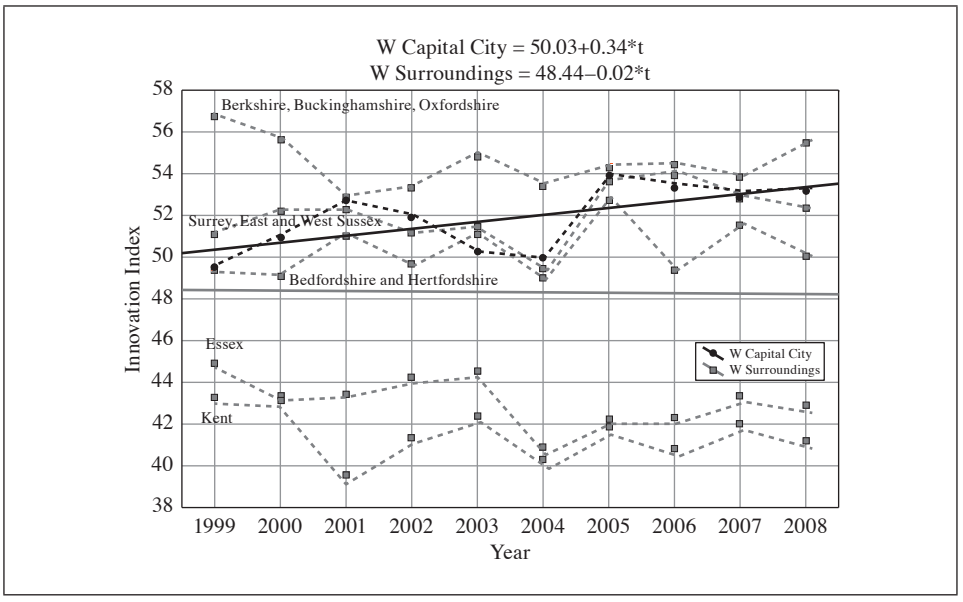

Fig. 5. Trends in Innovation Indexes for London and Its Surroundings
Source: the author's compilation.

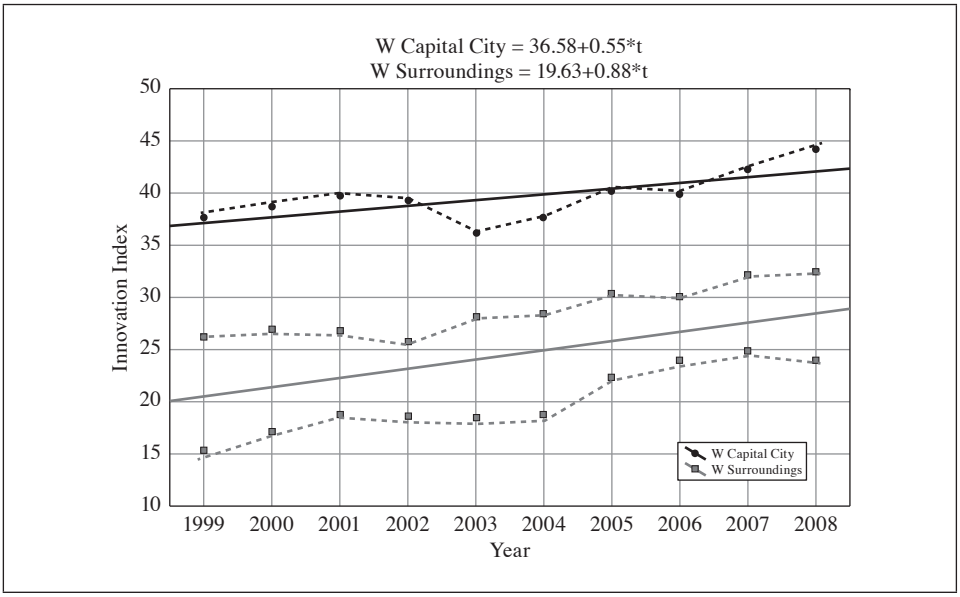

Fig. 6. Trends in Innovation Indexes for Madrid and Its Surroundings
Source: the author's compilation.

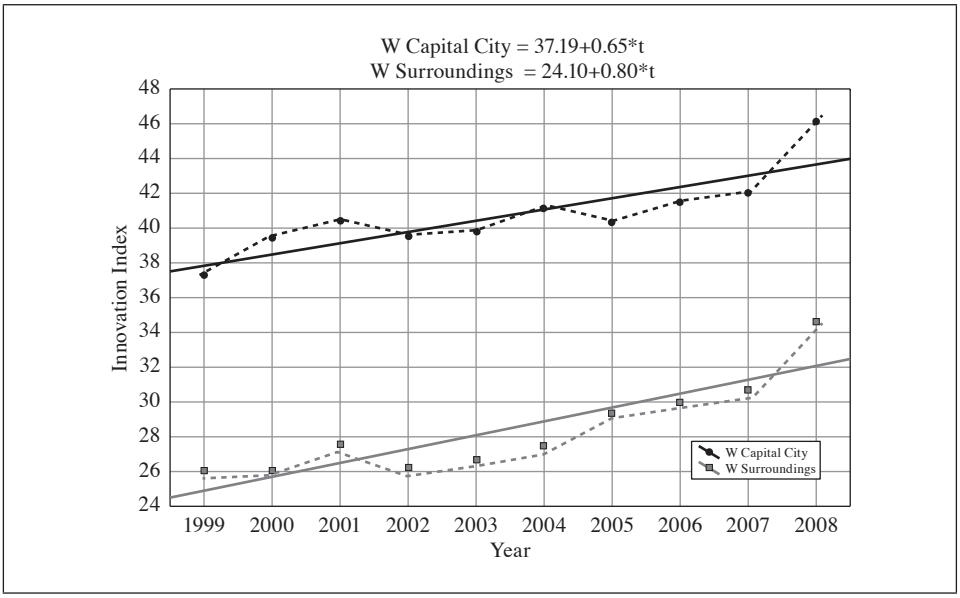

Fig. 7. Trends in Innovation Indexes for Prague and Its Surroundings
Source: the author's compilation.

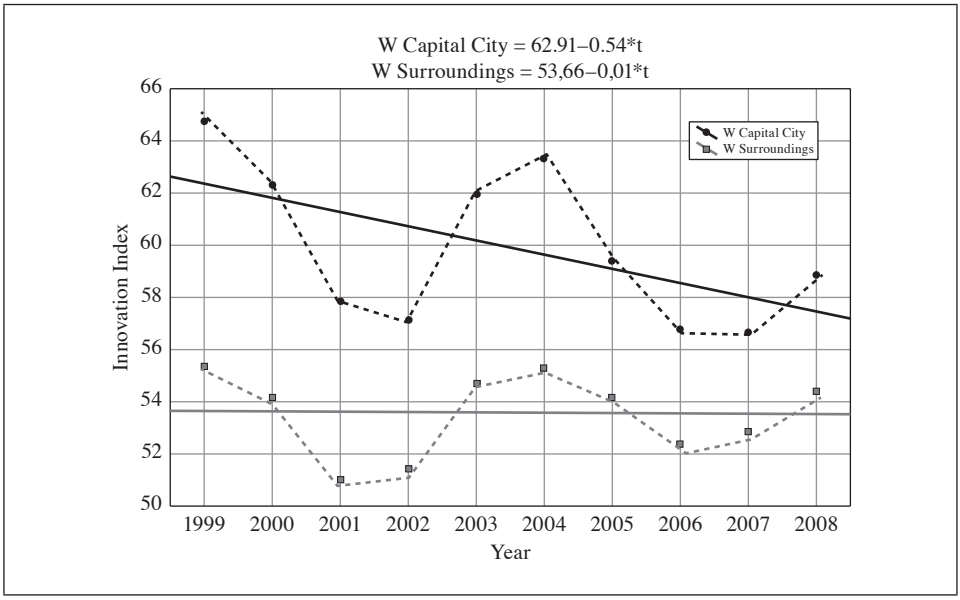

Fig. 8. Trends in Innovation Indexes for Stockholm and Its Surroundings
Source: the author's compilation.

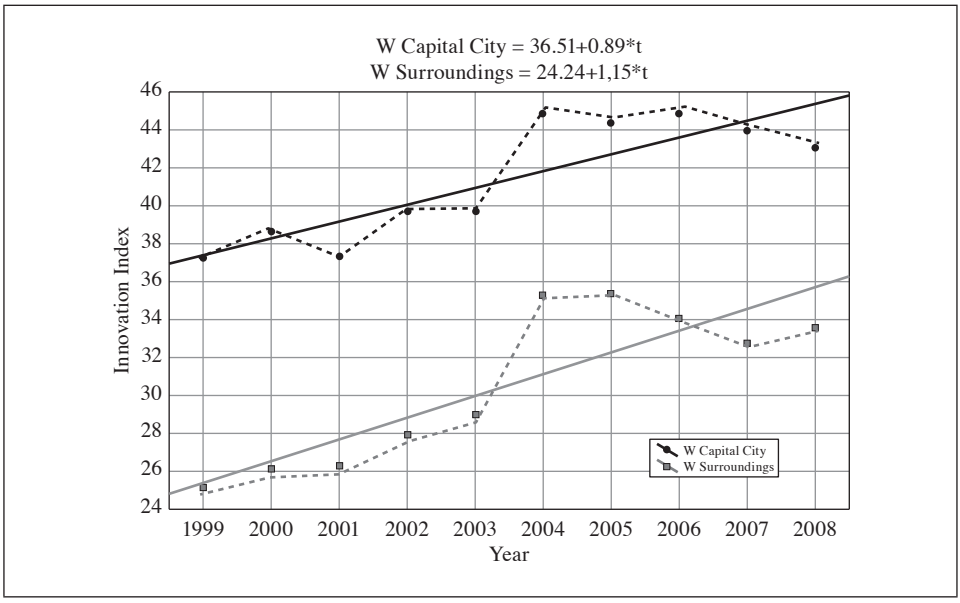

Fig. 9. Trends in Innovation Indexes for Vienna and Its Surroundings
Source: the author's compilation.

basic and decisive factor determining the course of the convergence process in terms of innovation.

Table 3. Regression Coefficients for the Final Regression Model of Variables Influencing the Difference in the Innovation Index between Capital Cities and Their Surroundings

Variable	Standardised regression coefficient	Partial regression coefficient	*p* value
Intercept		2.176	0.1166
t	–0.040	–0.085	0.1022
LLL – S	–0.630	–0.490	0.0000
KIS – S	–1.116	–0.646	0.0000
HIT2 – S	–0.761	–0.504	0.0000
LLL – CC	0.709	0.551	0.0000
HRST – CC	0.149	0.115	0.0001
KIS – CC	0.822	0.622	0.0000
HIT2 – CC	0.258	0.244	0.0000

Abbreviations used in the table: S – surroundings, CC – capital city.

Source: the author's calculations.

It is also worth mentioning that the model interpreted in this study has very good goodness-of-fit characteristics. The standard error of estimation amounted to 1.58 while the adjusted coefficient of determination was as high as 0.933.

6. Conclusions

In most of Europe's capital cities a convergence in innovativeness with the surrounding region has been observed (Brussels, Prague, Vienna, Lisbon, Madrid and Stockholm).

Important variables accounting for the diminishing differences in the Innovation Index from the perspective of the areas surrounding the capital cities include: KIS (the workforce employed in knowledge-intensive services as a percentage of the workforce), HIT2 (the share of the workforce in high- and mid-tech industry to the total number of workforce employed in industry) and LLL (the share of the population aged 25–64 participating in life-long learning in a region).

From the point of view of the capital cities, the most important variables which influence the size of the Innovation Index divergence from the surrounding regions are: KIS, LLL, HIT 2 and HRST (human resources in science and technology,

i.e. the total number of population actually employed in science and technology intensive professions in relation to the professionally active population).

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Stolice europejskie i ich otoczenie – konwergencja czy dywergencja w zakresie innowacyjności?

W pracy podjęto próbę odpowiedzi na pytanie, czy najbliższe otoczenie europejskich stolic nadrabia zaległości w stosunku do poziomu innowacyjności stolic tych krajów. Na podstawie ośmiu charakterystyk ustalono wartość wskaźnika agregatowego innowacyjności dla regionów UE szczebla NUTS 2.

Na tle zmian wartości wskaźnika innowacyjności w europejskiej przestrzeni regionalnej oceniono efekty wpływu stolicy na najbliższe otoczenie, w kontekście trendów obserwowanych pod względem innowacyjności. Analizie poddano kraje, w których stolica jest jednocześnie regionem szczebla NUTS 2. Wskazano zmienne decydujące o różnicach wskaźnika występujących pomiędzy stolicą a otoczeniem.

Słowa kluczowe: stolice UE, otoczenie, innowacyjność, konwergencja, NUTS 2.