Regions of Visegrad Group Countries in the European Innovation Space - Dynamic Assessment[1]

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Abstract

Innovation represents a multidimensional phenomenon, analysed in many perspectives and increasingly often referred to economy in the context of a territory (countries, regions). The problems of such complex phenomenon measurement constitute a challenge for statistical services, whereas the EU presentation attempts and methodology have been evolving for several years (Oslo manual and team work of the European Trend Chart on Innovation, Pro Inno Europe Inno metrics for European Commission). The changing approaches make dynamic assessments difficult since they do not allow for long-term analyses.

The diversification identification of the occurring changes level and their dynamics in terms of particular innovation measures included in Eurostat base, as well as innovation assessed by applying synthetic indicators or other tools for multidimensional data analysis is possible at the level of countries and NUTS 2 regions.

The disproportions in the level of innovation are quite extensive in Europe, whereas inequalities in this matter are particularly visible at regional level. The crucial differences refer to both, old EU (EU 15) and the regions from countries of the successive enlargements.

The purpose of the article is to assess the dynamic classification results of the European NUTS 2 level regions – conducted using eight innovation indicators – in the context of the position of Visegrad Group countries' regions, i.e. included in the group of countries from 2004 accession. The analysis background consists of the regions from 33 European countries (EU 28 regions and Norway, Switzerland, Iceland, Macedonia and Turkey) in the period 2008-2012.

Key words: regional innovation, dynamic classification, Visegrad Group

JEL Classification: O18: Regional Analysis, C38: Cluster Analysis; O31: Innovation and Invention, O52: Europe

1 Introduction

In the times of globalization and the intensifying competitive struggle between companies, regions and countries the ongoing advancement of economy innovation is indispensable. Innovation – i.e. the implementation of new, significantly improved products, processes, methods – presents, at the current level of global economy development, the essential factor facilitating the improvement of performance and creating new jobs. The policy focus of countries and regions on innovation is also of utmost importance for an effective management of the economic crisis effects.

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Competition and innovation, mainly referred to regional and local level (OECD 2001, 2007, 2011, Doloreux, Parto 2004), are considered increasingly important in economic literature references of the past decade. Moreover, the processes of policy management decentralization in terms of innovation facilitate upgrading competencies in creating innovation and delegating powers in this matter to regions (Magro, Wilson 2013). An important role in competitiveness and performance improvement is associated with regional innovation systems. Researchers indicate that science, technology and innovation represent the stimulating agents for long-term economic growth, whereas the development diversification of countries and regions can be explained by, among others, different level of knowledge, capacity and technology (Asheim, Gertler 2006; Soete 2011).

Monitoring and evaluation of the changes occurring in global economy, as well as ongoing adjustment to the changing reality of the performed pro-innovative activities are observed as the crucial components of the conducted innovation policy. The updated data which facilitate statistical measurement, dynamic assessment, defining the position and benchmarking, represent the indispensable elements for an effective innovation policy implementation.

The purpose of the article is to present the assessment results of the conducted dynamic classification covering regions of Visegrad Group countries at the background of the European NUTS 2 level regions in terms of innovation, based on eight characteristics selected for the purposes of this phenomenon quantification in the period 2008-2012.

2 Regional Innovation Measurement and Assessment – Brief Overview of Conducted Research

The efforts focused on preparing adequate methodology and the set of indicators allowing to measure the "creative destruction", as J. A. Schumpeter called innovations, have been going on in the European Union for the recent two decades. The measurement refers to both, national level (NUTS 0) and regional one (NUTS 2) (Commission 2011).

The first assessment of the EU regions innovation was performed in 2002 within the framework of Regional Innovation Scoreboard (RIS) as the result of the European Trend Chart on Innovation (European 2002) group work. The following approaches – and changes in the set of indicators – were carried out in 2003 (European 2003a, 2003b), next in 2006 (Hollanders 2006) and also in 2009 (Hollanders, Tarantola, Loschky 2009a, 2009b). In 2012 more changes were introduced (Hollanders, Léon, Roman 2012a, Hollanders et al. 2012b) (for more see the studies by (Markowska, Strahl 2006; Markowska 2012)). The list of indicators covered by RRSII (Revealed Regional Summary Innovation Index) was repeatedly verified and changed -see tab. 1.

Tab. 1 Regional Innovation Scoreboard – changes between 2002-2014

Report	Number of indicators	Number of regions covered (NUTS 1 and NUTS 2)
RIS 2002	7	148
RIS 2003	13	173
RIS 2006	7	208
RIS 2009	16	201 (7 Norwegian regions included)
RIS 2012	12	190 (55 NUTS 1 and 135 NUTS 2) (7 from Norway, 7 from Switzerland, excluding Malta, Luxembourg, Cyprus, Lithuania, Latvia, Estonia)
RIS 2014	11	

Source: compilation based on (European 2002, 2003a, 2003b; Hollanders 2006; Hollanders, Tarantola, Loschky 2009a, 2009b; Hollanders, Léon, Roman 2012a, Hollanders at al. 2012b; Hollanders et al. 2014)

The set of variables suggested for the assessment of regional innovation is currently made up of 11 variables which are listed below (Hollanders et al. 2014).

1. Percentage population aged 25-64 having completed tertiary education.
2. R&D expenditure in the public sector as % of regional GDP.
3. R&D expenditure in the business sector as % of regional GDP.
4. EPO patents applications per billion of regional GDP (in PPS€).
5. Non-R&D innovation expenditures as % of turnover.
6. SMEs innovating in-house as % of SMEs.
7. Innovative SMEs collaborating with other as % of SMEs.
8. Employment in knowledge-intensive services and employment in medium-high/high-tech manufacturing as % of total workforce.
9. SMEs introducing product or process innovations as % of SMEs.
10. SMEs introducing marketing or organisational innovations as % of SMEs.
11. Sales of new to market and new to firm innovations as % of turnover.

Several of the above listed variables (6, 7, 9 and 10) originate from CIS (Community Innovation Survey) studies performed every few years and their results are presented as the mean value of three years, which makes conducting dynamic analyses more difficult. Moreover, survey studies within the framework of CIS, are conducted at country level by means of selecting a representative sample, compatible to the structure of companies at a country level (NUTS 0), which prevents direct disaggregation of the obtained results to lower levels (NUTS 1 and 2).

3 Research Methodology

The starting point for taxonomic analysis is the grouping of objects covered by the research and characterized by the set of statistical characteristics. These characteristics include the description of an analysed object, i.e. a fragment of a particular socio-economic reality. The research purpose is focused on distinguishing clusters of objects characterized by a similar development level in the analysed area and by defining objects' diversification as well as their clusters. The dynamic approach to classification, suggested in the study, consists in considering the following (Markowska 2012):

- it was adopted that each region is referred to as an individual OUT (Operational Taxonomic Unit) in the subsequent years (Sokal and Sneath 1963; Sneath and Sokal 1973), which means

that e.g. region A is several times present in the classification process, however, is characterized by data illustrating innovation in the subsequent years;
- the process of variables normalization applies the so-called global approach: maximum and minimum values were specified for each variable based on the data covering the entire analysed period – this approach allows for the assessment of dynamics in each analysed area;
- the normalization of variables to [0; 1] interval was carried out through dividing by the global range for stimulants and the characteristics functioning as a destimulant was "inverted " in the normalization process;
- agglomerative Ward's method was used for the selection of optimal class number – based on the assessment of a dendrogram the number of classes was defined and for the final division the k-means method was applied;
- the obtained classes of regions were grouped – for clearer interpretation – using CII (Composite Innovations Index) composite measure (scaled to [0;100] interval), representing an arithmetic mean from the normalized variables (Handbook 2008);
- all variables are active in delimitating groups, which was proved by ANOVA, where *p value* for each variable equalled 0.0000).

The results of such classification allow for "tracking" the paths of regions in the obtained regional classes separated based on innovation characteristics.

Thinking in spatial and spatial-temporal categories in theory and practice is currently a common phenomenon, facilitating both comprehensive and modern approach towards analysing complex phenomena.

4 Innovation Characteristics and Their Diversification Assessment

In Visegrad Group countries there are altogether 35 NUTS 2 level regions, i.e. 16 Polish, 8 Czech, 7 Hungarian and 4 Slovak. They constitute 60.3% of the regions from the last three accessions (EU 13). Their share among all EU regions is 12,8%, whereas in the entire group discussed in the study it amounts to 11,3% of 310 regions.

The conducted evaluation covers the period 2008-2012, since for previous years – due to changes in NACE classification – the data presented in Eurostat are incomparable for some variables.

The following variables were selected for the classification of regions regarding their innovation level (based on data availability and completeness for 310 regions in the period 2008-2012):
LLL – Participation of adults aged 25-64 in education and training by NUTS 2 regions – %,
HRST – Human resources in science and technology – percentage of active population,
HIT – Employment in high and medium high-technology manufacturing by NUTS 2 regions – percentage of total employment,
KIS – Employment in knowledge-intensive services by NUTS 2 regions – percentage of total employment,
HIT 2 – Employment in high and medium high-technology manufacturing by NUTS 2 regions - percentage of total employment in manufacturing,

KIS 2 – Employment in knowledge-intensive services by NUTS 2 regions – percentage of total employment in services,
WORK_EDUC – Employees with higher education as percentage of work force aged 25-64,
YOUTH – Early leavers from education and training by NUTS 2 regions – percentage.

The first seven characteristics represent stimulants (the higher the characteristics value the better), whereas the last one is a destimulant (the lowest possible characteristics value is preferred). The assessment of innovation characteristics diversification was carried out using basic descriptive statistics in the system of all analysed regions and in the group of Visegrad Group countries – see tab. 2.

The most important conclusions resulting from the analysis of data presented in table 2 are as follows:
- the increasing minimum, maximum, mean and median values for LLL, HRST, KIS 2 and WORK_EDUC,
- the increasing minimum values for LLL, HRST, KIS 2 and WORK_EDUC in Visegrad Group regions,
- very low – comparing to the Europe-wide ones – maximum and low mean values and also median values for YOUTH (destimulant) in Visegrad Group regions,
- reduced (measured by variation coefficient) diversification in Visegrad Group in terms of HRST, KIS, KIS2 and YOUTH.

As far as LLL is concerned only two regions from Visegrad Group countries were ranked among the first 100 (Praha in 2008, 2010, 2011, 2012, in 2009 ranked as 103, in 2012 as 104; the second region was Czech Severovýchod ranked as 86 in 2012). The majority of Czech regions (except 2008) were ranked among the second hundred, whereas all Hungarian regions were ranked among the third hundred, similarly to the majority of Polish regions (except Mazowieckie: ranked as 147-180 as well as Śląskie and Lubelskie: in 2012 these two regions were ranked respectively as 198 and 192) and Slovak ones (only Bratislavský kraj was ranked as 150-194).
High rankings of regions with capital cities or capital regions are quite characteristic in terms of HRST, i.e.: Praha (2-7), Közép-Magyarország (43-78), Mazowieckie (57-92) and Bratislavský kraj (8-13). The other regions were mainly ranked among the third hundred, except:
- Czech regions Střední Cechy (162-193), Jihozápad (167 in 2008 and 179 in 2009), Severovýchod (195 in 2008 and 193 in 2010), Jihovýchod (ranked from 133 to 191 in the period 2008-2011), Moravskoslezsko (ranked as 191 in 2009 and 185 in 2010),
- Polish: Małopolskie (199 in 2011 and 194 in 2012), Śląskie (140-199), Zachodniopomorskie (166-196 in the first three analysed years), Dolnośląskie (179-192 in the period 2009-2011) and Pomorskie (159-177).

Tab. 2 Basic descriptive statistics of variables

Variable	Year	All regions						Regions from Visegrad Group countries					
		min	max	mean	median	SD	VC	min	max	mean	median	SD	VC
LLL	2008	0.6	34.9	9.7	7.4	7.4	76.0	1.8	11.1	4.2	4.3	1.8	44.1
	2009	0.7	34.7	9.8	7.2	7.3	75.0	2.0	10.8	4.5	4.2	2.0	44.3
	2010	0.7	35.7	9.9	7.2	7.7	77.9	2.2	12.1	4.9	4.7	2.2	44.5
	2011	0.8	36.1	9.8	7.5	7.2	74.0	2.0	16.3	5.5	3.7	3.6	65.0
	2012	0.9	35.4	10.0	7.9	7.3	73.0	2.0	13.2	5.3	3.6	3.3	62.5
HRST	2008	6.8	63.1	34.6	34.8	10.2	29.5	25.8	59.8	32.1	29.6	7.3	22.8
	2009	10.3	62.8	35.5	37.1	10.3	29.1	24.9	57.1	32.9	31.8	7.1	21.5
	2010	11.4	66.9	35.8	36.4	10.4	29.1	25.3	59.1	33.5	32.2	7.4	22.0
	2011	11.6	71.3	37.4	38.9	10.8	28.9	26.6	57.8	33.6	31.1	7.4	21.9
	2012	11.7	72.3	38.1	39.4	10.8	28.3	26.6	58.3	34.0	31.3	7.4	21.6
HIT	2008	0.3	20.5	5.6	5.0	3.4	61.4	2.4	15.7	7.7	7.2	3.7	47.9
	2009	0.2	18.0	5.3	4.4	3.4	64.0	2.0	15.6	7.0	6.1	3.5	50.3
	2010	0.2	18.2	5.2	4.6	3.3	63.8	2.0	16.2	6.9	5.9	3.6	52.4
	2011	0.2	20.7	5.1	4.4	3.4	66.0	2.4	15.6	7.4	6.3	3.8	51.3
	2012	0.1	20.1	5.2	4.5	3.5	66.7	2.6	15.2	7.5	6.3	3.9	51.3
KIS 08	2008	10.7	63.3	35.3	36.4	10.3	29.2	23.2	47.8	29.3	27.7	5.8	19.9
	2009	11.5	64.4	36.4	37.3	10.5	28.8	23.0	47.3	30.4	29.0	5.6	18.4
	2010	12.2	66.0	36.7	38.0	10.3	28.1	24.6	48.6	31.3	29.4	5.5	17.6
	2011	12.2	65.8	37.1	38.0	10.5	28.3	23.8	50.2	31.1	29.1	6.0	19.2
	2012	11.3	65.4	37.4	38.5	10.2	27.2	24.8	48.7	31.4	29.6	5.6	17.9
KIS2	2008	20.1	72.7	53.0	54.1	8.9	16.8	43.1	61.9	52.2	52.4	3.4	6.5
	2009	24.5	71.2	53.7	54.6	8.7	16.2	47.0	60.5	52.7	52.7	3.2	6.2
	2010	28.6	71.7	54.0	54.9	8.3	15.4	48.2	60.6	53.5	53.5	3.1	5.8
	2011	31.8	72.0	54.1	54.9	8.3	15.3	48.2	63.0	53.3	53.3	3.1	5.9
	2012	32.5	72.7	54.5	55.2	8.0	14.7	45.5	61.7	53.8	53.5	3.3	6.2
HIT2	2008	2.0	66.7	31.6	33.3	13.5	42.9	14.2	48.6	31.9	31.4	9.6	30.0
	2009	2.0	70.4	31.1	31.7	13.6	43.8	12.5	49.3	30.7	30.3	9.8	32.0
	2010	2.2	65.0	31.1	32.3	13.4	43.2	12.9	53.4	30.9	30.6	10.3	33.4
	2011	1.8	64.0	31.3	32.2	13.5	43.1	14.3	49.5	32.2	32.1	10.2	31.7
	2012	1.9	69.0	31.8	32.3	13.9	43.8	12.4	48.9	32.9	34.8	10.3	31.4
WORK_EDUC	2008	5.3	58.4	27.8	28.2	9.8	35.2	8.4	33.6	21.6	21.6	6.1	28.2
	2009	8.0	62.6	29.3	30.2	10.2	34.7	10.4	36.1	23.3	22.6	6.2	26.6
	2010	9.9	66.0	30.2	30.6	10.3	34.1	10.9	39.9	25.0	24.5	6.9	27.6
	2011	9.8	71.7	31.1	31.2	10.5	33.7	12.0	42.2	26.2	26.2	7.1	27.3
	2012	11.0	74.7	32.3	32.7	10.6	32.8	14.6	41.4	27.1	26.5	7.0	25.8
YOUTH	2008	2.3	76.1	17.5	13.9	12.7	72.4	2.3	14.9	6.8	5.6	3.5	51.5
	2009	2.6	73.1	16.9	13.5	12.0	71.2	2.6	14.8	6.9	5.7	3.5	50.2
	2010	2.3	69.3	16.4	13.3	11.5	70.0	2.3	15.6	6.7	5.6	3.2	47.4
	2011	2.0	68.1	15.9	13.1	10.9	68.4	2.0	15.1	6.9	5.9	3.2	46.7
	2012	2.4	63.0	15.0	12.5	10.3	68.7	2.4	16.7	7.2	6.6	3.4	46.8

SD – standard deviation, VC – variability coefficient

Source: author's compilation

High raking positions of Czech regions, except Praha region, are worth emphasizing. In terms of HIT they are ranked among the first one hundred and in case of Severovýchod even among the first ten. Similarly high ranking positions – first hundred – were recorded for five Hungarian regions (Közép-Dunántúl, Nyugat-Dunántúl, Dél-Dunántúl, Észak-Magyarország, Észak-Alföld) and the Slovak ones (except the region of Bratislavský kraj in the first three analysed years). Among Polish regions such high ranking positions, in terms of HIT, were achieved in each analysed year by: Śląskie and Dolnośląskie, whereas in the selected years it was true for:

Lubuskie (2009-2012), Podkarpackie (2011 and 2012), Pomorskie (2008 and 2009) and Opolskie (2012).

For KIS the following regions were ranked among the first hundred: Praha and Bratislavský kraj, in case of the other regions (except Közép-Magyarország (105-116), Dél-Dunántúl (176-197), Észak-Alföld (180-193), Mazowieckie (137-158) the recorded rakings were among the third hundred.

Only the regions: Praha, Bratislavský kraj in each analysed year, and Mazowieckie in the period 2008-2011 and also Dél-Dunántúl in 2012 were ranked among the first hundred in terms of Employment in knowledge-intensive services by NUTS 2 regions – percentage of total employment in services.
With reference to HIT 2 two Slovak regions were ranked among the first hundred (Bratislavský kraj and Západné Slovensko), and the other among the second hundred. Only Dolnośląskie, from Polish regions, was ranked among the first hundred. In relation to Czech regions Praha was among the first one hundred in the first analysed year and Strední Cechy, Jihozápad and Severovýchod in each analysed year. The other Czech regions were ranked among the second hundred. Four Hungarian regions occupied positions up to 99 (Közép-Magyarország, Közép-Dunántúl, Nyugat-Dunántúl, Észak-Magyarország).

Tertiary education of employees is mainly characteristic for capital regions and including the country capital – these regions are usually ranked among the first hundred in terms of WORK_EDUC, while the Czech region of Severozápad occupies 303-309 positions.

In terms of Early leavers from education and training by NUTS 2 regions (percentage) the majority of Visegrad Group regions showed very good results. YOUTH is the characteristics which presented one of the lowest values in the regions of Visegrad Group countries. A few regions are listed among the first ten (ranked from the lowest values – destimulant): Praha (in 2012 ranked as the first) Jihovýchod (in 2008-2009 1st position), Strední Morava, Małopolskie and Západné Slovensko (in the years 2010-2011 1st position). Severozápad is the only Czech region ranked in the second hundred. In Hungary these were: Közép-Dunántúl (in 2008 ranked as 77, and in the following years 117-157), Dél-Dunántúl (119-152), Észak-Magyarország (in 2008-2011 ranked as 168-195, and in 2012 position 215) and also Észak-Alföld (positions 147-181 in 2008-2011, and in 2012 ranked as 225).

5 Dynamic Classification Results

The ranking of regions is translated into CII synthetic measure values, as well as the obtained classification results. As it has been described in the methodological part each region was repeatedly covered, as an object-period, by the performed classification with data referring to the following analysed years (2008-2012), which means that for 310 units assessed in the course of five subsequent years the observation matrix was obtained measuring 1550x8.

A1 observation class is characterized by the highest value of innovation indicator (CII). This class refers to the high share of workforce employed in knowledge-intensive services in the total

workforce number and specialized services, as well as the personnel covered by the process of education and training (the highest mean value of LLL, KIS and KIS2 characteristics – see table 3). It covered the total of almost 400 taxonomic units, among others from such countries as: Great Britain (156 out of 185 possible – whereas each of 37 British regions was listed in this class at least once), all regions from Finland, Denmark, Switzerland and Sweden and also Iceland. This class included the majority of Norwegian regions (33 out of 35), Dutch (49 out of 60 possible) and also Vienna, Zahodna Slovenija and Luxemburg except for 2008. The regions listed in each of the five years in this class constitute 76% of all regions in this particular class (see tab. 4).

The next two classes, i.e. B1 and B2 are characterized by almost the same mean value of CII innovation indicator. B1 class including almost 200 taxonomic units constitutes the cluster of regions with highly qualified workforce (the highest mean values of HRST and WORK_EDUC characteristics, while B2 class (127 units) with specialized industry and the learning youth (the highest mean values of HIT, HIT 2 and YOUTH). The regions listed in each of five years constitute 34,9% of all covered by class B1 and 40% in class B2.

Class B1 includes the most of taxonomic units from: Germany (60 units – 19 regions), Belgium (44 – 10 regions) and France (38 – 12 regions). The following countries are also represented: Spain and Great Britain (15 taxonomic units and respectively 6 and 10 regions), Ireland (9 out of 10 possible taxonomic units) and one region (in the entire 5-year period) from Visegrad Group countries, i.e. from Hungary (Közép-Magyarország) and Slovakia (Bratislavský kraj).

Tab. 3 Within-group averages

Group	Number of year-regions	Averages								
		LLL	HRST	HIT	KIS	KIS2	HIT2	WORK_EDUC	YOUTH	CII
A	387	20.6	44.5	4.3	46.7	61.8	36.5	38.3	12.7	58
B1	195	8.0	46.2	6.0	44.7	59.0	42.9	39.1	12.7	55
B2	127	7.5	38.9	12.7	36.0	56.0	51.0	28.9	10.1	55
C	230	8.1	38.2	3.7	38.2	53.8	25.5	34.0	15.6	45
D	247	6.1	31.6	7.7	30.5	51.0	34.4	21.5	11.2	43
E	234	4.4	26.9	2.9	28.9	48.1	16.5	23.7	18.8	33
F	130	2.6	16.0	2.1	17.4	36.2	11.2	14.9	45.4	18

Source: Author's calculations

Tab. 4 Class size and their geography characteristics

Group	Number of year-regions	Number of regions	Number of regions always included in the class (2008-2012 r.)	Countries the regions of which are included in the class (number of regions/total in a given country)
A	387	87	66	UK (36/37), SI (1/2), SE (8/8), NO (7/7), NL (11/12), LU (1/1), IS (1/1), FI (5/5), ES (2/19), DK (5/5), **CZ (1/8),** CH (7/7), AT (1/9) – regions from 13 countries
B1	195	63	22	BE (7/11), **CZ (1/8)**, DE (19/39), ES (6/19), FR (12/22), HU (1/7), IE (2/2), NL (1/12), **SK (1/4)**, UK (10/37) – regions from 10 countries
B2	127	38	15	**CZ (3/8)**, DE (28/39), ES (1/19), FR (3/22), **HU (2/7)** – regions from 5 countries
C	230	69	23	AT (3/9), BE (3/11), BG (1/6), CY (1/1), DE (4/39), LT (1/1), LU (1/1), LV (1/1), MT (1/1), EE (1/1), EL (4/13), ES (12/19),

				FR (14/22), IE (1/2), IT (3/21), NL (4/12), NO (1/7), **PL (5/16)**, PT (1/7), RO (1/8), TR (1/26), UK (5/37) – regions from 22 countries
D	247	75	33	AT (8/9), BG (1/6), **CZ (7/8)**, IT (12/21), DE (12/39), EL (2/13), ES (1/19), NL (1/12), FR (6/22), HR (1/2), **HU (5/7)**, **PL (9/16)**, RO (3/8), SI (1/2), **SK (3/4)**, TR (2/26), UK (1/37) – regions from 17 countries
E	234	60	31	AT (1/9), BG (5/6), EL (10/13), ES (8/19), HR (2/2), **HU (1/7)**, IT (10/21), LV(1/1), RO (5/8), MK (1/1), **PL (8/16)**, PT (6/7), TR (2/26) – regions from 14 countries
F	130	32	21	EL (2/13), ES (1/19), PT (5/7), TR (24/26) – regions from 4 countries

Source: author's calculations

In the least numerous B2 class there are mainly German regions which make up over 73%. In this class 27 out of 37 German regions were, among others, recorded (93 units), three French (14 units), three Hungarian and three Czech ones (9 units each).

Class C, characterized by CII mean value equal 45, covers capital regions or the regions including the country capital: Yugozapaden (BG), Attiki (EL), Lazio (IT), Mazowieckie (PL), Lisboa (PT), Bucuresti-Ilfov (RO), Ankara (TR) and the regions-countries with NUTS 2 level equivalent to the country level: Cyprus, Estonia, Lithuania and Latvia and also Malta.

Class E mainly covers the regions from: Greece, Italy, Poland, Bulgaria, Portugal, Spain and Romania (the listed countries include at least 20 taxonomic units in class E).

Class D is represented by, among others, the following regions: Italian (52 taxonomic units), Polish and Austrian (30 each), Czech (26) and German (29), Hungarian (18), Slovak (15) and Romanian (14). This class recorded the second best result for YOUTH and HIT, whereas for CII it amounted to 43.

Class E (CII=33) includes the total of 234 taxonomic units and the most numerously represented countries are: Bulgaria, Greece, Spain, Italy, Portugal and from the Visegrad Group Poland and Hungary. The regions listed in each of the five years constitute 51,7% of all regions covered by this class.

Class F is characterized not only by the lowest innovation indicator (CII-18), but also by the lowest mean values of all analyzed innovation characteristics. Class F covered, at the beginning of the assessment period: three Spanish regions (Ionia Nisia and Illes Balears in 2008 and 2009 and also Notio Aigaio in 2009 and 2010), as well as four Portuguese regions (Regiao Autónoma dos Açores and Norte in the years 2008-2009, while in 2008 Algarve and Centro). The biggest representation in class F comes from Turkish regions: in each analysed year 21 of 26 Turkish regions were recorded in it and three more except in 2012. The total number of regions represented in each of the analysed five years in the class are responsible for 67% of all regions listed in this class.

6 The Regions from Visegrad Group Countries in Dynamic Classification

CII mean value, calculated based on the results of regions for the Czech Republic, increased from 45,7 to 50, for Hungary from 43,5 to 45,5, for Poland from 40,2 to 42,1 and for Slovakia from 45,8 to 48,7 – see tab. 5. The highest annual average growth in Visegrad Group regions is characteristic for the Czech Republic (1,15) and the lowest for Poland (0,47).

Tab. 5 Regional mean CII values for countries

Country	CII mean value in					Slope mean value		Country	CII mean value in					Slope mean value
	2008	2009	2010	2011	2012				2008	2009	2010	2011	2012	
BE	54.7	55.4	55.2	55.8	56.3	0.36		MT	40.5	40.0	40.0	42.4	44.1	0.98
BG	34.4	33.9	33.5	34.4	35.3	0.23		NL	53.1	53.0	53.7	54.0	53.6	0.20
CZ	45.7	46.5	47.5	49.4	50.0	1.15		AT	43.8	45.2	46.0	46.5	47.3	0.82
DK	61.0	61.8	63.4	63.8	63.6	0.72		PL	40.2	40.7	41.4	41.6	42.1	0.47
DE	53.2	54.3	54.1	53.9	54.8	0.28		PT	28.1	29.9	30.5	34.5	36.4	2.11
EE	44.3	47.6	47.3	49.2	49.9	1.28		RO	31.6	31.9	31.7	33.0	32.7	0.32
IE	48.2	51.8	53.9	54.8	55.6	1.78		SI	51.8	51.9	53.3	54.2	53.7	0.59
EL	32.1	31.8	32.8	34.7	35.7	1.03		SK	45.8	44.9	46.7	48.9	48.7	0.98
ES	40.2	41.6	42.7	44.5	45.1	1.27		FI	58.7	58.5	59.4	60.0	61.8	0.77
FR	49.1	49.2	48.9	50.5	50.5	0.42		SE	60.0	60.1	61.1	61.8	62.3	0.63
HR	37.1	37.9	39.2	39.5	40.5	0.85		UK	55.0	56.1	56.1	55.9	57.1	0.38
IT	39.3	39.3	39.0	39.0	40.1	0.13		IS	51.1	53.9	52.6	53.0	53.6	0.40
CY	39.9	39.3	39.6	42.0	42.8	0.84		NO	53.5	55.4	56.7	56.8	57.7	0.97
LV	38.2	37.9	38.4	39.3	41.6	0.83		CH	61.3	62.1	64.1	63.9	64.8	0.89
LT	40.2	41.1	42.1	42.6	42.8	0.66		MK	31.7	32.8	33.8	31.5	32.3	-0.00
LU	49.2	55.5	56.3	56.8	57.8	1.85		TR	16.8	17.9	18.9	19.3	21.2	1.00
HU	43.5	43.4	44.5	45.0	45.5	0.57								

Source: author's calculations

The conducted research illustrates that. among others. in each of the five analysed years covering the period 2008-2012 (see tab. 6):

- class B1 covered the regions with the country capital. i.e. Slovak (Bratislavský kraj) and Hungarian (Közép-Magyarország).
- class B2 listed only one region from the Visegrad Group. i.e. Hungarian Közép-Dunántúl.
- class D always included as follows: four Czech regions. three Slovak. five Polish and two Hungarian ones (14 out of 35 regions from the Visegrad Group countries).
- class E. in terms of the regions from Visegrad Group countries. listed four Polish regions (Łódzkie. Świętokrzyskie. Podlaskie and Warmińsko-Mazurskie).

Tab. 6 Regions from Visegrad Group countries in classes

Code	Region	Year					Code	Region	Year				
		2008	2009	2010	2011	2012			2008	2009	2010	2011	2012
Hungary							Poland						
HU10	**Közép-Magyarország**	B1	B1	B1	B1	B1	PL11	Łódzkie	E	E	E	E	E
HU21	Közép-Dunántúl	B2	B2	B2	B2	B2	PL12	**Mazowieckie**	C	C	C	C	C
HU22	Nyugat-Dunántúl	D	D	D	B2	B2	PL21	Małopolskie	E	E	E	C	C
HU23	Dél-Dunántúl	D	D	D	D	D	PL22	Śląskie	D	D	D	D	D
HU31	Észak-Magyarország	D	D	D	B2	B2	PL31	Lubelskie	E	E	E	E	C
HU32	Észak-Alföld	D	D	D	D	D	PL32	Podkarpackie	D	D	D	D	D
HU33	Dél-Alföld	E	E	E	D	D	PL33	Świętokrzyskie	E	E	E	E	E

Slovakia						
SK01	**Bratislavský kraj**	B1	B1	B1	B1	B1
SK02	Západné Slovensko	D	D	D	D	D
SK03	Stredné Slovensko	D	D	D	D	D
SK04	Východné Slovensko	D	D	D	D	D
The Czech Republic						
CZ01	**Praha**	B1	B1	A	A	B1
CZ02	Strední Cechy	D	B2	D	B2	B2
CZ03	Jihozápad	B2	B2	D	D	B2
CZ04	Severozápad	D	D	D	D	D
CZ05	Severovýchod	D	D	B2	B2	B2
CZ06	Jihovýchod	D	D	D	D	D
CZ07	Strední Morava	D	D	D	D	D
CZ08	Moravskoslezsko	D	D	D	D	D

PL34	Podlaskie	E	E	E	E	E
PL41	Wielkopolskie	D	E	E	E	E
PL42	Zachodniopomorskie	D	C	C	C	C
PL43	Lubuskie	D	D	D	D	D
PL51	Dolnośląskie	D	D	D	D	D
PL52	Opolskie	D	D	D	D	D
PL61	Kujawsko-Pomorskie	D	E	E	E	E
PL62	Warmińsko-Mazurskie	E	E	E	E	E
PL63	Pomorskie	D	D	C	C	C

Note: capital regions and regions including the country capital are marked in bold

Source: author's compilation

Out of 40 possible Czech OTU: 26 were listed in class D (65%). 9 in class B2. 3 in class B1 and 2 in class A. Out of 20 Slovak OTUs: 15 were in class D (65%) and 5 in class B1. In Hungary 51.4%. i.e. 18 OTUs were included in class D. 9 in class B2. 5 in class B1 and 3 in class E. In case of Poland out of 80 OTUs: 35 were in class E. 30 in class D and 15 in class C.

7 Final Remarks

The most important conclusions resulting from the presented research are as follows:

1. Dynamic classification methodology allowed for separating seven homogenous groups of regions characterized in terms of mean values adopted for the assessment of innovation characteristics and facilitated indicating the position of NUTS 2 regions from Visegrad Group countries in the analysed area.
2. Out of 35 analysed regions 12 improved their ranking position in the analysed period and in case of 22 no changes were recorded. The observed changes refer to the following classification "shifts":
   - 4 Czech regions improved their ranking position (from class D to class B2) and in case of three no changes were recorded (class D);
   - for Slovak regions no changes were observed in the period under analysis in assigning them to classes.
   - among 16 Polish regions their position improvement was observed in case of 6. while for 10 no changes were recorded (5 in class D. 4 in class E and Mazowieckie in class C).
   - for Hungarian regions: in case of 4 no changes were recorded and in case of three classification improvement was observed (two from class D to B2 and one from class E to D).
3. Slightly more than half (50.8%) of the analysed taxonomic units from the Visegrad Group were listed in class D (characterized by the second mean value of HIT and YOUTH). 21.7% in class E (mainly Polish regions). and 10.3% in class B2.

4. Praha achieved the best results of all regions from Visegrad Group countries. since for three years it was in class B1 (the highest mean values of HRST and WORK_EDUC) and for two years in the best A class in terms of the highest mean values of LLL. KIS and KIS2.

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