The Regional R&D Activity in Romania –
A Perspective Post-EU Accession

Babucea Ana-Gabriela
Răbonțu Cecilia-Irina
"Constantin Brâncuşi" University of Târgu Jiu
gabibabucea@gmail.com
cecilia.rabontu@gmail.com

Abstract

The study consists of analyzing the evolution of the research and development (R & D) sector in Romania, from the point of view of the structural changes registered at the level of the eighth development regions. The period considered in analysis consists in the years after the accession of Romania to the European Union, with the aim of identifying the territorial disparities as well as the generating factors associated with the general dysfunctions of the economic and social system. The data used in the study refers to the 2007-2014 period, 2014 being the last year with data available on Eurostat database for all the indicators considered.

Key words: research and development, regions, disparities, Romania
J.E.L. classification: C19, O39, R12.

1. Introduction

In the last ten years, on the efforts to build up the European System of Innovation at the level of the EU member states has been a progressive and systematic process of convergence in terms of national R&D strategies and policies, as well as in terms of R&D expenditures (Goschin, Sandu, and Goschin, 2016, p.1). However, Romania had an insufficient and inadequate investment in this important sector. Nowadays, our country is still an insignificant force through the EU member states, with only 0,5% of its GDP dedicate to these important activities, even if a number of facilities have been thought, of lately to stimulate the sector, like labor incentives, fiscal incentives, reinvested profit, and state aid for R & D or intellectual property (Buciuman, Tapai, and Grigore, 2017, p.2). More than that, the territorial component of the national innovation system is still underdeveloped. The existence of major technological disparities among Romanian regions and counties has been recognized as a constraint in building an efficient national innovation system, but it is still lacking a strong regional R&D policy to address such disparities (Goschin, Sandu, and Goschin, 2016, p.2). To growing the R&D sector, is needed a continuous attention from the Romania's government, with higher targets, capable to create a functional and sustainable context to developing public and private research and development facilities.

2. Datasets and methodology

We considered two important classes of relevant indicators to defining the regional profile from this perspective: a) R & D expenditure (GERD), which includes spending on research and development by business enterprises, higher education institutions, as well as government and private non-profit organizations, and b) the number of researchers involved in R&D activities. Taking into account regional specific issues, to have a complete picture of the size of the R & D sector we consider the main indicators that can synthesize both the dimension of this sector and correlation with the regional employment profile, too:

- *Group 1 – "Expenditures",* including 3 indicators: IND_1 - total R&D, which indicates the level of investment in R&D activities, IND_2 - total R&D expenditure / inhabitant, (measured in Euro), indicator describing the investment in R&D relative to the size of the region, respectively the number of inhabitants, and IND_3 - Total R&D expenditure as a percentage of GDP of the region, named "R&D intensity" because it is used to measure the relative degree of an economy to invest in new knowledge and innovation (See Table no. 1), and
- *Group 2 – "Researchers",* including 4 indicators: IND_4 - R&D Researchers measured in FTE, IND_5 - R&D Researchers measured in HC, IND_6 - R&D Researchers, as % of total employment - numerator in FTE, and IND_7 - R&D Researchers, as % of total employment - numerator in (HC) (See Table no. 2).

Table no. 1. R&D expenditure (GERD) by NUTS 2 regions

Region	Indicator	Year								Changes 2014/2007	
		2007	2008	2009	2010	2011	2012	2013	2014	$\bar{I}$ (%)	$\bar{R}$(%)
Nord-Vest (N-V)	IND_1	58,003	70,182	45,816	46,859	71,189	66,965	51,325	45,92	96,72	-3,28
	IND_2	21,3	25,8	16,8	17,2	26,2	25,8	19,8	17,7	97,39	-2,61
	IND_3	0,38	0,44	0,33	0,33	0,49	0,44	0,32	0,27	95,24	-4,76
Centru (C)	IND_1	22,264	21,793	40,109	26,229	29,228	34,421	21,279	52,824	113,14	13,14
	IND_2	8,8	8,6	15,9	10,4	11,6	14,6	9	22,4	114,28	14,28
	IND_3	0,15	0,14	0,29	0,18	0,2	0,23	0,13	0,32	111,43	11,43
Nord-Est (N-E)	IND_1	49,039	58,279	37,233	37,545	40,632	54,945	44,739	43,088	98,17	-1,83
	IND_2	13,2	15,7	10	10,1	11	16,7	13,6	13,2	100,0	0,00
	IND_3	0,36	0,39	0,29	0,28	0,3	0,4	0,3	0,28	96,47	-3,53
Sud-Est (S-E)	IND_1	24,175	26,941	21,602	21,152	14,959	12,121	10,502	10,918	89,27	-10,73
	IND_2	8,5	9,5	7,7	7,5	5,3	4,8	4,2	4,4	91,02	-8,98
	IND_3	0,18	0,18	0,17	0,16	0,11	0,08	0,06	0,06	85,48	-14,52
Sud – Muntenia (S-M)	IND_1	69,49	62,319	52,07	57,156	62,712	74,359	59,839	66,735	99,42	-0,58
	IND_2	21	18,9	15,9	17,5	19,3	23,8	19,3	21,6	100,4	0,40
	IND_3	0,45	0,35	0,33	0,36	0,38	0,47	0,34	0,37	97,24	-2,76
Bucuresti – Ilfov (B-I)	IND_1	376,063	504,311	320,197	339,884	379,372	353,332	312,718	313,875	97,45	-2,55
	IND_2	168,5	224,9	142,1	150,3	167,3	155	137	137,5	97,14	-2,86
	IND_3	1,24	1,33	1,06	1,04	1,05	1	0,81	0,78	93,59	-6,41
Sud-Vest Oltenia (S-O)	IND_1	20,326	23,941	17,863	16,653	29,639	13,079	20,146	16,472	97,04	-2,96
	IND_2	8,9	10,5	7,9	7,4	13,3	6,3	9,8	8,1	98,66	-1,34
	IND_3	0,2	0,22	0,19	0,17	0,28	0,13	0,19	0,15	95,97	-4,03
Vest (V)	IND_1	33,455	41,628	20,997	27,493	29,679	34,99	37,22	25,289	96,08	-3,92
	IND_2	17,4	21,6	10,9	14,3	15,5	19,1	20,4	13,9	96,84	-3,16
	IND_3	0,27	0,29	0,18	0,22	0,23	0,27	0,27	0,18	94,37	-5,63
Romania (RO)	IND_1	652,815	809,401	555,887	572,971	657,411	644,211	557,769	575,12	98,21	-1,79
	IND_2	30,9	39,2	27,2	28,2	32,5	32,1	27,9	28,8	99,00	-1,00
	IND_3	0,52	0,57	0,46	0,45	0,49	0,48	0,39	0,38	95,62	-4,38

Source: Based on Eurostat,
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_e_gerdreg&lang=en

The data in the table shows a lent tendency to decrease R & D expenditure nationwide for all three indicators considered, while the only region that in the year 2014 has an 11-15% increase from 2007 is the Centru Region. On the opposite side, we find the South East region where the relative decrease reaches 10,73% for IND_1, 8,98% for IND_2 and more than 14% for IND_3. Even with a relative decrease above than the national level for the period 2007-2014, București - Ilfov remains the region with the highest level of R&D spending, indicating the concentration of the sector, especially in the capital of the country, București. As can be seen in the table below, between the year 2007 and 2014, the changes in the volume and structure of the researchers involved in the sector are much more obvious. While for most regions, including at national level, the trend was generally in decline, there are two regions where the trend is increase and a significant one: Vest and Centru Regions.

Data analysis consists of two successive stages in which two of the most usual methods in territorial studies, which allow comparability of the territorial units with the average level, or the "best performance", as the case may be, as well as the measurement of the gaps between its, were applicated.

Table no. 2. R&D Researchers of all sectors of performance by NUTS 2 regions

Region	Indicator	Year								Changes 2014/2007	
		2007	2008	2009	2010	2011	2012	2013	2014	$\bar{I}$	$\bar{R}$
Nord-Vest (N-V)	IND_4	1.254	1.829	2.005	1.946	1.273	1.551	1.236	1.453	115,87	15,87
	IND_5	2.321	2.784	2.863	2.952	2.458	2.320	1.962	2.280	98,23	-1,77
	IND_6	0,1093	0,1622	0,1822	0,1728	0,1136	0,1343	0,1068	0,1242	113,63	13,63
	IND_7	0,2023	0,2469	0,2602	0,2622	0,2193	0,2008	0,1696	0,1948	96,29	-3,71
Centru (C)	IND_4	837	1.052	1.391	2.159	1.308	1.477	1.263	1.285	153,52	53,52
	IND_5	2.257	2.504	2.823	2.842	2.027	1.831	1.606	1.832	81,17	-18,83
	IND_6	0,0832	0,1024	0,1396	0,2418	0,1512	0,1689	0,1434	0,1453	174,64	74,64
	IND_7	0,2242	0,2437	0,2833	0,3183	0,2343	0,2094	0,1823	0,2072	92,42	-7,58
Nord-Est (N-E)	IND_4	1.632	1.977	1.804	1.606	1.572	1.668	1.775	1.730	106,00	6,00
	IND_5	3.269	3.387	3.244	2.966	3.190	3.277	3.372	3.332	101,93	1,93
	IND_6	0,0962	0,1181	0,1083	0,106	0,1037	0,1092	0,1158	0,1119	116,32	16,32
	IND_7	0,1928	0,2024	0,1947	0,1957	0,2105	0,2145	0,2201	0,2155	111,77	11,77
Sud-Est (S-E)	IND_4	1.006	746	749	669	503	543	454	435	43,24	-56,76
	IND_5	1.776	1.267	1.331	1.302	1.096	1.133	1.088	1.211	68,19	-31,81
	IND_6	0,0871	0,0646	0,0653	0,0649	0,0506	0,0543	0,0467	0,046	52,81	-47,19
	IND_7	0,1538	0,1096	0,116	0,1263	0,1102	0,1133	0,1119	0,128	83,22	-16,78
Sud – Muntenia (S-M)	IND_4	2.074	1.928	1.711	1.691	736	1.221	1.787	1.594	76,86	-23,14
	IND_5	2.724	2.823	2.372	2.342	1.321	1.823	2.385	2.160	79,30	-20,70
	IND_6	0,1413	0,1298	0,1184	0,1234	0,0589	0,0952	0,1365	0,1207	85,42	-14,58
	IND_7	0,1855	0,1901	0,1641	0,1709	0,1056	0,1422	0,1821	0,1635	88,14	-11,86
Bucuresti – Ilfov (B-I)	IND_4	9.807	9.993	9.426	9.176	7.883	8.958	9.182	9.059	92,37	-7,63
	IND_5	14.361	14.347	13.399	13.225	11.398	13.131	12.652	12.468	86,82	-13,18
	IND_6	0,9631	0,9679	0,9051	0,8616	0,7338	0,8448	0,8833	0,8531	88,58	-11,42
	IND_7	1,4103	1,3897	1,2866	1,2418	1,061	1,2383	1,2171	1,1741	83,25	-16,75
Sud-Vest Oltenia (S-V)	IND_4	1.120	973	951	840	1.347	1.243	1.254	934	83,39	-16,61
	IND_5	2.175	2.071	2.082	2.127	1.700	1.608	1.612	1.625	74,71	-25,29
	IND_6	0,109	0,0936	0,0922	0,089	0,1424	0,1316	0,1397	0,1018	93,39	-6,61
	IND_7	0,2116	0,1992	0,2018	0,2253	0,1797	0,1702	0,1796	0,1771	83,70	-16,30
Vest (V)	IND_4	1.078	896	1.234	1.693	1.457	1.355	1.626	1.619	150,19	50,19
	IND_5	1.857	1.681	2.531	2.951	2.300	2.716	2.923	2.626	141,41	41,41
	IND_6	0,1291	0,1083	0,1513	0,2205	0,1913	0,1782	0,2137	0,2111	163,52	63,52
	IND_7	0,2223	0,2032	0,3104	0,3843	0,302	0,3572	0,3842	0,3424	154,03	54,03
Romania (RO)	IND_4	18.808	19.394	19.271	19.780	16.080	18.016	18.576	18.109	96,28	-3,72
	IND_5	30.740	30.864	30.645	30.707	25.489	27.838	27.600	27.535	89,57	-10,43
	IND_6	0,2127	0,2184	0,2189	0,2381	0,1976	0,2191	0,2271	0,2194	103,15	3,15
	IND_7	0,3477	0,3475	0,348	0,3697	0,3132	0,3386	0,3374	0,3336	95,94	-4,06

Source: Based on Eurostat,
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_p_persreg&lang=en,

Firstly, the NUTS2 regions were clustered based on the multicriteria similarities of the seven indicators considered. The number of clusters was determinate by using the Hierarchical Cluster Analysis with Ward's method, and then for regions classification, the K - means Cluster algorithm. Ward's method is „similar to other linkage methods in that it begins with N clusters, each containing one object, it differs in that it does not use cluster distances to group objects. Instead, the total within-cluster sum of squares (SSE) is computed to determine the next two groups merged at each step of the algorithm. The error sum of squares (SSE) is defined (for multivariate data) as:

$$SSE = \sum_{i=1}^{K} \sum_{j=1}^{ni} (y_{ij} - \bar{y}_{i.})^2 \tag{1}$$

where y_{ij} is the jth object in the *i*th cluster, and n_i is the number of objects in the *i*th cluster" (Ferreira and Hitchcock, 2009, p4) For both procedures, the data were processed with SPSS v.20.0.

The NUTS2 regions were hierarchized in the second stage. From a large class of hierarchy techniques were used, the real rank method, which is based on the gapes to the best performance as the referential value, relative to the amplitude variation. This technique assumes that, depending on the nature of the indicator, the calculation of the real rank for each indicator is performed with a specific formula. (Nelea, 2006) We used for the seven indicators analyzed, the formula:

$$R_j^i = n - \frac{a_j^{max} - a_j^i}{a_j^{max} - a_j^{min}}(n-1), i = 1,2,\ldots,n; j = 1,2,\ldots,m \qquad (2)$$

where: a_j^i - the value of the j indicator for the territorial unit i, n - the number of territorial units, m - the number of indicators considered, a_j^{max} - the maximum value of indicator j, the "best" depending on the nature of the indicator. Final real ranks are calculated as average values. The method allows the calculation using the weighted arithmetic average model, the weights being determined according to the importance of each indicator considered in the study. In this case, the weights were considered equal. The hierarchy has been ranked according to the rank level, allowing for the identification of changes between and within regions. To highlight the evolution and structural changes of the R & D sector al the territorial level, from the perspective of the considered indicators, the results for the years 2007 and 2014 were compared.

3. Results and discussion

For both the 2007 and the 2014 situation, the clustering result revealed the major gap between the București-Ilfov Region and the other Romanian 7 NUTS2 regions, which remain grouped as similar.

Figure no. 1. Dendrograms
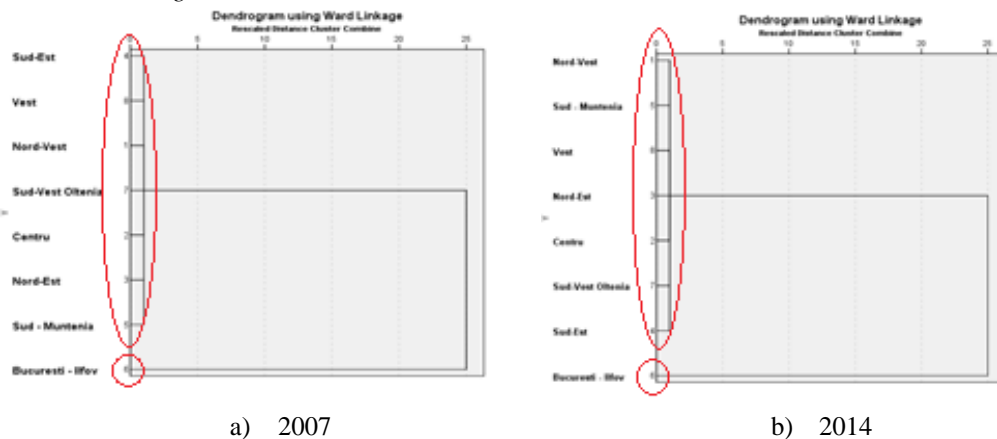
a) 2007   b) 2014
Source: SPSS 20.0 Outputs for Hierarchical Cluster Analysis with the Ward's procedure

Note only two clusters formatted both in the year 2007 and 2014, too. Cluster 1: București - Ilfov Region, and Cluster 2: all the rest seven regions. The results of the clustering in 2 cluster using SPSS K - means Cluster procedure highlights the large distances between the two cluster centers and the role of the chosen variables in classifying. By using Ward's method, the two clusters have been formatted to maximize the differences among the eight regions, so the F tests from ANOVA table are used only for descriptive purposes. In this case, the observed significance levels indicate that there are not indicators, among the 7 indicators considered in the multicriteria analysis, with large F values which can provide a greater separation between the two clusters. However, note a smaller distance between cluster centers, only 12915.826, in 2014, versus 14739.567 in 2007. That can explain a reduction in disparities. Because of all of that, it was necessary to hierarchize the eight development regions using real ranks method to put in evidence the real distances between them.

Finally, was analyzed the cumulative influence of the seven indicators in re-ranking regions in the national hierarchy.

Regarding the hierarchy based on the indicators of *Group 1-"Expenditures"* note the advance of the București-Ilfov Region compared to all the others. București - Ilfov placed in the first position, with "best performance" since 2007. The other regions are positioned especially on the final positions, 7-8 in terms of real ranks, both for each indicator, as well as multicriterial. Only Sud-Muntenia Region seems to be placed closest from București-Ilfov, but only on the 6,85 position (See Table no. 3.). Remark Centru Region placed in the last position for all indicators, and Vest Region on the 7,53 position in terms of real ranks, but the position 5 in the final ranking.

For the year 2014, București - Ilfov remains in the first position, while four of the other regions are advancing in the hierarchy, although insignificant, grouping on positions 6-7, and only three places in positions corresponding to 7-8. Looking at the hierarchy changes for each region, in 2014 compared with 2007, in terms of real rank, can note that, excepting București -Ilfov Region, which remained in the first place, and Sud-Est Region, which had an insignificant decrease but remained in the last place, the other six regions recorded easy improvements in positions, climbing in the hierarchy. In terms of final hierarchy, Bucuresti-Ilfov maintained the first position; Sud-Muntenia maintained the second place, too.

When all the other regions have advanced one place in 2014 compared with 2007, only the Centru Region climbed 5 positions, from the last one, the 8th, in the hierarchy in 2007, to the position 3 in the hierarchy in 2014, indicating the efforts of the region to alleviate the major gap in 2007 faced by the region with respect to the others in terms of Total R&D expenditure.

Table no. 3. The algorithm of hierarchizing concerning the group -1 of indicators, for the years 2007 and 2014

Region	Indicator_2007			Indicator_2014			Ranks_2007					Ranks_2014				
	IND_1	IND_2	IND_3	IND_1	IND_2	IND_3	R_1	R_2	R_3	R_{Real}	R_{Final}	R_1	R_2	R_3	R_{Real}	R_{Final}
N-V	58,00	21,3	0,38	45,92	17,7	0,27	7,3	7,4	6,5	7,07	3	7,19	7,3	5,96	6,82 ↑	4 ↓
C	22,26	8,8	0,15	52,82	22,4	0,32	8	8	8	7,98	8	7,03	7,05	5,47	6,52 ↑	3 ↑
N-E	49,03	13,2	0,36	43,08	13,2	0,28	7,4	7,8	6,7	7,29	4	7,26	7,54	5,86	6,88 ↑	5 ↓
S-E	24,17	8,5	0,18	10,91	4,4	0,06	7,9	8	7,8	7,91	7	8	8	8	8 ↓	8 ↓
S	69,49	21	0,45	66,73	21,6	0,37	7	7,5	6,1	6,85	2	6,71	7,1	4,99	6,26 ↑	2 →
B-I	376,0	168,5	1,24	313,8	137,5	0,78	1	1	1	1	1	1	1	1	1 →	1 →
S-V	20,32	8,9	0,2	16,47	8,1	0,15	8	8	7,7	7,89	6	7,87	7,81	7,13	7,6 ↑	7 ↓
V	33,45	17,4	0,27	25,28	13,9	0,18	7,7	7,6	7,2	7,53	5	7,67	7,5	6,83	7,33 ↑	6 ↓

Source: Calculated by the authors using MS Excel, based on data from Eurostat database
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_e_gerdreg&lang=en

Regarding the *Group 2 -"Researchers"* included four indicators, in 2007, București - Ilfov Region placed in the first position, with "best performance". All the other regions are positioned especially on the final positions, from 7,467 to 7,959 in terms of real ranks as a multicriterial view. Almost half of the Romanian researchers are concentrated in București - Ilfov Region in 2007. In the year 2014, we found a slight movement of real positions, from 7,467 to 7,959, to 6,82- 7,63. The Vest Region occupied the second position, after București - Ilfov Region - "the best performance", and Sud-Est Region, the last one.

Table no. 4. The algorithm of hierarchize concerning the group - 2 of indicators, for the years 2007 and 2014

g i	Indicator_2007				Indicator_2014				Ranks_2007						Ranks_2014					
	IND_4	IND_5	IND_6	IND_7	IND_4	IND_5	IND_6	IND_7	R_4	R_5	R_6	R_7	R_{Real}	R_{Final}	R_4	R_5	R_6	R_7	R_{Real}	R_{Final}
N-V	2321	1254	0,2023	0,1093	1453	2280	0,12	0,19	7,7	7,67	7,73	7,79	7,724	4	7,17	7,34	7,32	7,56	7,35 ↑	4 →
C	2257	837	0,2242	0,0832	1285	1832	0,15	0,21	7,73	8	7,61	8	7,836	7	7,31	7,61	7,14	7,48	7,39 ↑	5 ↑
N-E	3269	1632	0,1928	0,0962	1730	3332	0,11	0,22	7,17	7,38	7,78	7,9	7,558	3	6,95	6,68	7,43	7,42	7,12 ↑	3 →
S-E	1776	1006	0,1538	0,0871	435	1211	0,05	0,13	8	7,87	8	7,97	7,959	8	8	8	8	8	8 ↓	8 →
S	2724	2074	0,1855	0,1413	1594	2160	0,12	0,16	7,47	7,03	7,82	7,54	7,467	2	7,06	7,41	7,35	7,77	7,4 ↑	6 ↓
B-I	14361	9807	1,4103	0,9631	9059	12468	0,85	1,17	1	1	1	1	1	1	1	1,01	1	0,97	1 →	1 →

S-V	2175	1120	0,2116	0,109	934	1625	0,1	0,18	*7,78*	*7,78*	*7,68*	*7,79*	7,758	6	*7,59*	*7,74*	*7,52*	*7,68*	7,63 ↑		7 ↓
V	1857	1078	0,2223	0,1291	1619	2626	0,21	0,34	*7,95*	*7,81*	*7,62*	*7,63*	7,756	5	*7,04*	*7,12*	*6,57*	*6,57*	6,82 ↑		2 ↑

Source: Calculated by the authors using MS Excel, based on data from Eurostat database
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_p_persreg&lang=en,

In terms of changes in real ranks generated by the Group 2 of indicators – "Researchers", excepting Sud - Est Region, which fell a from the position 7,96 in 2007 to 8 position in 2014, all the others advance their real position. However, in terms of changes in the national hierarchy, four regions maintained in 2014 their places from 2007 (București - Ilfov – in the first place, Sud - Est – in last place, Nord - Est in the 3rd place, and Nord – Vest in the 4th place). Other two regions have descended into the hierarchy (Sud-Muntenia from the second position in 6th place, Sud - Vest Oltenia Region from the 6th place in 7th place) and only the Vest Region registered the performance to climb from position 5 to position 2 (See Table no. 4.). Regarding the changes in hierarchy generated by all seven main indicators, the algorithm of real ranks reveals that București - Ilfov Region maintained as the best region in 2014 as in 2007. Only two regions, Sud - Muntenia and Sud - Est, worsed their positions in the hierarchy, and the other four regions, Nord - Vest, Centru, Nord - Est, Sud - Vest Oltenia, and Vest Region registered better positions in 2014 as in 2007. (See Table no. 5)

Table no. 5. NUTS 2 Changes in hierarchy

NUTS2 Regions	Real Ranks						Changes in Ranks	Final Ranks		Changes in Ranks
	2007			2014				2007	2014	
	IND_1-3	IND_4-7	IND_1-7	IND_1-3	IND_4-7	IND_1-7		IND_1-7	IND_1-7	
Nord-Vest	7,07	7,72	7,395	6,82	7,35	7,085	↑	4	4	→
Centru	7,98	7,83	7,905	6,52	7,39	6,955	↑	7	5	↑
Nord-Est	7,29	7,55	7,42	6,88	7,12	7	↑	3	3	→
Sud-Est	7,91	7,96	7,935	8	8,00	8	↓	8	8	→
Sud – Muntenia	6,85	7,46	7,155	6,26	7,40	6,83	↓	2	6	↓
Bucuresti – Ilfov	1	1	1	1	1	1	→	1	1	→
Sud-Vest Oltenia	7,89	7,76	7,825	7,6	7,63	7,615	↑	6	7	↓
Vest	7,53	7,75	7,64	7,33	6,82	7,075	↑	5	2	↑

Source: Calculated by the authors

However, in the national hierarchy by final ranks, remark two regions that registered the performance to climb in the hierarchy, Centru Region from position 7 to position 5, and Vest Region from position 5 to position 2. Sud - Muntenia Region descended into the hierarchy from the second position in the 6th place. Only regions Centru and Sud - Muntenia manage to get closer to București - Ilfov in 2014 as in 2007, placing themselves in the positions 6,955 and 6,83. The Sud - Vest Oltenia Region descended into the hierarchy from the 6th place in 7th place, even if in real ranking had a better performance in 2014 as in 2007. Nord - Vest and Nord - Est Regions, with better performances in 2014 as in 2007, remained in the same places in the national hierarchy. (See table no. 5.)

5. Conclusions

The identification and measuring the regional gaps, tendency to sustain or increase regional disparities with territorial concentration effects, can be a useful tool in the development policy of a state by forecasting, preventing, and correction the socio-economic disparities. It is well-known that supporting research leads to increased attractiveness of a region for investments, given that there is an availability of knowledge and professional human resources there. București - Ilfov is such an example in Romania, București, the capital of the Romania, being included in the region.

The clustering could only highlight the great gap between the București - Ilfov Region and the rest of the NUTS2 regions, which was maintained throughout the analyzed period. That can be explained by included Romania's capital in this region, the largest city with the highest standard of living. Eurostat statistics placed only București - Ilfov Region, as NUTS 2 region in Romania, above the European average in terms of GDP per capita, in 2014, (129%), while among the other 7

only two others were slightly above half of the European average: the Vest region - by 58%, and the Centru - by 52%. Development of Research and Development sector can be one explanation.

6. References

- Altuzarra, A., (2016). Convergence in R&D intensity across European countries: A fractional integration approach, *Acta Oeconomica*, 66(2), 351-374.
- Buciuman, M., Tapai, F., Grigore M., (2017). Romania – striving to become a better host for R&D investments, *Emergency Legal Kit for Business* Series Year 4, Issue 12, February 2017, [online]: Available at: <https://s3.amazonaws.com/documents.lexology.com/55d89172-c023-4d60-9c31-ffd2e9dd298d.pdf> [Accessed 10 August 2017].
- Ferreira, L., Hitchcock, D.B., (2009). A comparison of hierarchical methods for clustering functional data. *Communications in Statistics-Simulation and Computation*, 38(9), 1925-1949.
- Nelea, N.M., (2006). Utilizarea metodei rangurilor reale pentru ierarhizarea multicriterială a noilor state membre ale Uniunii Europene, prin prisma indicatorilor calității vieții, *Analele Universității din Oradea, Management și Marketing*, 690-694.
- Goschin, Z., Sandu, S., and Goschin, G.G., (2016). The impact of economic crisis on R&D convergence in Romania. *56th ERSA Congress*, Viena, 23-26 August 2016. Available at: <http://www-sre.wu.ac.at/ersa/ersaconfs/ersa16/Paper499_ERSA2016.pdf > [Accessed 10 August 2017].