A SPATIAL ANALYSIS OF YOUTH RESEARCHERS IN ROMANIA[1]

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Abstract

Under the New Economic Geography and Evolutionary Economy framework we make a spatial analysis of the youth researchers in Romania. The youth researcher's presence in urban locations predict according to Moretti's (2012) the sustainability of the engine of economic growth. We profile the salaried employment in "R&D activities ISIC 4/ United Nations respectively 72 NACE (Act 72) classification/ INS Romania), at NUTS5 level, using 2011 RPL microdata provided by INS. Applying Univariate Local Moran's, calculated in GeoDa 1.10.0.8 (Anselin 2003, 2005, 2016) reveals for Romania a pronounced clustering tendency for this division, pattern illustrated in Choropleth maps made in ARC GIS. For any competitive city, ***the human capital*** *is a* ***top priority*** *(World Bank, 2015, p.45) as the foundation for its growth policy and to the attraction of the investors.*

Keywords - *youth research, innovation performance, knowledge production, RD agglomeration*

1. Introduction

Importance of RD agglomeration

Mora et al., (2011) found „that highly skilled labour pools induce regions to increase their level of Specialization". Bishop and Gripaios, (2010) points that "local specialization policy option that is likely to yield substantial short-term gains in terms of employment creation". They accentuate the thin frontier between specialisation and diversity, where unrelated diversity brings long term gains in employment creation. Not at least, Bishop and Gripaios, (2010) stress that diversity is "complex and heterogeneous phenomenon, dependent critically on the specific technologies, customers and knowledge relevant to a particular sector".

Kalemli - Ozcan et al. (2003) point out that „human capital may be a better indicator of development than per capita GDP". Di Cataldo and Rodríguez-Pose (2017), finds that "higher innovation and education" contribute to overall employment generation in some regional contexts, low-skilled employment grows the most in regions with a better quality of government". Founds that "the growth rate in one municipality is affected by the growth rates in its neighbouring municipalities" and that "net migration tends to 'spillover' to neighbouring municipalities". Moretti (2012) considers that the high human capital agglomeration is the best predictor for the success of a location.

"**Performance in the area of research and innovation remains modest**. Despite a solid IT infrastructure and the rapid development of the ICT sector, Romania continues to score low on all European Innovation Scoreboard indicators and there are no signs of improving

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performance. **The degree of digitization of both the public and private sector remain very low.** (COM (2018) 120 final)

Dachin and Postoiu, (2015) founds for Romania that "since 2000 industrial restructuring in the context of economic growth, foreign direct investment and integration in the European research networks led to an increase in the polarization of research and development (R&D) activities between NUTS3 and even NUTS2 regions". It remarked the case of Arges and Ilfov counties, are the leaders in 2011 with 1.2-2.9% of regional GDP for R&D expenditures at NUTS 3 level. Locations that attract people indicates success in a global world. Beyond the economic performances, these places are more and more important for their role in the mechanism of empowerment of people. Pollock and Hind, (2017) found that place' will become an ever more important concept in understanding the motivations for civic and political engagement". On the other side, the pursuit of identity and personality formation is another driver for global mobility for youth. Roman and Vasilescu, (2016) found that age is a relevant factor for the intention of the youth to migrate: the younger a person is, the higher the probability of wanting to emigrate. Sandu et al., (2014) found that "almost 40% of the respondents state they would like to emigrate, even if only temporarily (for studies or work)".

Our research question is how human resource is in general and youths in special, from the R&D sector spatially distributed? The identified patterns are random or clustered?

Rodríguez-Pose and Crescenzi, (2008) announces since 2008 the importance of "proximity for the transmission of economically productive knowledge, as spill overs are affected by strong distance decay effects". In this context, the youth researcher's spatial analysis at LAU2/NUTS5 level is an original contribution, first time made for Romania.

2. R&D&I short profile in Romania

2.1.Human resource from R&D activity in Romania - focused on youth researchers

According to Iagăr, (2017) INS in December 2017 were 44,8 thousand persons employed in R&D activity, from which 32,6 thousand employees with full-time equivalent. Female represent a share 45.8% from total employees in R&D activity and 44.7% from total researcher's employees. The tertiary education level of this employees have the following structure: 42.2% with doctoral and post doc studies, 41.6% with tertiary level (exclusive doc and post doc), and 1.3% short term education for tertiary graduates before Bologna system implementation and of the education (tertiary exclusive one) 14.9%.

Youth concept from the Age perspective

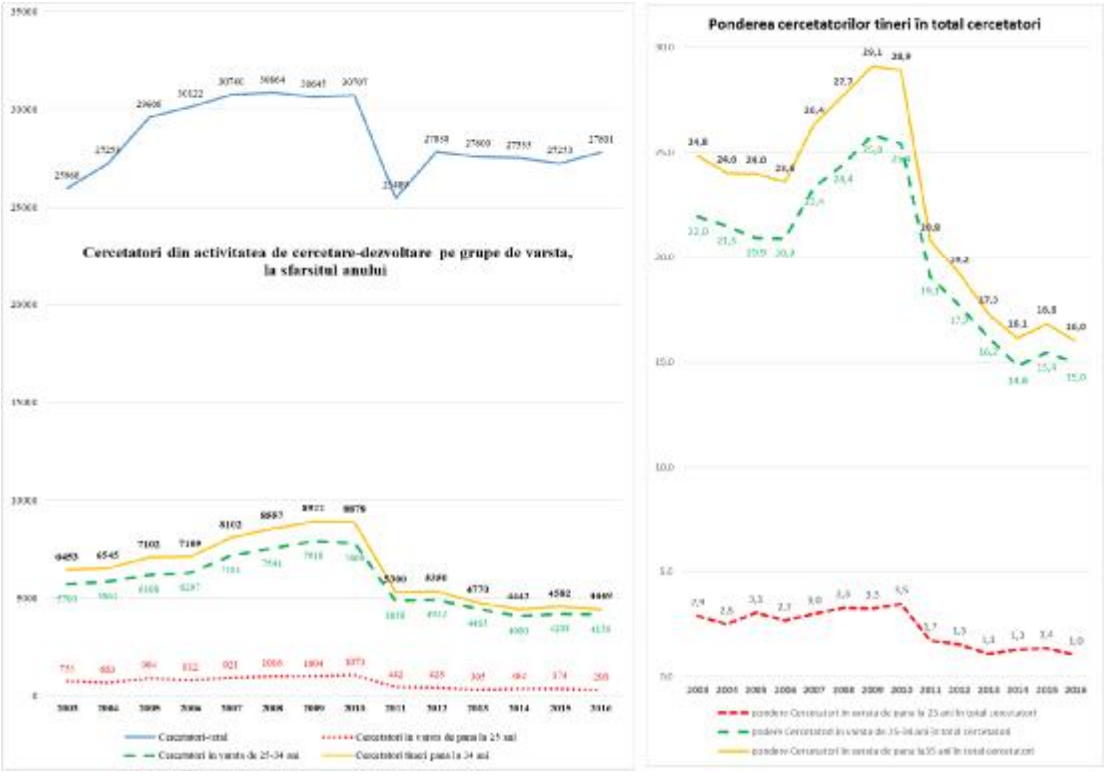
Perovic, (2016) points that Romania defines youth age between 15-35 years old, the 35 years is regulated by housing law eligibility support. EU in its strategic framework targets young people between 15 and 29 years of age. The usual youth age group for labour market comparability is 15-24 years.

Youth researchers in Romania

The research activity for youth is at the frontier between high education and work. On the background of Bologna framework (3 – 2 – 3) the access to doctoral programs is in education system, counted for 15-24 years old age group. POCU doctoral programs provide bursaries fact that indicate the presence of a "work contract" in appropriate research activities. The 25-34 /35

years is the second age interval where is possible to found youth researchers, as freelancers but mostly as employees in RD institutes.
Research activity is a long term team work. Gingras et al., (2008) founds for US that "the average age at which U.S. researchers receive their first grant from NIH has increased from 34.3 in 1970, to 41.7 in 2004". Blau and Weinberg, (2017) establish in 2017 a "steady-state mean age 2.3 y higher than the 2008 level of 48.6". The authors signal as effects of researcher ageing the risk of decreasing the scientific production coupled with extension of the age exit from the labour market for the old one.
In Romania the total researcher gather 27.8 thousand in 2016, higher with 2.5 thousand compared to 2011 and less with 10 thousand compared to 2008! Youth researchers, below 34 years old counts in 2016 around 4.4 thousand from which 290 are aged less 25 years old. In 2009 with 8.9 thousand was reached the maximum of total youth researchers (with age less than 35 years), while the youth researcher's accounts more than one thousand. The loss of youth in research is dramatic, following the shock from 2010.
The number of youth researches (15-34 years old) halved in 2016 since 2008. There is a more accentuate process for the youth researcher's ages 15-24 years old, which decreased tree times in 2016 compared to 2010. (See Figure 1)
The speed of youth researchers decreasing is vital for the policies.

Figure 1. Researchers from the research-development activity by age group at the end of the year and their share in total researchers, during 2003-2016



Sursa date: INS / TEMPO / CDP102H - Researchers from the research-development activity by age group at the end of the year

According to EIS 2018[1] database Romania has a low coverage in terms of:

[1] https://ec.europa.eu/docsroom/documents/30282

-**The percentage population aged 25-34 having completed tertiary education** with 25.6% in 2017 higher with 0.2pp than the level from 2011. Its rank is 34/34, the lowest performance, at 65% only form the EU average;
-**New doctorate graduates per 1000 population aged 25-34 years old** decrease from 2 in 2011 to 0.85 in 2016. This decrease is very sharp, the number of new doctorate graduates in 2017 is 42% only form the level in 2011. EU tendency reverse, new doctorate graduates per 1000 population aged 25-34 years old increasing from 1.5 in 2011 to 2.01 in 2016, or in absolute terms with 1/3 in 2017 compared to 2011.
-**Foreign doctorate students as a % of all doctorate students** is 3.8% in 2016 for Romania, higher with 0.8 compared to 2011. At EU average the doctorate internationalization is 26.1% in 2016, higher with 1.6pp than 2011. This positive trend fail to fill the gap of 85% compared to the EU level for 2016 performance.

2.2.Knowledge production

Following the developed countries model, the development countries build strategies to create comparative advantage. This process request more and more to increase the adoption of the technologies on the background of exponentially increasing of the technological rate of changes. Freeman, (2010) found that scientific and engineering talent are globalised. He also points 5 types of the manifestations in which "Globalization of scientific and engineering has proceeded: (1) expansion of mass higher education worldwide; (2) growth in number of international students; (3) immigration of scientists and engineers; (4) non-immigration trips: academic visitors, conferences; (5) greater international co-authorship and co-patenting."
Knowledge production is decreasing for theoretical publication and improved in applied intellectual protection mechanisms (patents, trademarks and designs).
International scientific co-publications per million population increase for Romania with 50.4 % growth rate form 120.9 in 2011t to 181.8 in 2019, representing 35.1% from the average EU performance. At EU level this rate was 42.5% reaching 517.5 international scientific co-publications per million population in 2017.
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country confirm the negative trend for Romania with 4.8 in 2015, with 0.21 less than the performance from 2011.
The impact of scientific of Romanian publication compared to EU average decrease from 47.8% in 2011 to 45.4% in 2015. This indicator is slightly higher with 0.07pp in 2015 at 10.57 scientific publication compared to 2011 level.
Public-private co-publications per million population is 3.7 in 2017 for Romania, less 1.4 publication than 2011.
In EU this indicator is 40.9 in 2019, higher with 1.4 than the level from 2011.
PCT patent applications per billion GDP (in PPS) is 0.22 in 2015 for Romania, slightly higher than the 2011 level of 0.21. At EU average the PCT patent application decrease form 3.87 in 2011 to 3.53 in 2015, contraire tendency to Romanian one.
Trademark applications per billion GDP (in PPS) increase in Romania with a growth rate of 16.7% in 2017 compared to 2011 while in EU average this rate was only 12.8%, reaching only 33.6% from the EU average. In 2017 Romania have 2.64 Trademark applications per billion GDP (in PPS) wile EU average is of 7.9.

Design applications per billion GDP (in PPS) boosts in Romania with 158.4% growth rate in 2017 compared to 2011 while at EU average the growth rate is -1.9%. Even is an important development f design application in Romania covers only 29.4% from EU average in 2017, form 11.9% in 2011.

2.3.R&D expenditure

In Romania in 2016, R&D intensity fell slightly to 0.48 % of GDP In the 2018 budget, the R&D allocation was increased by about 15 % compared to the budget executed in 2017 (*Source: 2018 European Semester Country Report, p .42-43).*

According to EIS 2018[1] **:**

- In the **public sector** (% GDP) is 0.21 in 2016, decreasing with 0.1pp compared to 2011. EU in 2016 make 1.32% GDP expenditure in the business sector, increasing with 0.13pp
- **In the business sector** (% of GDP) is 0.27 in 2016, increasing with 0.9pp compared to 2011. EU in 2016 make 1.32% GDP expenditure in the business sector, increasing with 0.13pp

2.4.Regional innovation performance is decreasing visible

2017 Summary Innovation Index (SII) is for Romania 0.157, present a negative change of -14 for SII during 2017-2010. The same tendency is evident for human resources sub index, from 0.089 in 2017 present an accentuated negative change of 18.3 in 2017 compared to 2010. We mention that 2011 SII was 0.223.

At regional level in 2017 all regions are included in the modest innovators performance group, with a negative trend in relative performance to EU in 2011. This status is available to Bucharest – Ilfov region, labelled as a modest innovator but with a positive trend. (Table 1)

RII's values reflects the innovation crises in Romania, losing pace towards EU tendency in 2017 to 2011.

Table 1. Regional Innovation Scoreboard 2017 - Relative performance to EU in "2011"
Corrected version of 21 September 2018: results for Chemnitz and Dresden swapped.

	Macro regions	RII2011	RII2017	RII2017-RII2011	"2017" - score relative to EU 2017	Performance group
RO12	Centru	39,1	31,5	-7,6	30,7	Modest -
RO41	Sud-Vest Oltenia	34,2	23,9	-10,3	23,3	Modest -
RO42	Vest	46,5	35,9	-10,6	35,0	Modest -
RO31	Sud - Muntenia	38,6	27,6	-11,0	26,9	Modest -
RO32	Bucuresti - Ilfov	62,1	48,5	-13,7	47,2	Modest +
RO11	Nord-Vest	44,2	29,1	-15,1	28,4	Modest -
RO22	Sud-Est	45,0	27,1	-18,0	26,4	Modest -
RO21	Nord-Est	44,3	23,7	-20,7	23,0	Modest -

Source: https://ec.europa.eu/docsroom/documents/31644

[1] https://ec.europa.eu/docsroom/documents/30282

3.Youth policy aspects focused on youth attraction in R&D&I

3.1.Youth Researchers in the EU policy

The main EU documents regarding youth policy are:"EU Council Approves EU Youth Strategy 2019-2027", the "Regulation on European Solidarity Corps 2021-2027" and the "Conclusions on the role of youth work in the context of migration and refugee matters."

The 6th cycle of the EU Youth Dialogue –

Youth in Europe, create the European Youth Goals, in the framework of Youth Strategy 2019-2027, based on the Council Resolution of 26 November 2018:

1) "Connecting EU with Youth
2) Equality of All Genders
3) Inclusive Societies
4) Information & Constructive Dialogue
5) Mental Health & Wellbeing
6) Moving Rural Youth Forward
7) Quality Employment for All
8) Quality Learning
9) Space and Participation for All
10) Sustainable Green Europe
11) Youth Organisations & European Programmes"

Recently EU launched the initiative „The Pool of European Youth Researchers –PEYR, which "represents a contribution of both the Council of Europe and the European Commission to evidence based policy-making in the field of youth"[1]. Krzaklewska, (2016) identifies in the context of PEYR an Europe-centric perspective in youth research with specific domains: inequality, health and mental health, attitudes and norms among young people, well-being, and citizenship. Also, there are identified new research topics with request funding such as inflow of refugees and the rise of nationalism while other topic decreases in its importance (i.e. migrant integration).

Stafseng (2001) in his reflections on the development of Agendas for European Youth research points that the general problem of younger researchers is the "reality of academic slavery". Intellectual career is specific, request both cooperation and competition among peers. Stafseng (2001) emphasis that problem "for youth researchers is the organisational orientation – between policies based networks and academic networks". Policies based networks block the research career development and transform them in administrative functionaries. The academic networks are "gerontocratic" by nature and based on merits and hierarchies. There are problems to access a research field, to tasks and projects and develop its peer relations. Stafseng, (2001)

[1] https://pjp-eu.coe.int/en/web/youth-partnership/peyr

These conclusions are confirmed by Krzaklewska, (2016). Krzaklewska found that from the EU perspective the number of researchers is relatively high but "in most cases youth research has limited resources and little impact on national youth policy." Kovacheva, (2001) identifies as a common changes for the youth research in East Central Europe "the pressure of reduced state funding, fact that generate a competition for limited resources" which shapes the youth research community in the region.

In regard research spill over and regional innovation policy approach Guastella and van Oort, (2015) support in the EU case both strategies approaches place based policy strategies alongside with place-neutral (people based) policy strategies. Both types of strategies are important for innovation policies intended to promote research cooperation and dissemination.

3.2.Youth Policy in Romania

European Commission (EC, 2017) regarding youth policies in Romania reports that the National Strategy for Research Development and Innovation (2014-2020) "supports measures to attract young people to science, in formal education and beyond, through measures such as:

• Attracting talented young people to the research career by organizing competitions with prizes for innovative solutions.

• Establish a Science City in the proximity of an innovation cluster or major infrastructure.

• Organizing tours, exhibitions, open days, to promote science to the public, including and promoting the outstanding results of Romanian research.

• Promote interest in science and innovation in pre-university education by including recent findings in textbooks and electronic didactic materials by including in the curriculum some elements of education on innovation-based entrepreneurship through collaboration with technical magazines addressed to pupils and publications popularization of science.

Fostering innovation through non-formal and informal learning and youth work

Fostering innovation through non formal and informal learning and youth work is only targeted through the Erasmus + granted projects implemented by nongovernmental organizations."

We have to emphasize, that at this moment, by our knowledge there is no specific youth policy in Romania dedicated to attract youth in R&D.

4. Method

Using microdata from 2011 RPL data provided by INS we build LISA (local indicator of spatial association) maps. These maps allow us to make an analysis for spatial distribution of the employees from M 72 CAEN Rev 2 at NUTS5 level in 2011 by the following groups: total, tertiary level of education and youth (15-24 years) total, men and females.

Patacchini and Rice, (2007) uses Exploratory Spatially Data Analysis (ESDA) to analyse patterns of spatial association for different indicators of economic performance. ESDA has the Local Indicator of Spatial Analysis (LISA) technique useful to select clusters Low–Low and High-High - spatial cluster hot spots, in GeoDa and Arc Gis Desktop (Anselin, 2010).

This is a technique of LISA allows the decomposition of global indicators like Moran's I into the contribution of each individual observation.

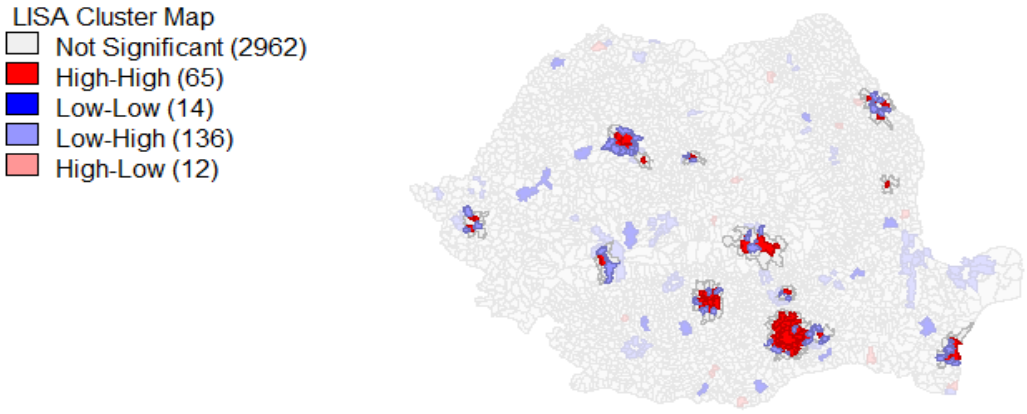
These statistics served "to identify local pockets of no stationarity or hot spots and to assess the influence of individual location on the magnitude of the global statistics and to identify outliers" (Anselin, 2003. 2005, 2016).

With this technique, we could answer the research question **if the identified pattern for the employed person the sector M72 is random or clustered distributed.** We apply Queen Contiguity weight rule of first order. Moran's I Spatial Autocorrelation Statistic is a cross-product statistic with inference based on permutation estimation (Anselin, 2018, GitHub); a Moran's Index value near +1.0 indicates clustering, while an index value near -1.0 indicates dispersion.

5. Results

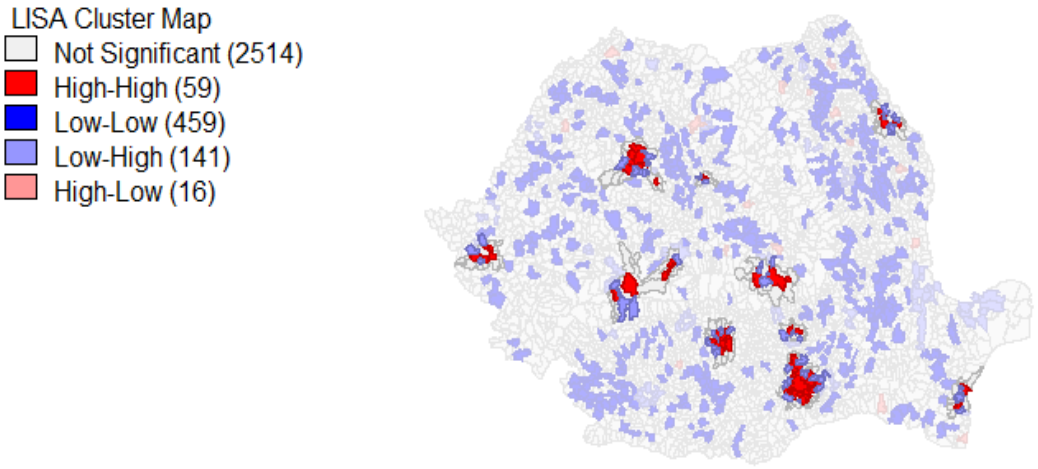
Employees form M 72 NACE Rev.2 at NUTS5 level in 2011 are agglomerated / spatially clustered in 65 locations HH level (location with high level of employees in R&D surrounded by locations with high level of employees) see Figure 2. These locations are agglomerates in urban areas Bucharest, Cluj, Constanta, Brasov, Pitești, Timisoara, Iasi, Hunedoara and Bacău.

Figure 2. ***LISA (local indicator of spatial association) analysis for spatial distribution of the employees from M 72 CAEN Rev 2 at NUTS5 level in 2011, (RPL / INS data)***



Employees with tertiary level of education form M 72 NACE Rev.2 at NUTS5 level in 2011 are agglomerated / spatially clustered in 59 locations HH level (location with high level of tertiary employees in R&D surrounded by locations with high level of tertiary employees) see Figure 3. These locations are agglomerates in urban areas mentioned in the case of Figure 2, with exception Bacău.

Figure 3. ***LISA (local indicator of spatial association) analysis for spatial distribution of the tertiary employees from M 72 CEAN Rev 2 at NUTS5 level in 2011, (RPL / INS data)***



	E[I]	**-0.0003**										
	A05Ps3	**Moran's I**	**pseudo p value**	**mean**	**sd**	**Z value**			**N0 NH**			**Rank cluster**
3Ps	**Act2_72**	**0.0183**	**0.005**	**-0.0003**	**0.0025**	**7.3521**	**reject NH**	**Clustering tendency**	**59**	**Cercetare-dezvoltare**	**72**	**10**

Figure 4. ***Spatial distribution (LISA analysis - hot spot) for young people in the research sector M 72 CAEN Rev 2 - 15-24 years clustering tendency: Bucharest, Timisoara, Cluj, Pitesti, Buzau, Ploiesti, Braila,***

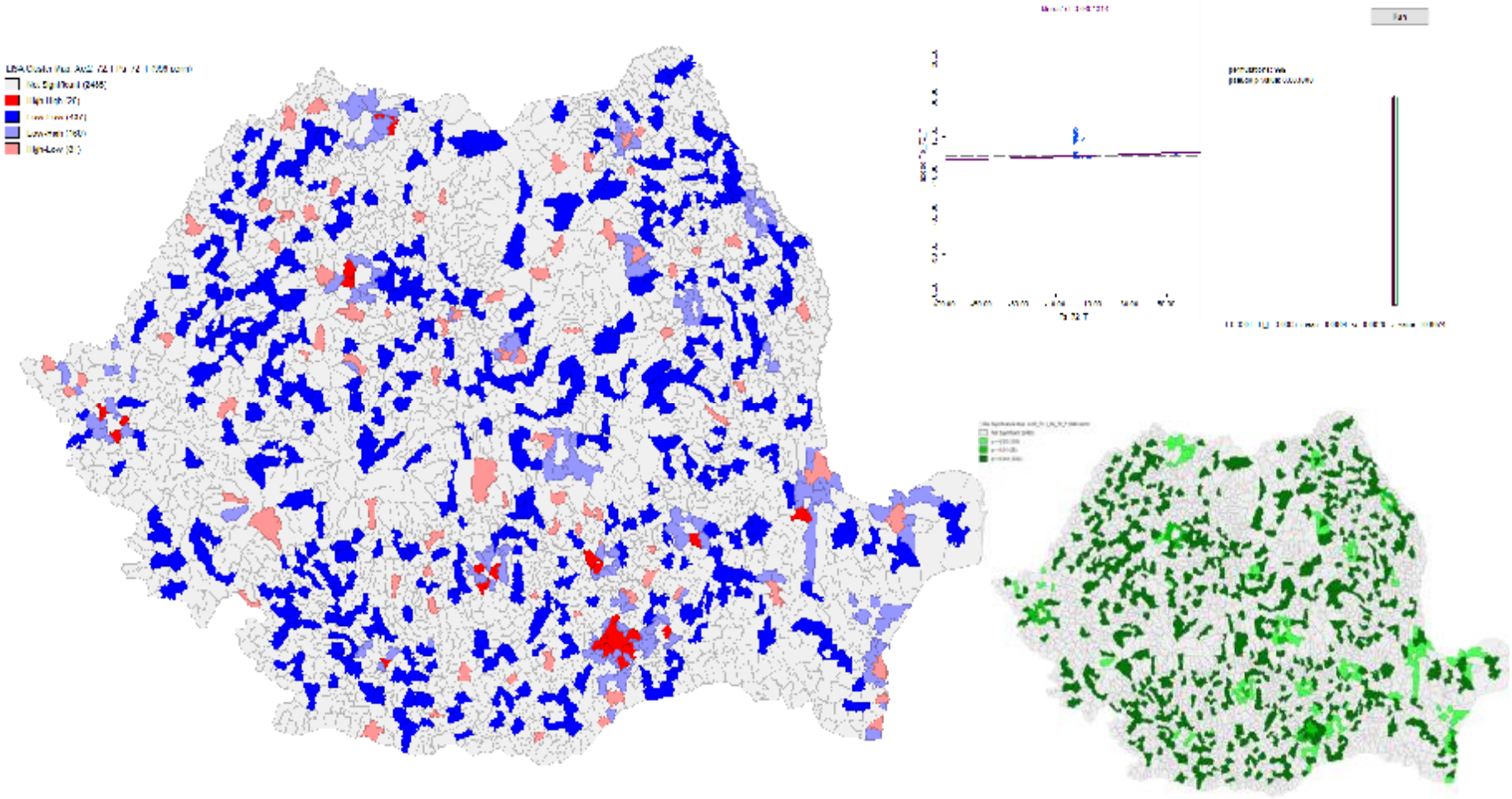


Figure 5. ***Spatial distribution (LISA analysis - hot spot) for young female's employees in the research sector M 72 CAEN Rev 2 - 15-24 years. Clustering trend: Bucharest, Timisoara, Cluj, Buzau, Ploiesti, Galati, Arad, Baia Mare***

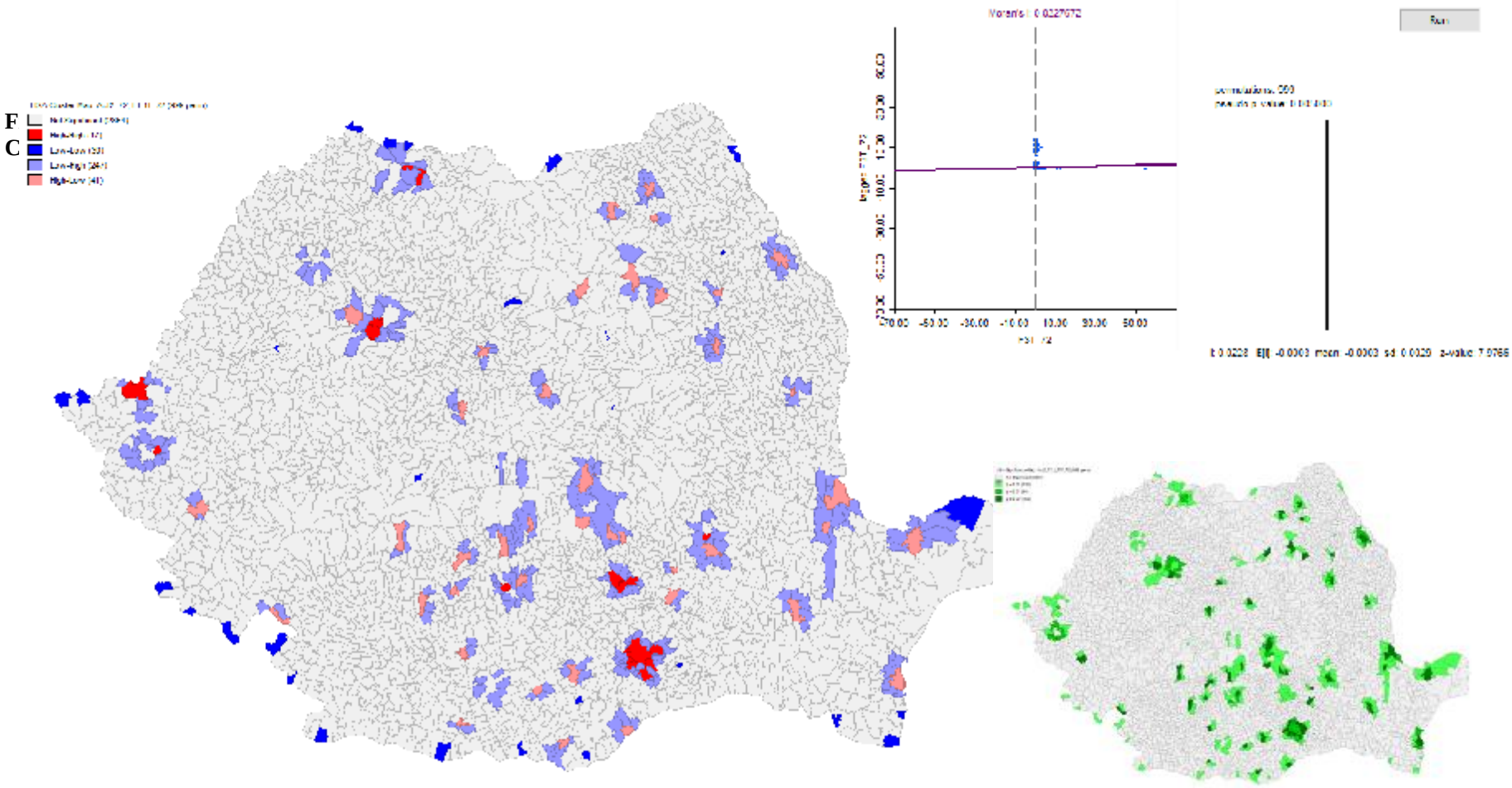
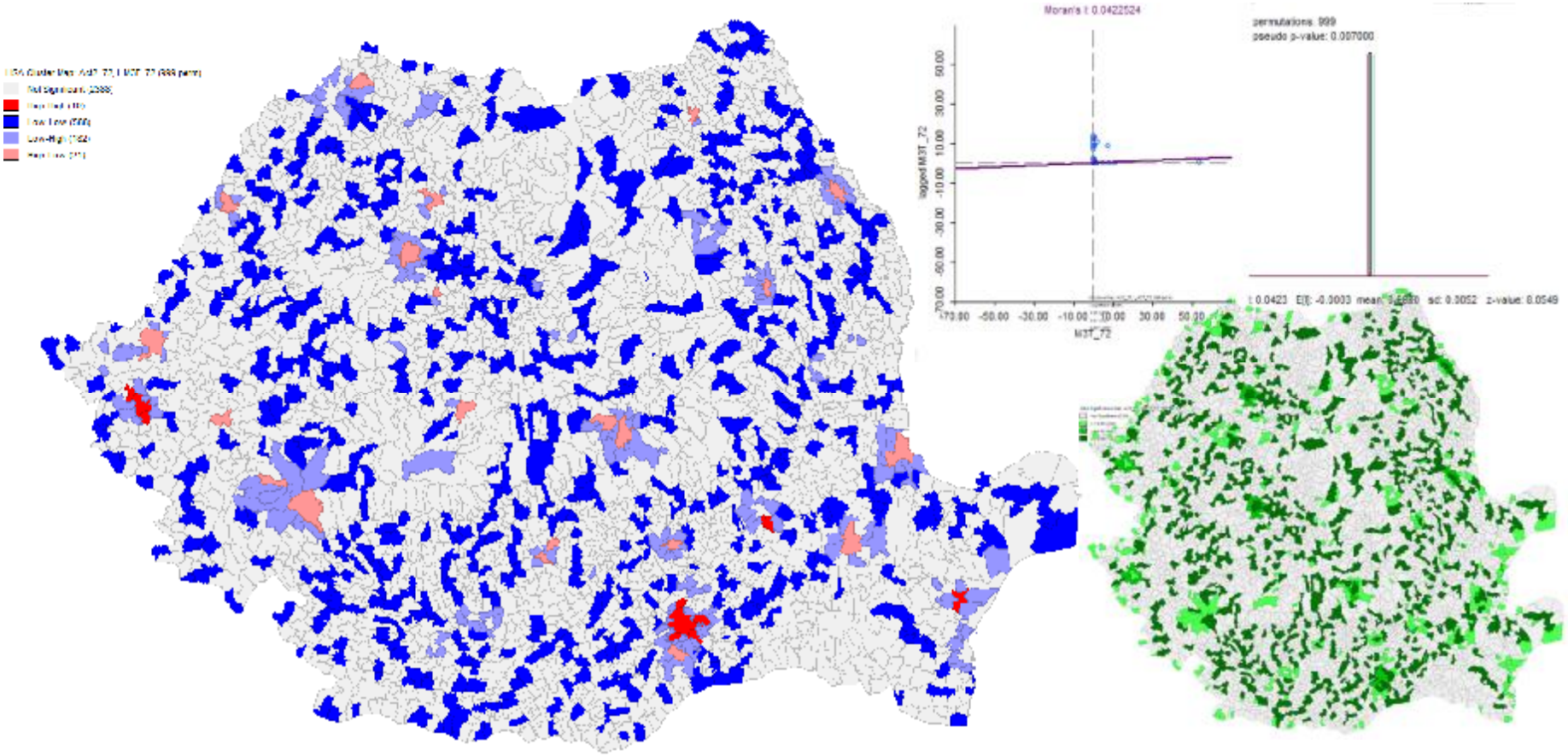


Figure 6. Spatial distribution (LISA analysis - hot spot) for young people (men) employed in the research sector M 72 CAEN Rev 2 - 15-24 years. Clustering trend: Bucharest, Timisoara, Buzau, Galati, Constanta



Employees aged 15-24 years old form M 72 NACE Rev.2 at NUTS5 level in 2011 are agglomerated / spatially clustered **in only 26 locations HH level** (location with high level of youth employees in R&D surrounded by locations with high level of employees) see Figure 3. These locations are agglomerates in urban areas Bucharest, Timișoara, Cluj, Pitești, Buzău, Ploiești, Brăila.
Female Employees aged 15-24 years old form M 72 NACE Rev.2 at NUTS5 level in 2011 are agglomerated / spatially clustered in **only 17 locations HH** level (location with high level of youth employees in R&D surrounded by locations with high level of employees) see Figure 4. These locations are agglomerates in urban areas Bucharest, Timișoara, Cluj, Buzău, Ploiești, Galați, Arad, Baia Mare.
Male Employees aged 15-24 years old form M 72 NACE Rev.2 at NUTS5 level in 2011 are agglomerated / spatially clustered **in only 10 locations HH level** (location with high level of youth employees in R&D surrounded by locations with high level of employees) see Figure 5. These locations are agglomerates in urban areas Bucharest, Timișoara, Buzău, Galați, Constanța.
Brașov and Iași do not present youth R&D agglomerations. Bucharest is cluster for both females and males youth researchers. Arad and Cluj are locations only for youth females employed in RD. Constanța, Timișoara and Buzau are locations only for youth males employed in RD.

6. Discussion and conclusions

The spatial analysis of human capital involved in R&D activities in Romania is heterogeneous spatially distributed with presence in towns/ urban environment. The presence of researchers and of youth researchers in agglomeration is explained by the heterogeneity R&D allocation funds, differences in regional R&D infrastructure development and life infrastructure quality. In some scientific fields is a high infrastructure dependence (engineering and technical domains) and in others – socio-economic fields is a high dependency on academic /social networks.
In important urban centres like Brasov and Iasi do not presents youth researchers entrances in 2011. This fact could be explained through differences in the life quality infrastructure (housing, water, gases, heat roads, transport, pollution, leisure areas, etc.). Cultural model and its life quality infrastructure is more and more, in the globalised era, the choice criteria, overpassing the pecuniary offer some times, fact emphasized also by Ghosh, (2011). Romania lose in the global completion the race of high quality of life infrastructure, especially for the 25-34 years old youth R&D, their decrease is not compensated by foreign researchers.
Youth inclusion in RD is not enough. There is need more and more strongly connected youth R&D with local community. In Romania, is need to empower youth research, concordant conclusion with Krzaklewska, (2016). This is the bi-univocal solution to "address key social issues and revitalize communities and the organizations and individuals within them" (London et al., 2003). London et al (2003) advocates for a youth empowerment through youth-led research, evaluation, and planning, in community development framework. Lundberg, (2006)
Both solutions are at the tip fingers of the policies: to hunt talents, the most global mobile human capital, with high quality of life infrastructure or to build intergenerational bridges and empower youth through active involvement in the community decision.
The clock is ticking ruthless, if the youth high human capital is not attracted, retained and empowered then the vicious circle of losing growth is unstoppable. Failing to replace the losses of high human capital (by relocation in developed metropoles, exit from labour market, exit from research, etc.) sharply decreases the capacity to attract funds, to produce knowledge and not at least to be competitive in a global world. Winners are gathered in competitive cities, locations that controls the three "sources of growth: expansion of existing firms; creation of new firms; and attraction of investors" (World Bank, 2015).
Our main conclusion is, that, especially in the case of youth researchers is need to combine both strategies approaches blind space and place based strategies, in line with Guastella and van Oort, (2015).

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