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Territorial Patterns of Romanian Research and Innovation Projects: Could Smart Specialisation Ultimately Contribute to Reducing Intra-Regional Disparities?

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A B S T R A C T

The study aims to address the concerns of policy makers from Romania's less developed regions regarding the growing intra-regional disparities. This problem has been highlighted in the smart specialisation strategies for 2014-2020, which have been designed in a bottom-up manner, involving stakeholders. The research is based on NUTS3 or county level project data. The data are used to compare the territorial patterns of research and innovation projects funded by the Horizon 2020 programme and the Competitiveness OP 2014-2020 with the spatial distribution of regional smart specialisation projects implemented with financing from the Regional OP 2014-2020. The approach considers the smart specialisation methodology as well as the innovation potential of the Romanian counties. It also embeds the cohesion policy logic, the 'double bell' conceptual framework on intra- and inter-regional disparities and the polycentric development model. The paper shows that greater experience in implementing smart specialisation and the use of mixed funding sources influences, to some extent, a more equitable distribution of funds at the sub-regional level. However, the ability of policymakers to leverage funding for projects resulting from entrepreneurial discovery and a more balanced urban settlement structure within a development region is more important and can promote the reduction of intra-regional disparities in the long term. Regions with a less balanced urban settlement structure should distribute funds more evenly between counties and invest more in urban development. Otherwise, it is very likely that investment will be attracted to the core counties, leading to increased polarisation within the regions.

1. INTRODUCTION

The Cohesion Policy of the European Union (EU) is a territorial planning tool (Medeiros, 2017) and its reforms were also influenced by spatial planning documents (Loewen and Schultz, 2019). "Spatial planning refers to the methods used largely by the public sector to influence the future distribution of activities in space (...), embraces measures to co-ordinate the spatial impacts of other sectoral policies, to achieve a more even distribution of economic development between regions (...), encompasses elements of (...) regional policy, regional planning" (European Commission, 1997, p. 24). The main aim of

Cohesion Policy is to reduce the disparities between less and more developed NUTS2 regions. These are measured in GDP per capita in Purchasing Power Standard.

The latest Cohesion Policy reform, introduced in the context of the Europe 2020 Strategy, put emphasis on innovation driven growth (European Commission, 2010). The reform was applicable to the 2014-2020 programming period. By its start, the disparities between NUTS2 regions had stopped narrowing (European Union, 2014). Smart specialisation strategies were at the core of the reform (McCann, 2015). These became an ex-ante conditionality for the use of Cohesion Policy funds applied to investments in research–innovation and technological development under Thematic Objective (TO) 1 (McCann, 2015; Foray, 2015; Regulation (EU) 1303/2013). Methodologically, the design of smart specialisation strategies relies on the latest concepts from economic geography and on the regional innovation system literature (McCann, 2015). The smart specialisation approach channels investments towards a limited number of priority domains to achieve spillover effects and offers a space for every region (Foray, 2015). For this reason, the approach was considered by McCann (2015) as beneficial for less developed regions. Others (Medeiros, 2017; Loewen and Schultz, 2019; Lagendijk and Varró, 2013) reasoned that smart specialisation will run counter to or substitute territorial and economic cohesion objectives. The latter arguments are based on the theories on regional innovation systems (e.g. Asheim et al., 2020; Asheim et al., 2016; Isaksen et al., 2018) and the implementation experience of previous generations of research and innovation strategies (Bellini and Landabaso, 2005; Asheim et al., 2020). Accordingly, smart specialisation should lead to growing interregional disparities, favouring core regions (Medeiros, 2017; Loewen and Schultz, 2019). Interregional disparities are linked to intra-regional disparities according to the 'double bell' conceptual framework, which relies on polarisation and location theories (Capello and Cerisola, 2024).

Against this background, the aim of the paper is to answer the following research question: could the territorial patterns of the smart specialisation projects financed under Priority Axis (PA) 1 of the Regional Operational Programme (ROP) 2014-2020 indicate the possibility that intra-regional disparities in the less developed regions of Romania could be reduced over time? In doing so, the research responds to the concerns of Romanian regional policymakers as expressed in the smart specialisation strategies drafted for the 2014-2020 programming period. The sub-regional, or NUTS3 level in Romania is represented by counties, which are second-layer administrative units. Existing research (Păcurar et al., 2016; Şerbănică, 2021) shows that the innovation potential of these counties varies.

To answer the research question, data on the funds invested in regional smart specialisation projects are compared with the territorial patterns of investment in research and innovation projects from the Romanian Competitiveness Operational Programme (COP) 2014-2020 and the EU level Horizon Programme. The logic of the Cohesion Policy, as suggested by Berkowitz et al. (2020), is built into the approach chosen. This also draws on the 'double bell' conceptual framework (Capello and Cerisola, 2024) and embeds the concept of polycentric development, which makes it a novelty in the field. In addition, the research is the first one focusing on sub-regional territorial units (NUTS3) in the context of smart specialisation. Previous studies looked at the territorial patterns of these projects from the perspective of the urban-rural divide (Mieszkowski and Barbero, 2021) or studied project beneficiaries and the technological domains addressed by these (D'Adda, 2022).

Besides these advantages, the paper also has limitations. Firstly, it relies solely on project data and desk research methods, without including qualitative information collected from primary sources. Secondly, due to its timing, it cannot address the impact of funds spent, as Crescenzi et al. (2020) did for the Italian research and innovation projects financed between 2007 and 2013. Such research can be carried out later for the regional smart specialisation projects funded in the 2014-2020 exercise, as the financial eligibility period ended in 2023, and the investments have not yet had an impact. Nevertheless, this research tries to draw preliminary conclusions about the likely impact of regional smart specialisation projects on reducing disparities within regions. A future analysis of the impact of these projects would be an obvious further development of this paper, as well as addressing the complementary research topics suggested in the final section of the paper which is preceded by the literature review, methodological considerations, and the presentation and discussion of data.

2. THEORY AND METHODOLOGY

2.1. Smart specialisation and spatial planning

Cohesion Policy aims to foster economic, social and territorial cohesion within the EU (Benedek, 2004; McCann, 2015; Brunazzo, 2016). Most of its budget is allocated to less developed regions (McCann, 2015; Loewen and Schultz, 2019). These NUTS2 regions have a GDP per capita below 75 percent of the EU average (McCann, 2015; Bachtler and Mendez, 2016) and lag in their innovation performance (European Commission, 2023; Commission Implementing Decision (EU) 2021/1130). The less developed regions from Central

and Eastern Europe depend highly on Cohesion Policy funding (Loewen and Schultz, 2019; Pálné-Kovács, 2016).

Cohesion Policy has undergone several reforms since its inception (Benedek, 2004; Manzella and Mendez, 2009; Brunazzo, 2016; McCann, 2015). A part of these were influenced by spatial planning documents, such as the European Spatial Development Perspectives (ESDP) (Loewen and Schultz, 2019). The ESDP (European Commission, 1999), and the subsequent Territorial Agenda 2030, focus on the polycentric development model. This model offers a role for every place in a multicentred structure, placing cities in a hierarchy based on their functions (Hall, 2009). The latest Cohesion Policy reform was introduced starting with the 2014-2020 programming period (McCann, 2015; Bachtler and Mendez, 2016). The Europe 2020 Strategy, emphasizing smart, sustainable and inclusive development to boost economic growth and jobs, offered its context (European Commission, 2010). The main elements of the reform included a more targeted approach towards investments and emphasis on place-based, tailor-made and bottom-up approaches relying on wide stakeholder involvement (Barca, 2009).

Smart specialisation strategies, as the third generation of research and innovation strategies at EU level, were one of the key elements of this reform (McCann, 2015; Loewen and Schultz, 2019; Gonzáles-López and Asheim, 2020), marking a "reversal in the roles of innovation and cohesion" (Lagendijk and Varró, 2013, p. 115). Such strategies, developed at national or regional level, became an ex-ante conditionality for the use of the European Regional Development Fund - ERDF (McCann, 2015; Foray, 2015). There are two important and intertwined elements in the smart specialisation approach, *i.e.* (a) the definition of a limited number of vertical specialisation priority domains, at a mid-grained level of granularity, that point towards new economic activities, based on (b) the results of the entrepreneurial discovery process (Foray, 2015). Through the definition of specialisation priorities, each region should differentiate itself from others (Foray, 2015), and policymakers should avoid 'picking the winners', and 'picking the same winners', enforcing the existing specialisations (Boschma and Gianelle, 2014). The entrepreneurial discovery process is inclusive, involving all interested stakeholders from education and research organisations, companies, the public administration and civil society (Foray and Goenaga, 2013; Foray et al., 2012). It should involve key stakeholders on an ongoing basis, not only in the design of the strategy, but also throughout its implementation (Marinelli and Perianez-Forte, 2017). The specialisation priorities represent a link between strategies and Cohesion Policy financing, as these are translated into eligibility requirements within the calls for proposals (Gianelle et al., 2020). The success of the policy depends on the quality of the smart specialisation strategy and that of the implementation process (Gianelle et al., 2020). The capacity of both policymakers and of organisations participating in the process influence the success of a smart specialisation strategy and the effective and efficient use of European funds (Bachtler et al., 2013; McCann and Ortega-Argilés 2016a, 2016b). To measure the impact of funds invested in research and innovation on regional development, one should consider the logic of Cohesion Policy and its direct and indirect transmission channels: (a) funds are directly invested projects, benefitting companies, that increase their competitiveness and productivity; (b) than, these benefits are indirectly transmitted to other companies through knowledge spillovers and mobilisation of private investments; (c) the results of these projects, together with other investments made from Cohesion Policy (e.g. in education and public infrastructure) and from EU programmes (e.g. the Horizon 2020 research and innovation programme) have a collective impact on regional development (Berkowitz et al., 2020). By the time smart specialisation was implemented, the economic disparities between European regions had stopped narrowing, due to the negative impact of the economic crises on these and on the cities within these (European Union, 2014).

Eastern European regions face several challenges linked to the design and implementation of smart specialisation strategies, however, if correctly used, the policy approach is an opportunity for capacity development and for creating links between the organisations participating in the entrepreneurial discovery (McCann and Ortega-Argilés 2016b; Rodríguez-Pose and Wilkie, 2017). McCann (2015) argued that the approach could be beneficial for less developed regions, whereas others (Medeiros, 2017; Loewen and Schultz, 2019), the opposite. One of the arguments was that the smart specialisation approach will lead to further disparities between regions, possibly sustaining the polarisation of those from Central and Eastern Europe, as innovation strategies usually favour economically developed, highly urbanised regions (Loewen and Schultz, 2019). Indeed, previous generations of research and innovation strategies deployed in the EU at NUTS2 level have been more beneficial to core regions, with more experience in strategy design and more developed regional innovation systems (Bellini and Landabaso, 2005; Asheim et al., 2020). The "Growth Centre" strategy, as the first and partial manifestation of an innovation approach in Cohesion Policy, introduced based on Perroux's work (1970), led to growing inequalities and further polarisation (Asheim et al., 2020). This is attributable to the fact that regions that have diversified industries and are thick in organisations that produce knowledge

(universities, research institutions) are more likely to be more innovative if they can rely on strong collaboration networks (Asheim et al., 2016; Isaksen et al., 2018). These more advanced, core regions are also called metropolitan regions or agglomerations, while, conversely, peripheral regions are those that fail to innovate due to the lack of institutions and connections within the innovation system (Asheim et al., 2016; Coenen et al., 2016). These concepts are applied to regions at NUTS2 level, but also at the sub-regional level. Graffenberger (2019) studies firms in two peripheral, predominantly manufacturing regions that correspond to the NUTS3 level (Germany, Erzgebirgskreis, DED42) or are a part of this level (all subdivisions of Estonia EE008, except for two).

Actually, there are links between the different territorial scales, as well as the polarisation theories (that measure regional economic disparities relying especially on GDP) and those on location that focus on spatial structures and the role of urban networks and agglomerations in innovation processes (see in more detail Benedek, 2004; Benedek and Moldovan, 2015). According to the conceptual framework developed by Capello and Cerisola (2024), polarisation can occur both between and within regions, while intra- and inter-regional disparities are linked, *i.e.* after a concentration phase in urban areas with location advantages, growth opportunities will spread to other urban areas if the settlement structure is balanced or, in regions with an unbalanced settlement structure, if resources are distributed evenly by public authorities. Therefore, Capello and Cerisola (2024) argue for a more equitable distribution of European funds on both NUTS2 and NUTS3 levels, taking into account, in particular, the settlement structure.

2.2. The context in the Romanian less developed regions

The seven less developed NUTS2 regions of Romania are lagging behind in both economic and innovation performance (European Commission, 2023; Commission Implementing Decision (EU) 2021/1130). There are four to seven counties (NUTS3), or second-layer administrative-territorial units, in each region. The urban settlement structure is rather balanced in each region, however development regions North-East, North-West and South-East have a bigger number of counties with primary and secondary regional urban poles (Table 1).

Table 1. Counties and urban settlements in Romanian NUTS2 regions.

NUTS 2 REGIONS	COUNTIES (NUTS 3)	NUMBER AND TYPE OF URBAN UNITS
North-East	Bacău, Botoşani, Iaşi, Neamţ, Suceava, Vaslui	1 regional primary pole (Iaşi), 4 secondary regional poles (Suceava, Neamţ, Bacău, Botoşani), 1 county pole (Vaslui)
South-East	Brăila, Buzău, Constanţa, Galaţi, Vrancea, Tulcea	1 regional primary pole (Constanţa), 3 secondary regional poles (Galaţi, Brăila, Buzău), 1 county pole (Tulcea)
South-Muntenia	Argeş, Călăraşi, Dâmboviţa, Giurgiu, Ialomiţa, Prahova, Teleorman	2 secondary regional poles (Argeş, Prahova), 5 county poles (Teleorman, Giurgiu, Călăraşi, Ialomiţa, Dâmboviţa)
South-West Oltenia	Dolj, Gorj, Mehedinţi, Olt, Vâlcea	1 primary regional pole (Dolj), 2 secondary regional poles (Vâlcea, Mehedinţi), 2 county poles (Gorj, Olt)
West	Arad, Caraş-Severin, Hunedoara, Timiş	1 regional primary pole (Timiş), 1 secondary regional pole (Arad), 2 county poles (Caraş-Severin, Hunedoara)
North-West	Bihor, Bistriţa-Năsăud, Cluj, Sălaj, Satu Mare, Maramureş	1 regional primary pole (Cluj), 3 secondary regional poles (Bihor, Satu-Mare, Maramureş), 2 county poles (Bistriţa-Năsăud, Sălaj)
Centre	Alba, Braşov, Covasna, Harghita, Mureş, Sibiu	3 secondary regional poles (Sibiu, Braşov, Mureş), 3 county poles (Alba, Harghita, Covasna)

Source: own compilation based on Law 315/2004 and MRDPA (2016a).

South Muntenia is a special case, as it surrounds the capital region. It has no primary regional urban pole, but two secondary regional urban areas and five county-level urban poles. The Centre region, which is surrounded by the other less developed regions, has no primary regional urban pole either.

The Regional Development Agencies (RDAs) are responsible for strategic planning at regional level but are not part of the Romanian innovation system that is centralised (Ranga, 2018). During the 2014-2020 programming period, the RDAs acted as Intermediate Bodies for the ROP 2014-2020. The programme was standardised (Szabo, 2017), but with separate allocations for each region (Szávics and Benedek, 2020). The RDAs are the Managing Authorities of decentralised regional programmes implemented during 2021-2027.

The national strategy submitted to fulfil the ex-ante conditionality under PA 1 of the ROP 2014-2020 and the COP 2014-2020 did not fully comply with the requirements, e.g. inclusion of the regional dimension through the entrepreneurial discovery (Szávics, 2020). In order to fulfil the conditionality under TO1, the European Commission required the elaboration of smart specialisation strategies in the seven less developed regions eligible for funding under PA1 of the ROP 2014-2020 (Healy, 2016; Ranga, 2018). The RDAs first finalised Concept Notes for Smart

Specialisation to substantiate the implementation of the technology transfer component of PA1 (Szávics, 2020). The operationalisation of the entrepreneurial discovery process and development of project portfolios were mandatory elements of the concept note design (MRDPA, 2016b). By 2018, all less developed regions had a smart specialisation strategy (Szávics and Benedek, 2020), which were then revised for 2021-2027.

North-West and North-East regions received support from the European Commission between 2016-2028 linked to smart specialisation, the project being extended to all Romanian RDAs in mid-2018 (Ranga, 2018). The consolidation of the entrepreneurial discovery process was part of this project (Ranga, 2018). Since 2018, Romanian regions also received support from the World Bank (Administration Agreement, 2018). Under the Agreement, North-West and North-East regions benefitted from a Research Valorisation and a Structured Research Contract Programme, while all the other regions from the Proof-of-Concept Programme. The implementation of strategies advanced faster in North-West and North-East (Ranga, 2018). A study conducted by Szávics and Benedek (2020) found that these two regions have a better mix of economic and scientific or technological domains at the level of their smart specialisation priority areas.

Based on the results of these projects, the PA1 of the ROP 2014-2020 has been amended to ensure access to funding for the project ideas stemming from the entrepreneurial discovery, and the programmes implemented by the World Bank. Bucharest-Ilfov, the more developed capital region, also became eligible under the Proof-of-concept call. With the diversification of the funding instruments, the number of operations under PA1 increased from three to six, with a final budget of 59.04 million EUR from ERDF. More than 96 percent of this was allocated to less developed regions (Table 2).

Table 2. Types of calls and eligibility requirements under PA 1 of ROP 2014-2020.

TYPE OF OPERATION	ELIGIBLE BENEFICIARIES	TERRITORIAL ELIGIBILITY
A. Technology transfer (investments in infrastructure and services)	Innovation and technology transfer entities	All seven less developed regions
B. Technology transfer (investments in infrastructure and services)	Scientific and technological parks	
C. Technology transfer	SMEs in partnership with innovation and technology transfer entities	
D. Lagging regions' call or complex research and innovation projects resulting from the entrepreneurial discovery, also covering initial investments in production to bring innovation to the market	SMEs, optionally, in partnership with other actors from the regional innovation system	North-West and North-East development regions initially, with the possibility for other regions to opt for this call; only South-East development region decided to take advantage of this opportunity
E. Proof-of-concept (projects starting at Technology Readiness Level 3)	SMEs, optionally, in partnership with research organisations	All eight development regions
F. Research Valorisation Programme	Innovation and technology transfer entities from universities	North-West and North-East development regions

Source: own compilation based on the Romanian Regional Operational Programme 2014-2020 and Call guidelines.

In the long term, it is expected that the investments will lead to an increase in the proportion of innovative SMEs that cooperate with other organisations. This is an indicator from the Regional Innovation Scoreboard. The application of the Growth Pole concept, based on Peroux's theory and the polycentric development model, within the ROP 2007-2013, has led to increasing regional polarisation (Benedek, 2016; Benedek et al., 2019). The projects implemented were concentrated in seven cities (Braşov, Cluj, Constanţa, Craiova, Iaşi, Ploieşti, Timişoara). These were selected in a top-down manner, by a government decision, as representing the first tier of cities in the National Spatial Development Plan, being densely populated areas with good economic performance (Benedek, 2016; Benedek et al., 2019). The impact of the Growth Pole investments remained at the level of urban settlements, without positively affecting the development of their metropolitan areas, as expected (Lucaciu et al., 2019). The smart city projects implemented in Romanian urban areas in recent years are also unevenly distributed, not only across the country, but also within urban areas (Drăgan, et al. 2023; Nicula et al., 2020).

By the time the first regional smart specialisation strategies were elaborated, intra-regional disparities became a concern. Except for the one in South-East development region, every regional smart specialisation strategy pointed out that intra-regional disparities persisted or grew. The Romanian counties differ in their innovation potential and performance, the capital region (Bucharest-Ilfov) being at the forefront (Păcurar et al., 2016; Şerbănică, 2021), followed by Iaşi, Cluj, Argeş, Timiş, Braşov, Sibiu,

Suceava and Dolj in the study realised by Păcurar et al. (2016). Șerbănică (2021) includes Cluj, Timiș, Iași and Ilfov in the category of knowledge intensive hubs, Brașov, Argeș, Sibiu, Arad in that of technology intensive platforms and Dolj, Constanța and Galați in that of diversified agglomerations. According to Șerbănică (2021) these counties are more likely to innovate as they can rely on their public or private research and development capacities and medium to high-technology sectors or good economic performance. The remaining counties are industrial production zones and structurally challenged sub-regional areas (Șerbănică, 2021). Thus, Șerbănică (2021) argues for a differentiated approach at NUTS3 level within regional smart specialisation strategies.

2.3. Methodology and data

The methodology used aims to support answering the research question as presented in the introductory part. According to some of the literature, if smart specialisation policies were designed and implemented according to the approach, there should be a fair number of projects in non-core counties (other than those with primary regional urban poles, former Growth Poles, or those with high innovation potential). This should be more apparent in the less developed regions with a more balanced urban settlement structure. Another part of the literature would suggest that the research and innovation investments from the PA1 of ROP 2014-2020 should be concentrated in core-counties and likely to lead to growing intra-regional disparities in the long term. To answer the research question and test the two hypotheses, project data (number of projects and funding) were collected through desk research, comparing the Horizon 2020 programme and PA1 of the ROP with the COP 2014-2020. The source of the Horizon 2020 data is the Horizon Dashboard (2025), an open data platform including, for each county, the number of project participations and the net EU funding absorbed. The source of the data for the two Romanian programmes is the official webpage of the Ministry of European Investments and Projects (Managing Authority for the COP 2014-2020 and ROP 2014-2020) and the official webpage of the ROP 2014-2020. The latest database available for the COP 2014-2020 (July 2023), with more than 3.000 entries, and for the ROP 2014-2020 (August 2024) with more than 8.000 entries, have different levels of granularity. Both include the priority axis and call numbers, the name of the beneficiary, title of the project, place of implementation (NUTS3, NUTS2 and local administrative unit), financing amount (from the ERDF and the national co-financing) and the status of the projects. The ROP 2014-2020 database also includes the amounts paid to beneficiaries and each investment summary. There is a slight difference between the two databases regarding the status of projects. Both include projects classified as completed, not completed or with their contracts terminated. In the ROP 2014-2020 database there is a category of phased projects, while in the COP 2014-2020 list, some of the projects are marked as being under implementation. Phased projects are investments partially completed by the end of the programmes' financial eligibility period (December 2023 according to the n+3 rule) and are undertaken for financing from 2021-2027 allocations. The status 'under implementation' used in the COP 2014-2020 database was assimilated with that of projects likely to be finalised by December 2023, as the programme has achieved a 99.9 percent absorption rate (MEIP, 2024).

The databases were filtered for PA1 projects. The projects with the status 'not completed' or with 'terminated contracts' were excluded (19 projects from the ROP 2014-2020 and 22 from the COP 2014-2020 database). All projects implemented in Bucharest-Ilfov were eliminated, *i.e.* seven Proof-of-concept projects from the ROP 2014-2020 database, 129 projects from the COP 2014-2020 list and 914 project participations from the Horizon 2020 database. The remaining number of participations from the Horizon database for the rest of counties is 637. The final list of selected projects from the COP 2014-2020 database includes is 252 projects, out of which 167 under implementation, and 52 from the ROP 2014-2020 list. There are four phased projects from the North-West development region in the latter. Two of these are investments in technology transfer capacities (deployed by a scientific and technological park and by an innovation and technology transfer entity) and two projects were financed under the 'Lagging regions' call. The ROP 2014-2020 list also includes one project from South-West Oltenia development region (Dolj county) selected under the single call opened before the regional smart specialisation strategies were completed. The Operation C call was for projects contributing to the national smart specialisation priority areas. It was reopened later, for projects linked to regional specialisation priority domains. The project was kept as relevant for the development region, and the regional specialisation priorities were harmonised with the broader specialisation domains defined at the national level (Government Decision 929/2014; MRDPA, 2016; Szávics, 2020). The ROP 2014-2020 list does not include Research Valorisation projects. The COP 2014-2020 database additionally lists 39 projects with beneficiaries from multiple counties and 9 national level projects. As data regarding partners and their budget share is unavailable, the amounts for these projects were divided equally between the participating counties. The funds invested in Bucharest and Ilfov were eliminated. The data was processed in Excel and visualised on maps using the new Bing Maps software

developed by Microsoft. This was recently embedded in Excel and permits simple and fast data visualisation.

3. RESULTS AND DISCUSSION

After the capital region, Cluj and Iași counties are the largest fund recipients of the Horizon 2020 programme and the COP 2014-2020. These are followed by Brașov, Timiș, Constanța, Sibiu and Suceava, in the case of Horizon 2020, and by Prahova, Dolj, Giurgiu, Timiș, Vâlcea, Argeș, Galați, Constanța and Tulcea counties in the case of COP 2014-2020. The same counties have the highest number of project participations, however, Argeș and Alba in the case of Horizon 2020 or Dolj, in the case of the COP 2014-2020, precede these. Some of these counties - Cluj, Iași, Timiș, Argeș, Brașov and Sibiu – have a better innovation potential (Păcurar et al., 2016; Șerbănică, 2021). Nonetheless, within the top beneficiaries, there are also counties with a lower innovation potential according to the same studies, such as Prahova, Vâlcea, Tulcea or Giurgiu. The cumulative values from the two programmes show almost the same result. The slight difference is that Brașov and Sibiu are not amongst the biggest overall fund beneficiaries (Fig. 1 and Fig. 2).

In development regions North-West, North-East, South-East and West, most investments from both programmes are concentrated in the counties where the primary regional urban poles are located (in Cluj, Iași, Constanța and Timiș). These were Growth Poles during 2007-2013. In South-West Oltenia most of the COP 2014-2020 funds were attracted by Dolj. Nevertheless, Vâlcea, one of the two secondary regional poles was slightly more successful in absorbing amounts from the Horizon 2020 programme. In the two regions without primary regional urban poles, the counties where the former Growth Poles are located (Brașov and Prahova) are more successful in one of the programmes. In the case of the other programme, this applies to counties with secondary regional urban poles (Sibiu in the Centre region) or with a county level urban pole (Dâmbovița in the South-Muntenia region). These slight variations may be due to the location of the various beneficiaries eligible for funding. Vaslui, Caraș-Severin and Gorj, that did not benefit from the Horizon 2020 programme, are all counties with third-tier cities and with a lower innovation potential according to Păcurar et al. (2016) and Șerbănică (2021). Nonetheless, other NUTS3 regions, with similar characteristics did benefit from either the national or the EU level programme. The overall results show that the size and the different functions of an urban settlement are more relevant for the absorption of funds than the innovation potential of the counties. This is not to say that the categorisation or hierarchies from the two studies (Păcurar et al., 2016; Șerbănică, 2021) are incorrect. It means that the innovation potential of these counties might be driven by other types of investments, such as private funds, or, that the activity domain of organisations involved in innovation does not match the EU or national level research and innovation areas eligible for funding. The relatively good participation of less innovative counties in the two programmes can also mean that beneficiary organisations are more connected to wider national or European networks than to those in their geographical proximity, and that the results of projects carried out in partnership are translated into innovation elsewhere.

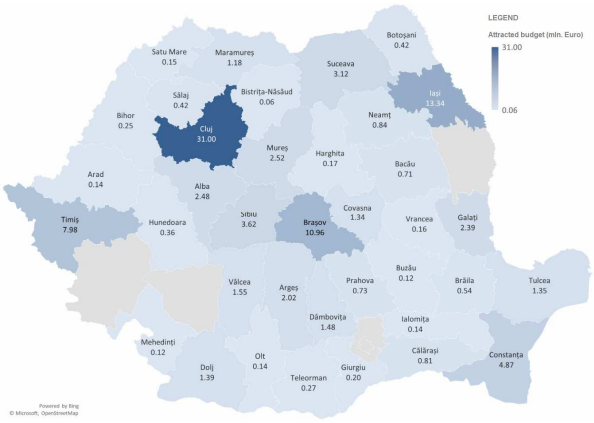

Fig. 1. Amounts attracted from Horizon 2020 in mln EUR by Romanian NUTS 3 regions *(source: own elaboration based on data retrieved from the Horizon Dashboard (Open Data Platform).*

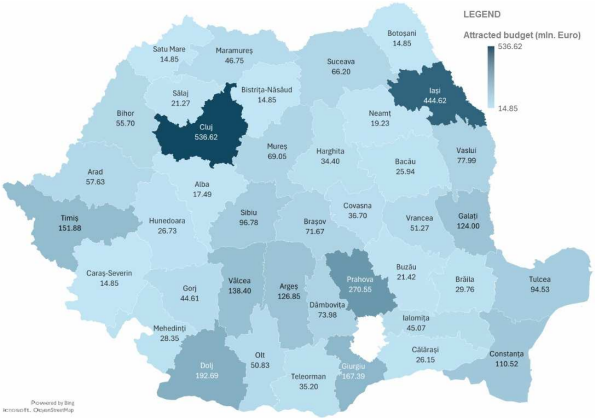

Fig. 2. Amounts contracted from PA1 of the COP 2014-2020 in mln RON by Romanian NUTS 3 regions *(source: own elaboration based on data published by the Ministry of European Investments and Projects).*

The territorial pattern of funds absorbed by regional smart specialisation projects shows a similar pattern with the two cases above in some regions and a very different one in others. At first glance, one can also observe that only half of the counties participate in these projects and both the number of projects (52) and the amounts paid (103.45 million RON) are much smaller than in the case of the COP 2014-2020. There is also a very uneven distribution of amounts between regions, in favour of North-West (48.96 million RON), North-East (22.94 million RON), followed by West (12.76 million RON). This is because the projects with higher eligible budgets (investments in technology

transfer capacities) are mainly concentrated in these regions. The amounts paid out for these projects range from 2.56 million and 4.30 million RON in Iași and Suceava (North-East region), respectively Timiș (West region). The two projects of the same type from the North-West region (Bihor) have received payments of 4.31 and 10.04 million RON, respectively. Such infrastructures were further developed in Dolj, Călărași, Mureș and Timiș counties, with smaller investment values (between 0.19 and 0.94 million RON). The amounts attracted by the North-West and North-East regions are also higher, as these regions, alongside South-East, also benefitted from the 'Lagging regions' call. The funding value of these complex innovation projects depends on the type of innovative product proposed for commercialisation. It can be below 0.5 million RON for a software development project finalised in Brăila county and more than 33 million RON for a project implemented in Bistrița – Năsăud aiming to produce a new vehicle. Due to the above reasons, Bistrița - Năsăud and Bihor counties in North-West development region, and Timiș, Iași, Neamț and Suceava counties from West and North-East regions are the largest fund recipients (Fig. 3).

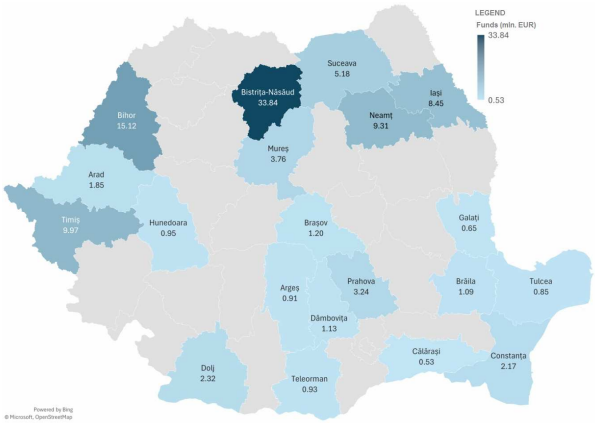

Fig. 3. Amounts paid out from PA1 of the ROP 2014-2020 in mln RON by NUTS 3 regions *(source: own elaboration based on official data published on www.inforegio).*

The highest number of beneficiaries, both overall and by type of investment (in technology transfer infrastructure or in SMEs), is in Timiș county (12 projects out of which 10 directly benefiting SMEs). It is followed by Bihor, Iași and Prahova, with four projects each. The four projects from Prahova are all SME investments. Iași and Mureș have high numbers of beneficiary SMEs (three per county) as well.

Almost half of the Romanian counties (18 out of 41) have no regional smart specialisation projects. These are: Satu-Mare, Maramureș, Sălaj, Cluj (North-West region), Caraș-Severin (West region), Gorj, Teleorman, Vâlcea, Olt (South-West Oltenia region), Giurgiu, Ialomița (South- Muntenia region), Vrancea, Buzău (South-East region), Sibiu, Harghita, Covasna and Alba (Centre region). The territorial distribution of smart specialisation projects is more balanced in development regions West (3 counties out of 4), South-Muntenia and South-East (4 counties out of 6). The highest concentration of projects in a NUTS3 area, within a region, is in North-West, where four out of five projects are localised in Bihor.

Compared to the territorial patterns of investments made from the COP 2014-2020 and Horizon 2020, in development regions North-West, North-East and South-East, there are fair amounts invested from PA1 of the ROP 2014-2020 in NUTS3 areas that were less successful in attracting funds from the EU or national level and are also less innovative. In the case of West and South-West Oltenia regions, investments in smart specialisation projects are concentrated in the core counties. These are the counties that have benefitted the most from national and EU programmes. The main regional urban poles are also located in these counties. The regions Centre and South Muntenia, which have no primary regional urban poles, are a special case. Their smart specialisation projects are partly located in more innovative NUTS3 regions, which additionally absorbed significant amounts from the Horizon 2020 programme and the COP 2014-2020. Another part of the funds was invested in regional smart specialisation projects implemented in NUTS3 regions that are neither very innovative nor competitive in national and European calls.

From the perspective of the literature and the research question, and based on the above information, the less developed regions of Romania can be categorised as follows:

a). North-West, North-East and South-East are breaking patterns with their regional smart specialisation projects. In the North-West and North-East regions, investments from PA1 of the ROP 2014-2020 are not concentrated in the same counties that benefitted more from the Horizon 2020 and the COP 2014-2020 or in those with primary regional urban poles. Nonetheless, there are some differences, as in the North-East, most projects are in Iași, while in the North-West there is no investment in Cluj. In the South-East region, Constanța, followed by Brăila, has been more successful in leveraging funding for smart specialisation projects. In the case of Horizon 2020 or the COP 2014-2020, Galați and Tulcea were the most successful after Constanța. Neamț, Bistrița-Năsăud and Brăila counties from these regions are less innovative (Păcurar et al., 2014; Șerbănică, 2021). The three NUTS2 regions are also the ones exploiting the 'Lagging regions' call. North-West and North-East are more advanced linked to the implementation of their smart specialisation strategies (Ranga, 2018) and benefitted more from the support of the European Commission. The specialisation priorities of both regions were of better quality (Szávics and Benedek, 2020). On county level, the biggest impact on innovation-driven growth is

expected in Bihor (North-West). The county is less innovative on national level but managed to attract funds both for an SME investment project and for two technology transfer infrastructures. The latter two can support research and innovation in SMEs.

b). West and South-West Oltenia concentrate most of their regional smart specialisation investments in Timiş and Dolj counties. The same counties were the main beneficiaries of the Horizon 2020 programme and the COP 2014-2020. Timiş and Dolj are core counties where the primary regional urban poles are located. Both counties are considered the most innovative NUTS3 areas in these regions by both Păcurar et al. (2014) and Şerbănică (2021). Timiş county concentrates the highest number of regional smart specialisation projects in the whole country, investing in both SMEs and technology transfer infrastructure. As the county has a good innovation potential and is successful in fund attraction from different sources, the intra-regional polarisation effects will be bigger in West region.

c). Centre and South-Muntenia are in between the two above mentioned categories. The two regions are without first-tier regional urban poles. The counties from the two regions are not particularly innovative, but some of these - Braşov and Sibiu (Centre) and Argeş (South-Muntenia) – have a good innovation potential according to Păcurar et al. (2014) and Şerbănică (2021). In South-Muntenia, Prahova, Giurgiu and Argeş counties received higher amounts from the COP 2014-2020, while Argeş, Prahova and Dâmboviţa, from Horizon 2020. Under the ROP 2014-2020 the funds were attracted by the same cities as in case of Horizon 2020, but also by Teleorman, which benefited more from ROP 2014-2020 funds than Argeş. The highest number of projects is in Prahova, a former Growth Pole. In Centre region, where, as opposed to South-Muntenia, there are not only SME projects, but also investments in technology transfer, Sibiu, which performed relatively well in Horizon 2020 and the COP 2014-2020, did not attract any funding from the ROP 2014-2020. Mureş, a less innovative county, leveraged more funding than Braşov did. Most of the regional smart specialisation projects (4 out of 6) are concentrated in Mureş, including an investment in technology transfer capacities.

4. CONCLUSIONS

The number of regional smart specialisation projects and their value is rather small, compared to the amounts invested in research and innovation projects from other national or EU level programmes. As it was shown, the core counties from each Romanian development region were the ones that managed to attract higher amounts from the Horizon 2020 and PA1 of the COP 2014-2020.

The primary regional urban poles are in the same counties. These were the Growth Poles in the 2007-2013 programming period. Part of these counties are also more innovative as shown by Păcurar et al. (2016) and Şerbănică (2021).

Since the impact of these more significant investments cannot be offset by those in regional smart specialisation projects under PA1 of the ROP 2014-2020, no definitive conclusions can be drawn as to their contribution to reducing intra-regional disparities. Instead, it can be concluded that some Romanian development regions are on a good path to reduce the development disparities between counties, if they continue to follow the same approach, linked to the territorial distribution of the funds available for smart specialisation projects during the 2021-2027 period, and relying on the entrepreneurial discovery process. Regions North-West, North-East and South-East are, without doubt, in this category. These regions have invested fair amounts in smart specialisation projects, even in less innovative NUTS3 regions that have received smaller amounts of funding from the Horizon 2020 programme or the COP 2014-2020. The same regions managed to leverage the call dedicated to projects generated at the entrepreneurial discovery.

In Centre and South Muntenia regions, the smart specialisation projects are partly located in more innovative NUTS3 regions, which have also managed to attract fair amounts of funding from the Horizon 2020 and COP 2014-2020, and partly in NUTS3 regions that are neither very innovative nor very competitive in national and European calls. The two regions could reduce their intra-regional disparities through an even fairer distribution of research and innovation funds within the region during the current programming period. In development regions West and South-West Oltenia investments in regional smart specialisation projects follow the same territorial pattern as in case of the Horizon 2020 and the COP 2014-2020. If the same core counties continue to attract higher amounts from the decentralised regional programmes, it is highly likely that intra-regional disparities will persist, or event grow in these regions.

Overall, it appears that the more balanced territorial distribution of projects within a development region is not solely due to the smart specialisation approach and the experience gained from its application, or to a greater mix of financial instruments used. It is also due to the flexibility in the financing and in the use of the funds available for the projects generated at the entrepreneurial discovery. The entrepreneurial discovery, as part of the smart specialisation governance, is at the core of the approach (Foray et al., 2012; Foray, 2015). Therefore, it would be relevant to carry out additional research on how the entrepreneurial discovery was conducted in each region, and how it affected the spatial distribution of

projects within regions. Further research should focus on the impact of the regional smart specialisation projects on reducing intra-regional disparities. This could cover not only the 2014-2020 programming period, but also the relevant investments from the regional programmes implemented in the current exercise. Last, but not least, another study could focus on the impact of reduced intra-regional disparities on the development gaps between the Romanian NUTS2 regions.

There are two complementary findings from this research. One is that North-West and North-East regions have attracted the highest amounts from PA1 of ROP 2014-2020. The two regions have started the implementation of their strategies sooner than the rest (Ranga, 2018). Iaşi and Cluj counties, with primary regional urban poles, are also forerunners in attracting financing from Horizon 2020 and the COP 2014-2020. The same two counties are the most innovative ones in the country, after Bucharest-Ilfov region. If these research and innovation projects turn into economic growth it is highly likely that, in the long term, the two development regions will also manage to reduce their existing interregional development disparities. The second additional finding is that the structure of the urban settlement network and location matters when it comes to attracting public funds for research and innovation. The North-West, North-East and South-East regions with a territorial pattern of regional smart specialisation projects that differs from the spatial distribution of funding from other sources have a more balanced urban settlement structure with a better ratio of primary and secondary urban poles. The spatial pattern of regional smart specialisation projects in West and South-West Oltenia development regions, with a smaller number of secondary regional urban poles, is exactly the opposite. The development regions of Centre and South-Muntenia, neighboured by other regions and, respectively, surrounding the capital city, characterised by no first-tier cities of regional importance, show a different territorial distribution pattern of funds than the rest of the less developed regions. While recognising the fact that innovation capacity is not only due to the public funds invested, the study shows that the overall innovation performance could be raised by further investing in secondary regional urban poles and third tier cities, as enhancing their role and functions within the polycentric urban network could also support innovation. In addition, the same findings suggest that more emphasis should be placed on creating synergies and complementarities between regional smart specialisation strategies on one hand and urban development strategies, on the other. As far as the latter are concerned, and, as also highlighted by Nicula et al. (2020), there should be more emphasis on governance. A more balanced territorial distribution of urban development projects and greater impact could be achieved through a broader and more inclusive involvement of key actors, similar with the stakeholder involvement in the smart specialisation approach.

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