



Article

The Role of Open Innovation, and the Performance of European Union Regions

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Abstract: This research aims to detect the factors that best explain the performance of regional innovation in the European Union (EU), in the year 2019, and compare the obtained results with the factors used to elucidate the performance of regional innovation in the EU during the year 2016. This comparison allowed us to identify the variations that have occurred during these 3 years. The methodology used is quantitative and served to identify the factors that clarify the performance of regional innovation in the EU in 2019. The data collected was treated in the econometric software Eviews10. Estimations used a multiple linear regression method. The attained results show that with the implementation of the Research and Innovation Strategy for Smart Specialization (RIS3), the Leader and Strong Regions benefited from its implementation. On the other hand, Moderate and Modest Regions failed to improve their innovative performance with the implementation of RIS3. On the practical contributions, it provides suggestions to the actors of the triple helix (Academy–Government–Industry) to improve the performance of innovation. Furthermore, it contributes to the theory by updating the knowledge of the existing literature with new dimensions from the 2019 RIS database. This research is original as it allows to appraise the evolution of the open innovative performance of the regions, by using comparative data from 2019 and 2016.

Keywords: innovation; regions; smart specialization; Regional Innovation Scoreboard; regional development; RIS3; open innovation



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1. Introduction

In the past two decades, we have witnessed a strong debate on how regional development, production, and innovation policies should be [1,2]. Nevertheless, over the past few years, the European Union (EU) has been losing international competitiveness. When comparing EU productivity with Asia and North America, an increasingly wide disparity can be observed [3–6]. The reason for this status is because the European knowledge transfer process comprises lower stages of development when compared with the regions of Asia and North America [6].

The Research and Innovation Strategy for Smart Specialization (RIS3), is a set of regional development strategies applied in the EU from 2014 until the year 2020, whereby several studies have been developed to study these strategies [7–12]. In RIS3, policymakers were able to redirect their regional innovation policies to economic development strategies, aiming to achieve certain levels of regional economic development. To attain this goal, European policymakers were encouraged to adopt policies based on regions, ensuring

the concentration and prioritization of smart specialization domains (on which the support/community funds framework would fall), to promote entrepreneurship, growth, and innovation [13,14].

However, the centralized system of regional and innovation policy in the EU (RIS3), did not achieve the expected results, with production disparities being maintained, when compared to other regions such as Asia and North America [6]. This fact consolidates the idea that for regions to gain competitiveness, investment and innovation in technologies are fundamental [15]. Lately, we have been witnessing significant deindustrialization and progressive abandonment of the manufacturing sector in the EU; this contrasts with the American and Asian continents, where there has been a strengthening of this sector. With this being the case, the EU needs strong policies based on innovation to promote and accelerate regional development [6,16].

For the period 2021–2027, there was a review and adjustment of the RIS3. It was not a profound and radical reformulation, but a revisit to the decisions previously adopted, in light of the developments and studies that have occurred in the meantime. In the 2021–2027 program, the environment, innovation, and sustainability occupy a relevant place in the adopted policies [17].

That said, studies should be done to ensure a better comprehension of the internal structure of innovation processes that occur in the EU [18], to expand and compare the performance of regional innovation in the EU, in different regions and different years, allowing researchers to identify which are the variables that generate lesser or greater impacts [19].

Consequently, the purpose of the present research is to identify the factors that best explain the performance of regional innovation in the EU in 2019. It is also intended to compare the results obtained with the factors that best explain the performance of regional innovation in the EU during the year 2016 and according to the study developed by Lopes et al. [20]; this comparison will allow the identification of the changes that occurred between 2016 and 2019.

This research is innovative and pertinent since the similar methodology used previously in the study by [20] will be applied (database 2016), in this case using data from 2019, allowing us to determine the factors that best explain the performance of regional innovation, thus, providing new resources for policymakers to support strategic decision making at this level. In the same manner, the factors that best explain this performance are determined; this will allow us to verify which are the factors that negatively affect the innovation performance of the regions in the EU. This study allows us to evaluate the evolution of the innovative performance of the regions (2016–2019), after the implementation of RIS3 in the EU. These data are of great importance since they will permit the redirection of European Community funds towards strategies leading to improvement on performance in regions with negative factors, thus, allowing a global increment in the performance of the regional innovation.

The current research is organized as follows: the first part outlines an introduction to the theme and problem under research. A literature review follows, with a particular focus on smart specialization and regional innovation scoreboards. In Section 3, all methodological processes are detailed. In Section 4, the results obtained are presented, discussed, and compared with the literature. In Section 5, we present the role of innovation in the performance of European Union regions and its interactions with open innovation. Finally, in part 6 the conclusions of the research are presented, as well as the contributions to the theory and practice, complemented with the research limitations and future lines of investigation.

2. Literature Review in Regional Governance of Smart Specialization

In recent decades, and throughout the world, governance at the local level has been very present on regional development agendas. Its contents are focused on the formulation and implementation of collective actions at the local level, encompassing the direct and

indirect roles of formal and informal institutions and through networks created with active agents, ranging from the top of governmental hierarchies, community organizations, to district associations [21–23].

According to Mariussen et al. [24], for excellence-oriented governance, it is essential to develop a strong innovation ecosystem. This will contribute to the exercise the governance that remains capable of responding to the growing challenges over time. Literature research on innovation ecosystems suggests that nowadays there is a free circulation of knowledge and an environment that promotes innovation, technology sharing, and know-how, which contributes to regional development, as well as the quality of life of its population [25–28].

In this context, smart specialization can be seen as the concept on which the progress of regional development policies are based, and, known as the Research and Innovation Strategy for Smart Specialization (RIS3) it was implemented in 2014 in the EU member states [12,29–31]. At the end of the first period with the RIS3 policies (2014–2020), the member states readjusted the RIS3 for the new period of 2021–2027. In this new period, EU policies aim to create conditions for sustainable, inclusive, and smart growth [32–34].

Smart specialization was recently introduced in the discussion of territorial development strategies and is based on local endowments, international network orientation of the regions, and their potential for excellence. In this manner, governments in different regions can align their actions with regional innovation and economic development strategies, which will lead to regional economic development [35–37].

Within this framework, decision-makers across the EU are encouraged to adopt policies based on location, ensuring thematic prioritization and concentration to foster innovation, growth, and entrepreneurship. Consequently, the development of regional policy has moved from an internal approach to networked development efforts involving several peers who have the know-how to formulate the necessary policies and other critical resources [8,38–40]. Intelligent specialization is therefore seen as an opportunity for innovation by the European Commission, which encourages its member states to formulate national and/or regional strategies for research and innovation to increase the impact of the structural funds and explore the potential for smart growth, focusing on the knowledge economy in all regions [12].

Embedded within these principles, the European Commission launched the Smart Specialization Platform, aligned to support investment policies in the main national or regional priorities, according to the challenges and needs for knowledge-based development, including the necessary measures related to Information Technologies to support each country or region, thus, enabling its competitive and potential advantages for excellence, technological innovation support, investment stimulation by the private sector and encouragement for innovation and experimentation. This new approach highlights that future innovation policy should go beyond traditional research skills and must consider all regional specificities and technological areas with high growth potential and investment intensification [41,42].

The regional dynamics, and the interaction of its actors (Academy, Industry, Government), known as the triple helix, have to work oriented towards the needs of the industry, thereby directing the research towards emerging domains previously selected in RIS3 [43–45]. Consequently, it is intended to enhance regional talent, physical assets, and local resources, to make the most of them, thereby, disseminating the benefits of research and innovation throughout the region, increasing the country's competitiveness, and enhancing the country's ability to manage the challenges that are being posed in society [12,46].

Thus, it can be understood that smart specialization is within the spectrum of multilevel governance, a concept that reports an increase in the interdependence between authorities working at different territorial levels and governmental and non-governmental representatives [30,47].

The Regional Innovation Scoreboard (RIS) is the best and most adaptable index to the context under analysis. It is published by the Directorate-General for the Internal Market, Industry, Entrepreneurship and SMEs of the European Commission and, together with

its application to the national level, the European Innovation Scoreboard (EIS), provides a macroeconomic analysis of regional innovative performances, highlighting the sectors where regions need to focus their efforts, intending to improve their performance [19,48]. The RIS is published every two years as an extension of the EIS. The regional index is calculated as the average score for a limited set of indicators, given the impossibility of completing the collection of all data. 25 EIS [49]. RIS [49] includes a set of 17 indicators: (1) Population with tertiary education (PTE); (2) Lifelong learning (LL); (3) Scientific copublications (SCP); (4) Most-cited publications (MCP); (5) R&D expenditure public sector (R&D EPS); (6) R&D expenditure business sector (R&D EBS); (7) Non-R&D innovation expenditures (Non-R&D IE); (8) Product or process innovators (PP_Innov); (9) Marketing or organizational innovators (MO_Innov); (10) SMEs innovating in-house (SMEs_Innov); (11) Innovative SMEs collaborating with others (Innov_Collab); (12) Public–private copublications (PPCP); (13) PCT patent applications (PCT PA); (14) Trademark applications (Trade) (TA); (15) Design applications (DA); (16) Employment MHT manufacturing and knowledge-intensive services; (17) Sales of new-to-market and new-to-firm innovations (SNMFI).

3. Data and Methodology

For this research, the data were obtained from the Regional Innovation Scoreboard 2019 (<https://ec.europa.eu/docsroom/documents/36081>, accessed on 31 July 2020) and collected on 1 August 2020. The Regional Innovation Scoreboard (RIS) is a regional extension of the European Innovation Scoreboard, through a set of indicators that allows performance assessment of European regions in terms of innovation. RIS [49] assessed the innovation performance of 238 regions in 23 countries in the European Union (EU), Norway, Serbia, and Switzerland. Additionally, included in this database are Cyprus, Estonia, Latvia, Luxembourg, and Malta [49].

RIS 2019 is the ninth edition of the regional innovation performance assessment, the previous edition being RIS 2017, which had data from 220 regions in 22 EU countries, Norway, Serbia, and Switzerland and at the country level for Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta [49].

RIS 2019 classifies the regions into four groups in terms of innovation performance, according to their performance on the Regional Innovation Index and compared to the EU average:

1. Regions Leaders with a performance above 120% of the EU average (38 regions).
2. Regions Strong performing between 90% and 120% of the EU average (73 regions).
3. Regions Innovators performing between 50% and 90% of the EU average (97 regions).
4. Modest Regions with performance below 50% of the EU average (30 regions).

In terms of country, the variation in the classification for innovation performance of the regions is limited. In Finland, Germany, Greece, The Netherlands, and Sweden alone, there are three different regional innovation performance groups, and in 15 countries there are two different regional innovation performance groups. The regions of Austria, Ireland, Lithuania, Slovenia, Slovakia, and Switzerland are all classified in the same innovation performance group [49].

The present research follows a quantitative methodology. This methodology is the most appropriate since the objective is to identify the factors that best explain the performance of regional innovation in Europe in 2019. The quantitative methodology allows to measure whether the results are causal, generalizable and possible to replicate [50,51]; this meets the proposed objective. The macroeconomic data analysis allows the generation of highly relevant information for policymakers. This type of approach has already been used in other studies, for example Garcia-Bernabeu et al. [52], Lopes, Farinha and Ferreira [19], and Szopik-Depczyńska, Cheba, Bąk, Kędzierska-Szczepaniak, Szczepaniak and Ioppolo [18].

After the regions categorization—mentioned in the RIS [49] database—into four groups performance (Leader, Strong, Moderate and Modest), and using Eviews10 software, the Stepwise forward method was applied to all variables available in the RIS [49] database.

This method assumes that there is no variable in the model, only the intercept, and adds one variable at a time. The first selected variable is always the one with the highest correlation with the response. The process is repeated, that is, the variable with the highest partial correlation with the dependent variable is added to the model if its partial F statistic is greater than F_{in} , until no further explanatory variable is included in the model [53].

Therefore, with the application of Stepwise forward method, SMEs Innovating in House (SMEs_Innov) was identified as a dependent variable, and defined previously, since it presented the highest level of significance. Regarding the independent variables, the condition was placed in the Stepwise forward method of eliminating the variables that were not significant ($p < 0.05$), thus, the multiple linear regression models of regional performance estimated were obtained by the method of ordinary least squares (OLS) [53]. Upon the application of the multiple linear regression model, it was verified that the following assumptions were fulfilled: (1) errors (ϵ_i) are zero mean random variables; (2) errors (ϵ_i) are random variables of constant variance (σ^2)—hypothesis of homoscedasticity; (3) random variables are independent; (4) explanatory variables are not correlated—hypothesis of absence of multicollinearity between explanatory variables; (5) errors (ϵ_i) follow a normal distribution: $\epsilon_i \sim n(0, \sigma^2)$, essential to perform the hypothesis tests that we will perform next [54].

4. Results and Discussion

With the application of the Stepwise forward method, three multiple linear regression models were obtained for the group of regions with Strong innovation performance, with the maximum use of three explanatory variables (Product or Process Innovators—PP_Innov, Marketing or Organization Innovators—MO_Innov, Trademark Applications—Trade); for the regions with Moderate innovation performance, two models were obtained with the maximum use of two variables (PP_Innov, Innovative SMEs Collaborating with others—Innov_Collab) and the regions with a Leader and Modest innovation performance, only one model with the explanatory variable PP_Innov. The summary of the models obtained for each group of regions shown in Table 1.

Table 1. Model summary.

| Regional Innovation Performance Groups | Model | R ² | Adjusted R ² | Std Error of Regression |
|--|-------|--------------------|-------------------------|-------------------------|
| Leader | 1 | 0.662 ^a | 0.652 | 0.072200 |
| Strong | 1 | 0.706 ^a | 0.702 | 0.053710 |
| | 2 | 0.707 ^b | 0.703 | 0.053626 |
| | 3 | 0.747 ^c | 0.736 | 0.050549 |
| Moderate | 1 | 0.956 ^a | 0.956 | 0.038508 |
| | 2 | 0.960 ^d | 0.959 | 0.037238 |
| Modest | 1 | 0.941 ^a | 0.939 | 0.023856 |

^a Predictors: (Constant), PP_Innov. ^b Predictors: (Constant), PP_Innov, MO_Innov. ^c Predictors: (Constant), PP_Innov, MO_Innov, Trade. ^d Predictors: (Constant), PP_Innov, Innov_Collab.

The next step, focused on the regional innovation performance group, aimed to find the multiple linear regression model with the highest R Square that is shown in Table 1, once again using the Stepwise forward method: (1) in the group of Leader regions, the model with the largest R Square is model 3; (2) in the group of Moderate regions, the model with the highest R Square is model 2; (3) and in the Leader and Modest regions, we only have model 1. The application of linear regression verifies the assumptions of normality demonstrated both by the graphs of the normal probability of the residuals and by the Kolmogorov–Smirnov test.

The summary of the best multiple linear regression models is shown in Table 2.

Table 2. Coefficients.

| Regional Innovation Performance Groups | Model | Dependent Variables | Coefficient | Std Error | t-Statistic | Prob. |
|--|-------|---------------------|-------------|-----------|-------------|---------|
| Leader | 1 | Constant | 0.056 | 0.067 | 0.838 | 0.4074 |
| | | PP_Innov | 0.884 | 0.105 | 8.397 | 0.0000 |
| Strong | 3 | Constant | 0.037 | 0.040 | 0.934 | 0.03535 |
| | | PP_Innov | 0.680 | 0.070 | 9.673 | 0.0000 |
| | | MO_Innov | 0.181 | 0.071 | 2.550 | 0.0130 |
| | | Trade | 0.097 | 0.038 | 2.538 | 0.0134 |
| Moderate | 2 | Constant | (0.003) | 0.010 | (2.910) | 0.0045 |
| | | PP_Innov | 1.086 | 0.024 | 43.757 | 0.0000 |
| | | Innov_Collab | (0.057) | 0.020 | (2.754) | 0.0070 |
| Modest | 1 | Constant | 0.014 | 0.008 | 1.717 | 0.0969 |
| | | PP_Innov | 0.821 | 0.038 | 21.159 | 0.0000 |

Dependent variable: SMEs_Innov.

RIS3 encourages the concentration of financial, human, and innovative resources in a few globally competitive areas of intelligent specialization, being advised to develop applications of generic technology or innovate services in one or several relevant areas in the regional economy, or the development of intersectoral approaches [7,54].

As mentioned earlier, the purpose of this article is to identify the factors that best explain the performance of regional innovation in Europe in 2019, as well as to compare the obtained results with the factors that best explain the performance of regional innovation in Europe in 2016, exhibited in the study that was developed by Lopes, Farinha, Ferreira and Silveira [20]. Subsequently, we will present the multiple linear regression equations (MLR) for the performance and innovation of regions in 2019, as well as in 2016, also presented in the study by [20].

4.1. Leader Regions

The MLR for the years 2019 and 2016 Lopes, Farinha, Ferreira and Silveira [20], and for the Leader Regions are:

- MLR Leader Regions (2019): $SMEs_Innov = 0.056 + 0.884 PP_Innov$.
- MLR Leader Regions (2016): “SMEs Innovating in House = 0.076 + 0.994* SMEs with Product or Process Innovations –0.142* Innovative SMEs Collaborating with Others –0.109* Sales of New-To-market and New-To-Firm Innovations” Lopes, Farinha, Ferreira and Silveira [20].

Regarding the regions with Leader innovation performance, we found that the variable “SMEs Innovating in House” has reduced impact in 2019; however, it remains positive. The same behavior is identified for the “Product or Process Innovators” variable. Nevertheless, the variables “Innovative SMEs Collaborating with Others” and “Sales of New-To-market and New-To-Firm Innovations” no longer have a negative impact on the innovation performance of the Leader regions, which clearly indicates a positive evolution. These regions have well-implemented coordination mechanisms based on the triple helix, as well as the development of new collaboration structures [54]. For institutions to be effective, good management needs to be applied by regional policymakers; this is fundamental to establish networks based on trust, as well as facilitating and dissemination of knowledge amongst the different types of regional economic actors [55–58].

4.2. Strong Regions

The MLR for the years 2019 and 2016 Lopes, Farinha, Ferreira and Silveira [20], and for Strong Regions are:

- MLR Strong Regions (2019): $SMEs_Innov = 0.037 + 0.680 PP_Innov + 0.181 MO_Innov + 0.097 Trade$

- MLR Strong Regions (2016): “SMEs Innovating in House = $-0.049 + 1.124 \times \text{SMEs with Product or Process Innovations} - 0.126 \times \text{Innovative SMEs Collaborating with Others} - 0.123 \times \text{Sales of New-To-market and New-To-Firm Innovations} + 0.106 \times \text{Population with Tertiary Education}$ ” Lopes, Farinha, Ferreira and Silveira [20].

Concerning Strong Regions, we found that the variable “SMEs Innovating in-House” started to have a positive impact on innovation performance, contrary to what was verified in the year 2016. The variable “Product or Process Innovators” continues to positively affect the innovation performance of this region but its influence is decreased when compared to the year 2016. In 2019, two new variables emerged, that positively affected the innovation performance of the Strong regions (“Marketing or Organization Innovators” and “Trademark Applications”). On the other hand, it seems that the variables “Innovative SMEs Collaborating with Others” and “Sales of New-To-market and New-To-Firm Innovations” no longer appear in the 2019 model, which is positive, as these variables in 2016 affected negatively the innovation performance of these regions. The variable “Population with Tertiary Education” appeared in the model for the year 2016, but in the year 2019, it no longer appears in the model. Consequently, the variable “Population with Tertiary Education” no longer has a positive impact on the innovation performance of these regions. According to Belgin [59], the Strong Regions are weak in obtaining high-tech exports; however, they are strong in the production of granted patents. Moreover, this author considers that such regions are not good at commercializing their R&D results. Nonetheless, Prokop and Stejskal [48] affirm that strong regions have a well-founded business fabric that can adequately absorb innovation. These regions thus have a high capacity for innovation with fast-growing industries and an internationally competitive industry [60].

4.3. Moderate Regions

The MLR for the years 2019 and 2016 Lopes, Farinha, Ferreira and Silveira [20], and for Moderate Regions are:

- MLR Strong Regions (2019): $\text{SMEs_Innov} = -0.003 + 1.086 \text{ PP_Innov} - 0.057 \text{ Innov_Colla}$
- MLR Strong Regions (2016): “SMEs Innovating in House = $-0.12 + 1.046 \times \text{SMEs with Product or Process Innovations} - 0.054 \times \text{Innovative SMEs Collaborating with Others}$ ” Lopes, Farinha, Ferreira and Silveira [20].

In the Moderate Regions, the results show that the variable “SMEs Innovating in-House” continues to affect the innovative performance of these regions in a negative way, despite having improved from 2016 to 2019. It should be noted that the variables present in the 2016 and 2019 models are the same, with no significant differences. Therefore, the results mention that the Moderate Regions failed to significantly improve their innovation performance. Thus, the gap in terms of innovative performance widens between the Moderate Regions and Strong Regions (improved). However, in previous years the Moderate Regions managed to significantly increase their innovative performance as there were qualitative improvements in the institutions, as well as high levels of public investments [61]. Looking to possible regional policies application by policymakers, we can mention the example of regions of Italy, whereby contributions and assistance were granted to individuals and companies in need to repair or recover assets. Another aid that provided a positive effect on innovation was training and education activities. This aid also was used for restructuring, ordinary maintenance, and renovation of buildings. For companies specifically, there were incentives for production units [61]. However, in countries such as Croatia, a clear background for innovation is still missing. Croatia faces obstacles in elements of its environment, for example, the scarcity of infrastructures [48]. Nevertheless, in Croatia, companies in the manufacturing industry can choose appropriate cooperation partners, such as public research institutes and universities. Companies may successfully target public financing and have a market orientation. Thus, they can significantly influence their turnover with innovations [48]. According to Ponsiglione et al. [62], even regions with identical industrial characteristics may present different results in terms of competitive

performance and innovation, which can be more pronounced in less innovative regions (Moderate and Modest). For Zygmunt [63] SMEs need to invest more in R&D. Within this perspective, SMEs have to consider R&D as an investment and not an expense [19]. However, it is not easy to change the business culture, and it may take several generations for regions to be able to ameliorate their innovative performance, and consequently improve their competitiveness.

4.4. Moderate Regions

The MLR for the years 2019 and 2016 Lopes, Farinha, Ferreira and Silveira [20], and for Modest Regions are:

- MLR Strong Regions (2019): Modest Regions (2019): $SMEs_Innov = 0.014 + 0.821 PP_Innov$.
- MLR Strong Regions (2016): “SMEs Innovating in House = $0.006 + 0.958 * SMEs\ with\ Product\ or\ Process\ Innovations + 0.208 * Innovative\ SMEs\ Collaborating\ with\ Others - 0.164 * Sales\ of\ New-To-market\ and\ New-To-Firm\ Innovations$ ” Lopes, Farinha, Ferreira and Silveira [20].

In the Modest Regions, it seems that in 2019 the variable rose slightly when compared to 2016; however, the variable “SMEs with Product or Process Innovations” decreased from 0.958 (2016) to 0.821 (2019). The variable “Innovative SMEs Collaborating with Others” is no longer included in the 2019 model, which may represent a setback, since in 2016 it had a positive impact on the innovation performance of the Modest Regions. The variable “Sales of New-To-market and New-To-Firm Innovations” was present in the 2016 model; nevertheless, in 2019 it is no longer included in the model. Regarding the “Sales of New-To-market and New-To-Firm Innovations” variable, the results point to an improvement, as this variable no longer reproduces a negative impact on the innovation performance of these regions. The results suggest that the innovation performance in the Modest Regions did not improve significantly during the year 2016–2019. Most of the Modest Regions are located in Eastern and Southern Europe. These regions are generally composed of industrial structures characterized by public administration and service functions and are dominated by agriculture and SMEs in traditional sectors [60]. In the Modest Regions, the problems concerning the development and commercialization of R&D are evident [20]. According to Prokop and Stejskal [48], there is an innovation paradox, as these regions have a greater need to invest in innovation; however, they have a small capacity to captivate public funds to promote innovation and invest in innovation-related activities, such as Horizon 2020 and Horizon 2021–2027. Generally speaking, these regions lack demand for innovative products, both by research organizations and companies [48].

Summarizing, the results suggest that Leader and Strong Regions have improved their innovative performance. In contrast, the Moderate and Modest Regions failed to improve significantly their performance related to innovation. Thus, it is possible to observe an increment in the dissymmetry between the Leader and Strong Regions towards the Moderate and Modest Regions. More densely populated and wealthier regions have higher participation or occupy a key position in the Horizon 2020 program [58,64,65].

5. The Role of Innovation in the Performance of European Union Regions and Its Interactions with Open Innovation

Innovation management models are nowadays fundamental aspects, since it is possible to witness permanent changes in organizational contexts, whether in the co-operation between people, either between entities, or even between people of different entities. The performance of European Union regions, in terms of innovation, is intrinsically associated with the adoption of the guiding principles for open innovation by organizations in their respective territories [66,67].

The most widespread concept of open innovation is the approach by [68]. This author characterizes open innovation as a set of multidirectional flows of knowledge (produced and consumed by organizations) aimed at fostering internal innovation and the

expansion of markets for the external application of innovative results. The strengthening of cooperation in research and development and the more active use of external resources play an important role in the generation of new ideas and their rapid promotion in the market. Thus, in the current status, open innovation can be associated with several dimensions, such as the economy, business, and management.

According to [68] open innovation means that valuable ideas can come from inside or outside the organization and reach the market. The idea of openness supposes a break with a traditional philosophy of not revealing issues of internal knowledge to the outside, recognizing the opportunity to obtain competitive advantages through relationships with professionals and external organizations, sharing resources and knowledge, and establishing alliances and partnerships [66].

In open innovation, it is necessary to combine internal research with external ideas and then implement those ideas, in the organizations of the origin or a region and in other organizations, in the same or another region. In a broader analysis, the objective is to accelerate internal innovation and expand markets for the external use of innovation, influencing organizational results. In this sense, and according to [69], for the organizations of the different regions to pursue the principles of open innovation, the key element is to discover: what the organization lacks, what can be achieved internally and what can be integrated from the outside. Thus, unlike the traditional model of vertical integration, open innovation leads us to seek external sources of ideas, in addition to internal flows of knowledge, to increase the innovation process [68].

In the present research, we have already noticed that RIS3 encourages the concentration of financial, human, and innovative resources in a few globally competitive areas of intelligent specialization, with the development of generic technology applications or service innovation being advised in one or more relevant areas of the regional economy, or the development of intersectoral approaches [7,54]. In line with the objective of this research, it is now possible to identify the regions where there is a better fulfillment of the precepts of open innovation, and also where the most innovative performances are verified. This is especially true in the leader and strong regions. To confirm this theory, we restate the findings related to regions with Leader innovation performance, these regions have well-implemented coordination mechanisms, based on the triple helix, as well as the development of new collaboration structures [54]. To be effective, institutions within increasing open innovation, it is essential to establish networks based on trust, as well as to facilitate and disseminate knowledge among the different types of regional economic actors [55,58]. In contrast, in the moderate and modest regions, which have failed to significantly improve their performance in terms of innovation, in a direct association with a lower relation to open innovation, we can see that the problems related to R&D development and commercialization are evident [20]. According to [48], there is an innovation paradox, as these regions have a greater need to invest in innovation; however, they have a relatively lesser capacity to absorb public resources to promote innovation and invest in innovation-related activities. Thus, the adoption of the precepts of open innovation presents itself as one of the best hypotheses that these regions have at their disposal to reduce the asymmetries that they present for the leader and strong regions.

6. Conclusions

When compared with the 2016 study from [20], the results from our research point to a general improvement in the performance of innovation in the Leader and Strong Regions. Nevertheless, the results also suggest that in the Moderate and Modest Regions there were no significant improvements regarding innovation performance. With this being the case, the results lead us to conclude that the EU operates at two completely different speeds concerning the performance of innovation. In RIS3, the Leader and Strong Regions benefited from its implementation. On the other hand, Moderate and Modest Regions failed to improve their innovative performance with the implementation of RIS3. This may be because the Leader and Strong Regions have a stronger capacity to raise European

structural funds [58]. Moreover, and to aid a further understanding of the obtained results, we have divided the main conclusions according to the regions:

In the Leader Regions, we found that the variable “SMEs Innovating in House” reduced its impact in 2019; however, it remains positive. The same behavior is identified for the “Product or Process Innovators” variable. Nevertheless, the variables “Innovative SMEs Collaborating with Others” and “Sales of New-To-market and New-To-Firm Innovations” no longer have a negative impact on the innovation performance of the Leader regions, which clearly indicates a positive evolution. The literature stresses the importance of effective collaboration amongst institutions to enhance networks based on trust [58] which favors knowledge flow. These regions have well-implemented coordination mechanisms based on the triple helix, as well as the development of new collaboration structures [54], and are undoubtedly linked to robust regional innovation systems [70].

For Strong Regions best equipped in terms of innovative organizations and with a high level of education, and circulation of knowledge, our research confirms that these were the areas that benefited the most from the EU funds available from the H2020 program [64,71]. Indubitably, this is a topic that the EU should accommodate for the next cycles, as it seems to be in contrast to the “overall harmonious development of its Member States” and, explicitly, with the principles of the ERA (European Research Area) that, as an example, claim the integration of EU scientific resources and an active program of researchers, scientific knowledge and technology. This is an important factor to take into account, as internal R&D investment and development is no longer sufficient to match the rising costs, competition, complex technologies, and shorter life cycle of products [48]. Cooperation between universities and the industry should be extensively promoted and encouraged. A key player in this area is the policymakers who, together with the industry and the market, should stimulate the creation of mechanisms and regulations to ensure that the R&D flow to support projects is constantly granted.

The results in the Moderate Regions enable us to suggest concrete and tailored policy proposals, involving fund and investments reallocation towards the sectors that are more likely to produce positive effects on innovation. As an example, we can refer to the importance of stimulating the Italian financial market and providing it with the necessary support, managerial and technical skills [72,73]. Finally, given the casual (and indirect) link between innovation and quality of life [74], the findings from our analysis can represent possible drivers towards the improvement of innovative performance achievable through better levels of institutional quality and quantitative efficiency (as required in the EU context) [75] followed by the reallocation of funds towards some specific issues. Numerous studies have shown that RIS with similar industrial structures and characteristics may strongly differ from each other, even in terms of innovation and competitive performance. The adoption of specific policies and incentives to fulfill this type of gap is more obvious in the so-called lagging regions (which are considered moderate and modest when confronted with the levels of innovativeness) [62,76].

Most of the modest regions are located in Eastern and Southern Europe. These regions are generally composed by industrial structures characterized by public administration and service functions and are dominated by agriculture and SMEs in traditional sectors [60]. The earlier example mentioned from the manufacturing industry in Croatia is an important sample that denotes a country that has chosen to cooperate with other partners (universities and public research institutes) and managed to direct to other elements of innovation activities (i.e., market orientation) and influenced their income from innovations. This is a possible example of synergies construction and spillover effects [48]. It is noticeable that the cooperation with universities and public research institutes is a strong point that should persist and be strengthened; this was also visible and pointed out in other areas as being fundamental and a focus of support by policymakers. Moreover, this should be accompanied by promotion and cooperation with customers and competitors, as this type of cooperation has not given significant results to this date [48]. Collaboration with customers is a significant factor of competitive advantage; the main user theory suggests that user-

centered innovation is a strong and widespread phenomenon that supports innovative activities [77]. Moreover, cooperation with competitors may also lead to substantial results. For [78], the quest for collaboration between competition (also known as co-opetition) is a key factor for customers and market advances. When occurring, it causes consequent collaboration amongst firms and further results in advanced technological development.

On the theoretical implications of this research, we updated the knowledge of the existing literature with new dimensions from the 2019 RIS database.

As for practical implications, suggestions were given for the actors of the triple helix (Academy–Government–Industry) to improve the performance of innovation. Furthermore, the segregation of the results from Leader Regions, Strong Regions, Moderate Regions, and Modest Regions, allows policymakers to take the necessary actions to improve innovation performance in their own regions. A policy recommendation in this respect may consist of taking the present research into more careful consideration and converting some of its suggestions into specific political actions. For example, one option could be to encourage challenge-oriented participation by creating research groups in which marginally innovative or vulnerable regions are involved. This can lead to a wider and potentially impactful circulation of knowledge and lead to positive results [58].

The limitations encountered within this research are mainly related to the RIS3 database and some of the differences within the dimensions between 2016 and 2019; furthermore, some of the business groups (such as SMEs) may not be entirely representative of the evolution of some countries. As for future lines of investigation, we suggest that the outcome of this research could be implemented in other areas, taking into account comparable business areas and sizing as well as including EU peripheral and ultra-peripheral regions.

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