

Mapping Regional Innovation systems: The Role of Universities in Patenting Activity

Extended Abstract

Innovation plays a crucial role in the economic development and competitiveness of regions. The creation of innovations is increasingly understood as the result of collective efforts involving multiple institutions. However, individual regional innovation systems are not the same and require different support systems (Tödtling & Trippl, 2005). Several studies have focused on identifying overall patterns of innovation activities and typologies of regions (Pinto 2009; Capello and Lenzi, 2013; Filippopoulos and 2022;), but more detailed views are lacking that consider the analysis of the internal institutional structure of these regions and the different contributions of individual actors to the innovation process.

One of the important actors is universities. Universities are considered key actors in the field of innovation, as they contribute to the creation of knowledge and the development of patent activity, thereby directly influencing technological progress and economic growth (Etzkowitz and Leydesdorff, 2000). Their position in regional innovation ecosystems deserves special attention, where they can fulfill several key roles (Gunasekara, 2006).

The aim of our article is to examine the typology of regions with an emphasis on the role of universities in regional innovation systems, focusing on their patent activity in relation to the overall patent activity and the activity of companies in a given region, and subsequently to create a typology of regions that will point out the different positions of individual innovation actors in the process of innovation creation measured by their patent activity.

To achieve the aim, the paper uses OECD REGPAT and SCOPUS publication data, augmented with ETER and Eurostat, to identify university-owned and university-invented patents and geolocate inventors and owners at regional levels. To assess the importance of different innovation actors, indicators of academic and non-academic patenting intensity, academic share, the share of university-invented patents, and multiple patent-quality metrics were used. A K-median cluster analysis (Manhattan distance) was conducted, leading to four different types of regions in Europe. The Map 1 shows the results of cluster analysis. The analysis thus includes individual regions in one of the following 4 groups:

A: low-innovation regions with relatively low university activity

This group is characterized by very low patent activity of universities and is associated with medium-low patent activity of companies. The share of academic patents is medium-low (9.5%). In this group, at the same time, most academic patents belong directly to universities. The technological range of patents is narrow, but they have a larger family. Innovations are less scientific in nature and the least radical among all monitored groups. This group consists of regions with low innovation activity, which is rather concentrated in companies. Universities are relatively little connected to corporate research and rather focus on their own patents, which are very few, however. Another type of lagging regions are RIS type A. These are mainly regions of the Czech and Slovak Republics, Bulgaria, Croatia, but also parts of western Italy, Spain and France.

B highly innovative regions with relatively high university activity

In the regions of this group, very high university activity is associated with medium-high company activity. These are innovative regions, which, however, still do not have a sufficient supply of innovative companies as in the case of the regions of group C. The share of academic patents is medium-high (12.8%). University patents in this group are among the highest quality from the point of view of our indicators. Groups B and C also have the highest degree of patent radicality. These are also patents that are the most scientific. University patents in these regions are also the most cited among all groups. In these regions, universities play a significant role in innovation systems, and are well interconnected with company patents.

Group B is the most diverse from a geographical point of view. Here we find part of Great Britain, the south of France, most of Belgium, the Netherlands, Finland, several regions of Germany, Norway, Sweden, western Austria, Catalonia. This also includes two regions from the former Eastern Bloc countries - western Slovenia and the Bratislava region.

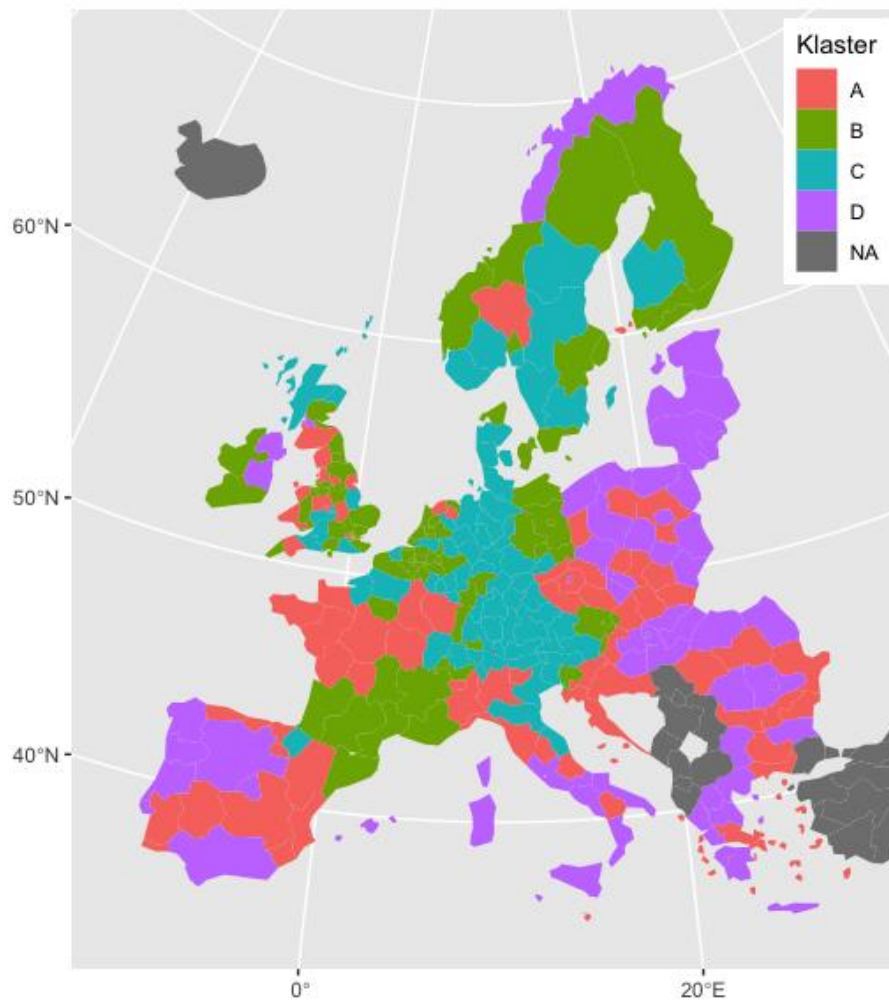
C high innovation regions with relatively low university activity

The most active in patenting are companies in group C, which is characterized by medium-high patent activity of universities. Patents are technologically narrow, less radical. On the other hand, they have a large patent family and there is intensive knowledge transfer. The share of academic patents is the lowest of all groups (about 5%). Moreover, most academic patents in this group belong to companies, which indicates that companies are hungry drivers of innovation and university staff work on their patents rather than institutionalizing support through universities. The technological range of patents is narrow, which indicates the existence of strong clusters in selected industries and highly specialized innovation activities. Groups B and C also have the highest degree of patent radicality. Even the citation of scientific literature in this group of regions is low, so universities are essentially less key actors of innovation systems in these regions. The regions of group C approximately copy the most advanced and innovative regions of Europe. These are concentrated in Germany, Denmark, Switzerland and Sweden.

D low-innovation regions with relatively high university activity

The least active are companies in group D, where the patent activity of universities is moderately high. The share of academic patents in all patents in the region is more than 23%, which is the highest share of all groups, but is due to the very low activity of companies. Patents of this group are also the least cited. The technological range of patents is the widest of all groups. Patents of regions with a narrower technological range of patents are anchored in a smaller number of technologies than those where the technological range is wider. A larger share of innovation output in the hands of universities is associated with a higher share of non-patent resources. Patents in this group are also the most scientific. They have the smallest patent family and the weakest intensity of knowledge transfer. These are regions with low innovation activity, but unlike group A, they have relatively strong universities that have the potential to bring new innovations to the region. Group D, with a lack of infrastructure for innovative companies, mainly includes regions of the Baltic countries, Poland, Hungary, Romania, Greece, southern Italy and Portugal.

Map 1: The typology of regional innovation based on patent data



Source: Own base on data from OECD a SCOPUS

The study's typology of regions highlights the diverse roles universities play in different innovation ecosystems, revealing that their contribution to regional innovation varies considerably depending on the regional context. The results show that in most RIS universities account for only a small share of innovation, but in a few RIS they account for an extremely large share. In regions where firms patent the most, the contribution of universities is lower and vice versa. The research shows the importance of universities especially in less developed and peripheral regions, where firms fail to innovate sufficiently.

The findings emphasize the need for tailored strategies that address the unique characteristics of each region. For example, in regions where firms struggle to innovate, policy interventions should prioritize enhancing firms' absorptive capacity and promoting collaboration between firms and universities. Conversely, in regions where firms are highly innovative, efforts should focus on supporting basic research and fostering the creation of new technologies.

A certain limitation of the research is that it only examines the total number of patents of companies and universities, while these systems may behave differently in individual sectors (Klincewicz, and Zaei, 2025). The intensity of knowledge transfer from university research to company innovations may vary across the spectrum of technological areas. Several studies indicate different sectoral effects of patents (Cohen, Nelson, Wals,; 2002). This could also be a direction for future research.