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The impact of intra- and inter-regional knowledge collaboration and technological variety on the knowledge productivity of European regions

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ABSTRACT

Collaboration is the cornerstone of European innovation policy, because it stimulates the recombination of knowledge across technological, social, institutional and organizational boundaries and strengthens the knowledge productivity of regions. Despite this key role, little attention has been paid to collaboration as a specific set of organizational arrangements strengthening the knowledge productivity of regions. Therefore, this study focuses on collaboration and looks at the effect of intra- and inter-regional collaboration on the knowledge productivity of regions. Furthermore, it examines the interaction between collaboration and technological variety as complementary drivers of this productivity. The analysis uses a large dataset referring to 269 European regions. This study produces some major original contributions. First, we show that a balance between intra- and inter-regional collaboration is required to support regional knowledge performance. Second, we emphasize that the effect on knowledge productivity is stronger in regions with a diversified knowledge base. The implications of these findings in terms of policy design are then discussed extensively.

1. Introduction

Collaboration is the cornerstone of innovation policy for the European Union (EU) (Hoekman et al., 2009; Scherngell and Lata, 2013). The main idea underlying this policy is that the flow of knowledge between and within regions strengthens the innovative capacity of regions through the continuous recombination of pieces of knowledge embedded in different technological, organizational and institutional settings (Marrocu et al., 2013; Paci and Usai, 2009). The theoretical foundations of such an idea are to be found in the literature on spatial agglomeration and more specifically in the evolutionary view of regional innovation systems (Cooke et al., 1998). Central to this literature are the concepts of knowledge spillovers, which represent the unconscious exchange of knowledge between two or more actors sharing some degree of cognitive proximity (Boschma, 2005), and of technological variety, a characteristic that strengthens the capability of regions to produce new knowledge by means of knowledge spillovers across technological boundaries (Asheim et al., 2011; Frenken et al., 2007). However, the capability of a region to sustain the production of new knowledge is also associated with its capability to sustain the recombination of knowledge through collaboration within and between regions (Maggioni et al., 2007; Marrocu et al., 2013). Even if the contribution of collaboration to the knowledge productivity of regions is commonly recognized, few studies attempt to assess its specific effect (Lamin and Dunlap, 2011). This is because the focus of most studies is on the role of regions in innovation, rather than the role of actors, and the outcome of collaboration is often treated as similar to knowledge spillover itself (Sun and Cao, 2015); however, there is a significant difference between knowledge spillovers and collaboration. The first is a largely unconscious and often unwanted process, while the second implies intentionality; indeed, and the definition of a specific organizational arrangement of strength: the capability of actors to innovate through sharing and knowledge recombination (Boschma, 2005; Marrocu et al., 2013).

Therefore, in this paper, we focus on collaboration between inventors at the regional level as a specific organizational arrangement meant to stimulate innovation through the sharing and re-combination of knowledge across organizational and institutional settings. We distinguish between two forms of collaboration: intra- and inter-regional (Sun, 2016; Sun and Cao, 2015). Intra-regional collaboration supports the recombination and sharing of knowledge within and between actors in a regional system (Belussi et al., 2010; Broekel, 2012; Fitjar and Rodríguez-Pose, 2013; Sun, 2016), while inter-regional collaboration, by providing access to complementary and diversified sources of knowledge, is supposed to be a remedy to the problem of spatial lock-in generated by an excessive propensity to collaborate intra-regionally (Boschma, 2005; Sun and Cao, 2015). Since these two forms of collaboration are often portrayed as complementary in the virtuous development of a region (Asheim and Isaksen, 2002; Boschma, 2005; Broekel,

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2012; Tödtling et al., 2009; Sun and Cao, 2015), the role of a balanced ratio between these two forms of collaboration is specifically explored in this study.

Furthermore, since it has also been shown that organizational and collaborative 'thickness' influences a region's capability to absorb the potential of diversification embedded in external sources of knowledge (Asheim and Isaksen, 2002; Tödtling et al., 2009), the interactive effect of collaboration with technological variety must be further investigated.

Based on a longitudinal panel dataset involving 269 regions in 29 countries over a 7-year period (2002–2008), this study makes two major contributions to the existing literature. First, it shows that inter-regional collaborations have a negative effect on the knowledge productivity of regions. Second, the effect of collaboration becomes positive in regions where there is a balance between intra- and inter-regional collaborations, and is even stronger in regions where a diversified knowledge base already exists. This result has significant implications in terms of policy.

The next section of this paper discusses the background literature and frames the hypotheses of the study. In Section 3, we address the methodology and the main results are presented. Section 4 discusses those results. In the last section, the results and limitations of the study are summarised while directions for further research are addressed.

2. Theoretical background and building of hypotheses

Collaboration is becoming a critical competence to strengthen the capability of regions to innovate (Fitjar and Rodríguez-Pose, 2013). The number of collaborations has grown in recent decades, for several reasons. Innovation requires exploring and exploiting a wide array of highly specialized and spatially distributed bodies of knowledge and know-how[1] (Singh, 2008). Thus, collaboration enables actors to jointly lower the costs associated with gaining access to, mobilizing, and exploiting complementary sources of knowledge (Powell and Giannella, 2010; Singh and Fleming, 2010). This is common not only in industries where invention is modular, such as software and biotech, but also in industries where the underlying process of solving problems cannot be broken apart and addressed discretely, such as the pharmaceutical industry (Powell and Giannella, 2010). However, productivity and efficiency are not the only reasons why inventors collaborate. Improving the quality of their outputs, developing path breaking inventions, and supporting acceptance and adoption of innovations, are other reasons that motivate both inventors and companies to unite their efforts in a collaborative venture (Singh, 2008).

For a long time, collaboration has mainly been associated with geographical proximity (Sun and Cao, 2015). Geographical proximity contributes to interactive learning and innovating by supplying actors with a common base of collaborative relationships (Boschma, 2005). Local collaboration is expected to facilitate and strengthen network embeddedness and to thicken social capital, stimulating the formation and evolution of organizations and institutions, which may reduce the cost of opportunism associated with the transmission and sharing of tacit knowledge and untraded interdependencies (D'Este et al., 2013; Johnston and Huggins, in press). In other words, geographical proximity supplies local actors with a form of collective capital, strengthening their collective capability to exchange and combine (tacit) knowledge smoothly across organizational and technological boundaries. However, too much geographical proximity may hamper the capability of local actors to harness these dynamics (Boschma, 2005; Sun and Cao, 2015). There are two main reasons why this may happen. First, geographically-bounded knowledge externalities and local collaboration may lead to the standardization of know-how between firms and inventors (Belussi et al., 2010; Fitjar and Rodríguez-Pose, 2013; Sun, 2016). Therefore, extensive sharing of knowledge between local actors does not lead to any innovation capable of stimulating the development of the local knowledge base. Moreover, dismissing knowledge diversity reduces the possibility for communication and interaction between different kinds of skills, knowledge and competencies, thus reducing learning possibilities (Nooteboom, 2000; Sedita et al., 2016). Second, local interaction and collaboration between geographically close actors fuel their inability to interact and collaborate with actors located outside the geographical system (Boschma, 2005). This is because local collaboration promotes the internalization of common organizational routines, which increasingly prevents members from seeing potential in ideas far away from the set of core competencies and know-hows already shared within the network (Andersen, 2013). Even if these two factors are often strongly interlinked, the difficulties encountered in collaborating with external actors is often the main driver triggering local homogenization of knowledge between actors and heightening their inability to absorb external knowledge that is cognitively distant from what is available locally (Boschma, 2005). Therefore, intra-regional collaboration is expected to positively influence the knowledge productivity of regions, but this effect is in decline (Broekel, 2012). Therefore the following hypothesis should hold:

H1a. :The relationship between intra-regional collaboration and the knowledge productivity of regions takes an inverted U-shape.

While this hypothesis implies the existence of an optimal level of intra-regional collaboration, at the same time we suppose that this optimum changes according to the level of technological variety characterizing the regional knowledge base. This occurs because we expect knowledge homogenization to take place more slowly in regions with a more diversified base of technological knowledge. In fact, even though the literature on agglomeration economies has initially emphasized the benefits of Marshallian externalities and the advantages of a local base of specialized knowledge, more recently the focus has shifted to emphasize the role of Jacobs' externalities and the advantages of a more diversified local knowledge base (Asheim et al., 2011; Frenken et al., 2007). As suggested by Asheim et al. (2011), the more diversified the regional knowledge base the better, because diversity triggers new ideas, induces knowledge spillovers and provides valuable resources required for innovation. This is because of the higher number of knowledge recombination opportunities (Sun and Liu, 2016), novel linkages and associations (Phene et al., 2006), and collaboration opportunities. Therefore, intra-regional collaboration in technologically diversified regions strengthens the flow of knowledge within and across industries, stimulating the production of further diversified knowledge and in contrast with the homogenization of the knowledge base.[2] Therefore, the following hypothesis should also hold:

H1b. : The more diverse the regional knowledge base, the higher the contribution of intra-regional collaboration to a region's knowledge productivity.

Although geographical proximity is still an advantage in exchanging information and sharing (tacit) knowledge, it is not a prerequisite for interactive learning to take place (Boschma, 2005). Other forms of proximity have recently been asserted to stimulate interaction and collaboration more than the spatial form. Boschma (2005) and Paci et al. (2014) emphasize the role of cognitive, social, organizational and institutional proximity as drivers affecting interactive learning,

[1] Even if the availability of powerful digital infrastructures has reduced the geographical constraints linked to the exchange of knowledge, it still makes sense to talk about the geographical distribution of knowledge, particularly because knowledge is often tacit, embodied, and embedded into specific geographical systems and/or fields of specialization.

[2] The extent to which intra-regional collaboration in technologically diversified regions contrasts homogenization depends on the morphology of the collaboration network. Specifically, if this is clustered within industries, the opportunities for recombination and collaboration do not increase. However, if it spans across industries than the opportunities to produce diversified forms of knowledge either through spillovers or collaboration increases.