Complementarities between geographical and cognitive proximity in university-industry linkages: a comprehensive analysis

Renato Garcia (presenting author)
Professor at Institute of Economics at University of Campinas, Brazil; renatogarcia@eco.unicamp.br.
Veneziano Araújo
Emerson Gomes dos Santos
Federal University of São Paulo, Brazil
Suelene Mascarini
Ariana Ribeiro Costa
Polytechnic School of University of São Paulo, Brazil

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Abstract

The role of geographical proximity in fostering innovation is widely recognized, and local flows of information and knowledge sharing play a very important role in interactive learning (Glaeser et al. 1992; Gertler 2003; Storper & Venables 2004). However, geographical proximity should not be consider a sufficient condition to foster interactive learning because, by itself, it cannot generate complementarities and synergies that can stimulate interaction among local actors (Gilly & Torre 2000; Boschma 2005; Broekel 2015). Based on this assumption, different dimensions of non-spatial proximity have been put forward, since they can complement, or substitute, geographical proximity (Boschma 2005; Knoben & Oerlemans 2006). If geographical proximity can be assumed to facilitate interactive learning and knowledge sharing, other dimensions of non-spatial proximity are also important in strengthening the ways in which actors collaborate and learn.

In this way, geographical proximity can be supplemented by other forms of non-spatial proximity shaped by, for example, cognitive proximity among actors. Cognitive proximity can be defined as the similarities in the way actors perceive, interpret, and evaluate new knowledge, and it implies that actors sharing the same knowledge base are better able to learn from each other (Noteboom 2000; Boschma 2005). Knowledge transfer and interactive learning requires absorptive capacity to identify, interpret and exploit new knowledge (Cohen & Levinthal 1990; Noteboom 2000; Boschma 2005). Complementary absorptive capacity between two partners is required, and overlaps in actors' knowledge bases are essential for efficient communication (Broekel 2015). For each new technology, a firm must dominate a minimum level of knowledge, under which it is not able to bridge the knowledge gap, and collaboration requires a minimum level of cognitive proximity between two actors. Cognitive proximity is commonly defined as the similarities in the way actors perceive, interpret, and evaluate new knowledge (Knoben & Oerlemans 2006), or the degree of overlap in two actors' knowledge bases (Broekel 2015).

Relations among the different dimensions of proximity are far from being understood. It is essential to consider the different types of proximity from a dynamic perspective because current proximity structures may affect actors' future collaborations (Balland et al. 2015; Broekel 2015). For example, actors who frequently interact are more likely to become

cognitively closer because they can learn more from each other and improve their communication structures.

Empirical studies have examined whether non-spatial forms of proximity can be a substitute for geographical proximity. The results obtained in a study from the Canadian infection and immunity research networks show that both institutional and geographical proximities are very important in supporting collaboration. In addition, institutional proximity can compensate for the lack of geographical proximity to support collaboration (Lander 2015). Geographical and cognitive proximity may induce a process of interactive learning and knowledge dissemination among actors, often without a conscious decision on the part of the involved actors (Paci et al. 2014). Substitution effects, in which non-spatial proximity substitute geographical proximity as a tool for interaction, were empirically found between cognitive and geographical proximity in collaborative innovation projects in the Danish clean tech industry (Hansen 2014). Network proximity also alleviates the impeding effects of geographical distance on collaboration (Bergé 2016). For high spatial distances, cognitive proximity is an important tool for scientific cooperation between researcher from distant different regions (Capello & Caragliu 2016). In addition, studies on industrial clusters have shown the importance of non-local relations of local producers, supported by the presence of cognitive proximity among actors (Vale & Caldeira 2007) or intermediated by technological gatekeepers (Morrison 2008; Hervas-Oliver & Albors-Garrigos 2014). However, in specific contexts, such as among small firms, relations between geographical and cognitive proximity could be complementary in nature because interactions characterized by both geographical and cognitive proximity are more likely to be realized than linkages characterized by only geographical proximity (Broekel & Boschma 2011).

Based on this debate, this paper aims to contribute to the literature by presenting new empirical evidence on the relations between geographical and cognitive proximity in fostering university-industry collaboration.

The main database used provides basic information on university-industry linkages in Brazil. The data were gathered from the Brazilian Ministry of Science and Technology. This database provides a broad set of data on the activities of academic research groups in Brazil and covers their main features, such as scientific field, number of researchers, research performance, and collaborating firms. Information on the collaborating firms from the Brazilian Ministry of Labour, such as size, industrial sector, localization, and labour force qualification, was added to these data. The final database includes 4,337 collaborations involving 3,063 firms and 1,738 Engineering and Agrarian Science research groups in 2010 from all Brazilian regions. Engineering and Agrarian Science are the most important knowledge fields involving collaboration in Brazil (Suzigan et al. 2009; Garcia et al. 2015).

An econometric model was estimated to analyse how geographical and cognitive proximity affects collaboration of a certain region. The dependent variable is number of collaborative projects of each region of the country, taking the Brazilian micro-regions (similar to EU NUTS-3). The most important independent variables are geographical proximity (*GeoProx*), and cognitive proximity (*CognProx*). Geographical proximity was measured as the distance in kilometres in a straight line between the georeferenced coordinates (latitude and longitude) of the localization (ZIP code) of the research groups and collaborating firms. An empirical measure for the cognitive distance was established using correspondence analysis, and considering the scientific field of the research group and sectoral industry of the firm. By defining these two main variables, it was possible to assess how cognitive proximity and geographical distance affect the collaborations in a certain region and to provide new empirical evidence on this issue.

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