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The impact of technological relatedness, prior ties, and geographical distance on university–industry collaborations: A joint-patent analysis

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ABSTRACT

Empirical studies on R&D collaborations between universities and firms have mainly centered their attention on universities and firms' characteristics that favor the establishment of collaborative agreements. In this paper, I extend the current research framework investigating the role that specific technological and relational attributes may play on the relevance of such collaborations. Specifically, I focus on the effects exerted by three relevant factors, namely technological relatedness, prior collaboration ties, and geographical distance, on university–industry joint innovation value. I develop testable hypotheses about their impact on the innovative performance of R&D university–industry collaborations, and test them on a sample of 796 university–industry joint patents, developed by 33 universities located in 12 different European countries. Our results suggest that partners' technological relatedness has an inverted U-shaped relationship with innovation value. In addition, prior ties and geographical distance between universities and firms are both positively related to the achievement of higher innovative outcomes.

1. Introduction

Nowadays, it is well understood that the creation and application of new knowledge are the primary factors that drive the economic growth. Moreover, it is also commonly accepted that universities are important sources of new knowledge, especially in the areas of science and technology (Rosenberg and Nelson, 1994; Etzkowitz and Leydesdorff, 2000). Thus, researchers have devoted a great effort to investigate the nature and the importance of university–industry (U–I) collaborations, trying to build a clear picture of which mechanisms may favor universities and firms interaction, promoting knowledge transfer and acquisition (Agrawal, 2001). In addition, a better comprehension of U–I links has assumed a great importance also at policy level, as shown by the several initiative launched by the European Commission to proactively enhance the transfer of technological knowledge from university to industry and identify effective and efficient innovation policies.

However, an excessive university's orientation towards the industrial environment has been also addressed as negative, since it may imply the engagement in too much consultancy-based research and the pursuit of short-term goals (e.g. Blumenthal et al., 1997), as well as problems related to knowledge disclosure (e.g. Mowery and Ziedonis, 2002).

The present study aims at contributing to the debate about U–I collaborations, focusing on the factors affecting the innovative results of U–I collaborations. Specifically, differently from previous works that have mainly centered their attention to identify universities and firms' characteristics promoting collaboration (e.g. Debackere and Veugelers, 2005; Veugelers and Cassiman, 2005; Rothaermel et al., 2007), I investigate the role that both technological and relational aspects, such as technological relatedness, prior collaboration ties, and geographical distance, exert on the value of U–I joint innovations.

Collecting data from the European Patent Office (EPO) in the period 1998–2003, I study U–I joint innovations in terms of joint patents, and present an econometric analysis examining the impact of the three variables on the value of innovative output. 796 collaborations are considered, developed by 33 universities located in 12 countries belonging to the European Union. Results show that the value associated to U–I joint innovations presents an inverted U-shaped relationship with partners' technological relatedness, and it is favoured by the existence of previous collaboration ties between organizations. Moreover, geographical closeness between universities and firms seems to not favor the joint development of more valuable innovative outcomes.

The paper is structured as follows. Section 2 presents the theoretical background and the hypotheses, whereas in Section 3 the research methodology and approach are described. Finally, Sections 4 and 5 discuss the main research results and conclusions, respectively.

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2. Theory and hypotheses

2.1. University–industry collaborations

It is commonly recognized that universities may be important sources of new knowledge and innovation (see also Agrawal, 2001). In fact, as shown by several studies (e.g. Saxenian, 1994; Adams, 2005; Audretsch et al., 2005), universities tend to act as explorative organizations, that present a great capability to recombine and integrate knowledge coming from multiple markets and technological domains. Therefore, such a gatekeeper character makes universities as ad hoc R&D partners for firms, allowing them to reach and acquire new competencies, necessary to innovate and to achieve a sustainable competitive advantage.

Moreover, universities are going beyond their traditional mission in terms of teaching and research activities, undertaking an entrepreneurial "third mission", that has significantly increased the links with the industrial environment (e.g. Etzkowitz and Leydesdorff, 2000; Nelson, 2005; Rothaermel and Thursby, 2005; Siegel et al., 2007; Todorovic et al., 2010). These links may occur in different ways, such as employment by industry of university graduates, joint research programmes, licensing of university patents, joint publications, etc. (e.g. Cohen et al., 2002; Schartinger et al., 2002; D'Este and Patel, 2007; Perkmann and Walsh, 2007; Abramo et al., 2009; Giuliani and Arza, 2009). Among the others, great attention has been devoted towards the analysis of U–I joint research collaborations (henceforth collaborations), as formal collaborative arrangements among organizations with the objective to co-operate on research and development activities. Much of the studies on this topic has focused the attention on the investigation of university and firm's characteristics affecting the likelihood of U–I collaborations being formed. Notwithstanding the broadness of this field of research, in the following a set of main factors identified as fundamental for favouring and supporting U–I research collaborations are presented. For example, Veugelers and Cassiman (2005), analyzing 748 Belgian manufacturing firms, have empirically demonstrated that firms' size, type of industry, government support, and the involvement in complementary innovative activities positively affect the likelihood to establish R&D collaborations with universities. Bercovitz and Feldman (2007) examined how firms' innovation strategies affect their involvement in university collaboration, founding that a research exploratory behavior and a centralized organization of R&D activities are positively related with the establishment of university relationships. A similar result is also revealed by Laursen and Salter (2004), who suggested that firms employing an "open" search strategy and investing in R&D are more likely to collaborate with universities. Finally, Giuliani and Arza (2009) analyzed U–I linkages established in two wine clusters in Chile and in Italy, and revealed that the occurrence of such relationships is favoured by the strength of firms' knowledge base.

Regarding universities, entrepreneurial orientation, existence and productivity of technology transfer offices (TTOs), creation of new firms, and environmental context are generally seen as the most important factors influencing their capability to collaborate and develop joint innovations with the industrial environment (for a complete review see Rothaermel et al., 2007). Specifically, institutional norms, incentive mechanisms, university reputation, intermediary agents, and faculty characteristics have been demonstrated to play a fundamental role for making some universities more entrepreneurial than others (e.g. Mansfield, 1995; Etzkowitz et al., 2000; Mowery et al., 2001; Thursby and Thursby, 2005; Boardman and Ponomariov, 2009; Bjerregaard, 2010; Gaughan and Corley, 2010; Giuliani et al., 2010; Prodan and Drnovsek, 2010). In addition, TTOs have been addressed as the formal gateway between university and industry, whose productivity strongly depend on factors such as structure and staff, different mechanisms of technology transfer, nature and stage of technology, as well as university system and various environmental factors (e.g. Bercovitz et al., 2001; Shane, 2002; Anderson et al., 2007; Sanjay and Gerard, 2007). Other scholars have focused their attention on the creation of new firms by universities (i.e. university spin-offs), often seen as one of the key drivers of economic change and growth (Bercovitz and Feldman, 2006). With this regard, university policy, underlying technology, founding teams, and network relationships appear to be positively related with such a tendency (e.g. Chiesa and Piccalug, 2000; Di Gregorio and Shane, 2003; Link and Scott, 2005; Clarysse et al., 2007; Hoye and Pries, 2009). Finally, the environmental attributes, including innovation networks, science parks, incubators, and geographic location, can significantly affect university's propensity to collaborate with industry (e.g. Audretsch and Stephan, 1996; Owen-Smith et al., 2002; Link and Scott, 2005).

Nevertheless, despite the growing interest towards U–I collaborations, some concerns have been posed, especially referring to the goals of public research and the appropriation and use of research outputs. In particular, it is argued that an excessive orientation towards the industrial environment may determine a loss of freedom by university, shifting its research activity from a long-term perspective to a short-term one, more devoted to consultancy and to solving practical problems (Tapper and Salter, 1995; Blumenthal et al., 1997). Moreover, the development of joint innovations with firms may cause problems related to the diffusion of knowledge, since firms tend to exclusively manage the rights on the innovations, limiting their disclosure (Mowery and Ziedonis, 2002; Fabrizio, 2007).

Thereby, what seems to emerge is the existence of some societal concerns about U–I collaboration. The present paper aims at contributing to this debate focusing on the factors contributing to make some collaborations more innovative than others. Rather than focusing on how collaborations' innovative outcome depends on universities and firms' characteristics, I investigate the impact exerted by specific technological and relational attributes. Specifically, I am interested at analyzing how technological relatedness, prior collaboration ties, and geographical distance may contribute to clarify why certain U–I collaborations more than others lead to the development of successful technological solutions.

2.2. Technological relatedness and joint innovation value

The notion of technological relatedness is based on shared technological experiences and knowledge bases between organizations. It refers not to the technologies themselves, in terms of tools and devices used to create new products and services, but to the knowledge actors possess about these technologies (Jaffe, 1986; Mowery et al., 1998; Knoben and Oelremans, 2006).

The importance of technological relatedness is strictly related to the notion of absorptive capacity. In fact, as shown by Cohen and Levinthal (1990), in order to successfully collaborate, the prior (technological) knowledge of an organization must be similar to the new knowledge on the basic level, but fairly diverse on the specialized level. Basic knowledge refers to the general understanding of the techniques upon which a scientific discipline is based, whereas specialized knowledge refers to the specific knowledge used by the actors in its everyday functioning. With this regard, Lane and Lubatkin (1998) showed that organizations with greater technological relatedness in basic technologies have greater relative absorptive capacity, and hence are more likely to learn from each other. This has to do with the technical and market competencies organizations own and have acquired when dealing with specific technologies and markets. If these are