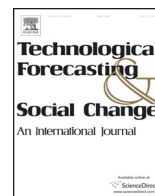


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Technological Forecasting & Social Change



How intermediary organizations facilitate university–industry technology transfer: A proximity approach

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ARTICLE INFO

Article history:

Received 21 September 2015

Received in revised form 5 June 2016

Accepted 6 June 2016

Available online xxx

Keywords:

Collaborative research centres

Proximity dimensions

Technology transfer

Technology transfer offices

University incubators

University–industry collaboration

ABSTRACT

The literature on university–industry (U–I) links has revealed many barriers that impede U–I technology transfer. A growing number of intermediary organizations, such as Technology Transfer Offices (TTOs), University Incubators (UIs), and Collaborative Research Centres (CRCs) have been established to mitigate such barriers. While the activities and effects of such intermediaries are frequently studied, conceptual understandings of how these organizations facilitate technology transfer are lacking. Our case study of nine Italian intermediary organizations shows that different types of intermediary organizations address the same fundamental issue of bridging the different logics of academia and industry in different ways. Based on a proximity approach, we develop a theoretical framework explaining how intermediary organizations can reduce cognitive, geographical, organizational, and social distance in U–I collaborations. Intermediary organizations address different proximity dimensions depending on the prior experience of academic and industrial actors and the nature of the knowledge that is transferred. In particular, TTOs focus more on improving cognitive and organizational dimensions, whereas UIs and CRCs attempt to reduce social and geographical distance.

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1. Introduction

The mechanisms that facilitate university–industry (U–I) relationships have gained substantial attention (Minguillo et al., 2015b; Perkmann et al., 2013; Wright et al., 2008). U–I technology transfer is a core element of most countries' innovation strategies, and universities are increasingly becoming ambidextrous institutions with both scientific and commercial missions (Ambos et al., 2008; Huyghe et al., 2014). To engage more actively in knowledge transfer and “third mission” activities, universities are currently promoting U–I links through a range of different intermediary organizations (Howells, 2006; Etkowitz and Leydesdorff, 2000), including Technology Transfer Offices (TTOs), University Incubators (UIs), and Collaborative Research Centres (CRCs). While the activities and effects of such intermediaries have been frequently studied, and factors that reduce the barriers between university and industry have been recently addressed (Bruneel et al., 2010), this paper addresses the lack of conceptual understanding of how different types of intermediaries facilitate U–I technology transfer.

Scholars have emphasized the barriers between universities and industry in terms of cultural differences (Bjerregaard, 2010), institutional differences (Bruneel et al., 2010), regulatory barriers (Jacobsson and

Karltorp, 2013), and geographical distance (D'Este et al., 2013). The main challenge in transferring technology between universities and industry is bridging their two different institutional logics (Murray, 2010; Sauermann and Stephan, 2012; Thornton et al., 2012), which may have conflicting sets of rules and norms (Tartari et al., 2012). Because of this difference in institutional logics, actors have diverse “rules of action, interaction and interpretation” (Thornton and Ocasio, 1999, p. 804) that guide and constrain their decision making. Intermediary organizations are conceived with the goal of overcoming these difficulties (Howells, 2006) and act as boundary organizations that manage the hybrid zone between academic and commercial logics (Murray, 2010; Alexander and Martin, 2013).

Knowledge and technology transfer are strongly related to the actors' proximity, which makes assimilation and the exchange of knowledge possible (Steinmo and Rasmussen, 2016; Mattes, 2012). Geographical proximity facilitates face-to-face interaction and improves the likelihood and success of U–I collaborations (Broström, 2010; Capaldo and Petruzzelli, 2014; Slavtchev, 2013; Dornbusch and Neuhäusler, 2015). Furthermore, several studies have highlighted the importance of non-spatial dimensions of proximity, such as cognitive, organizational, and social dimensions (D'Este et al., 2013; Nooteboom et al., 2007). Proximate actors interact more easily, and the proximity concept has gained increasing attention in explaining inter-organizational collaboration and innovation (Steinmo and Rasmussen,

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2016; Balland et al., 2014; Boschma, 2005; Knobens and Oerlemans, 2006).

Our study addresses the following research question: *How do intermediary organizations facilitate proximity dimensions between academia and industry to improve technology transfer?*

We conducted a multiple comparative case study covering three prevalent types of intermediary organizations that can be found at most research universities. First, most universities have TTOs that aim to commercialize research results through patents, licenses and start-up companies (Alexander and Martin, 2013; Algieri et al., 2013; Carlsson and Fridh, 2002). TTOs serve as brokers at the blurred boundary between science and business (O’Kane et al., 2015). Another type of intermediary organization that has emerged at most universities is the UI, which aims to facilitate knowledge flows from universities to new technology ventures (Grimaldi and Grandi, 2005; Rothaermel and Thursby, 2005). Third, CRCs have emerged as important intermediaries between universities and industry sectors (Minguillo and Thelwall, 2015a) and often aim to increase the R&D intensity of local industries (Boardman and Gray, 2010; Knockaert et al., 2014; Wright et al., 2008). These are three common types of university-operated intermediary organizations that exist among a variety of similar arrangements, such as cooperative research and development agreements (Wonglimpiyarat, 2006), proof-of-concept centres (Hayter and Link, 2015) and science parks (Minguillo and Thelwall, 2015a).

For all of these intermediary organizations, proximity between academic and industry actors is a pre-condition for achieving successful results. Despite differences in their technology transfer activities, all intermediaries must overcome barriers to collaboration between university and industry logics. For our purposes, we include three types of intermediary organizations that have different purposes and operational activities but share the same underlying challenge of reducing the complexity and distance between different logics. We selected three organizations of each type; thus, we study a total of nine of the most productive intermediary organizations in Italy.

This study makes two important contributions. First, it contributes to the proximity literature by analysing how intermediary organizations leverage different proximity dimensions in the context of U–I collaboration. We show that cognitive distance in inter-organizational collaborations can be modified both directly, by adopting ad hoc measures that affect the cognitive dimension itself, and indirectly, by influencing the other proximity dimensions. This enhances our knowledge of the inter-relationships among different proximity dimensions (Balland et al., 2014; Marrocu et al., 2013; Huber, 2011). Moreover, we show that a) the level of proximity in a particular dimension should not be viewed as fixed; rather, it should be viewed as dynamic and open to change; b) each proximity dimension should not be examined in isolation; rather, it should be examined in relation to other proximity dimensions and their interplay over time; c) intermediary organizations can purposefully affect the degree of proximity in collaborative relationships through specific direct and indirect activities; and d) proximities are strongly related to context-specific characteristics, such as the complexity of the knowledge being exchanged and the type of actor involved in the technology transfer.

Second, this study improves our understanding of intermediaries in U–I technology transfer by using a common theoretical framework to compare the specific activities in which different types of intermediary organizations engage to facilitate technology transfer (Klerkx and Leeuwis, 2009). We show that TTOs, UIs, and CRCs aim to bridge the university–industry interface by relying on different core and peripheral activities to increase the different dimensions of proximity between actors. We also show that the complexity of the knowledge being transferred may influence the type of activities that different intermediary organizations implement.

The paper proceeds as follows. The next section presents a theoretical framework outlining how different dimensions of proximity may be facilitated by intermediary organizations. Section 3 presents the

methodological approach. The empirical findings and propositions are outlined in Section 4. Finally, Section 5 presents the conclusions and implications.

2. Theoretical framework

2.1. U–I technology transfer and the rationale for a proximity perspective

Universities and industry represent two different logics that have different goals, cultures, and structures (Dasgupta and David, 1994; Murray, 2010; Tartari et al., 2012). Whereas the academic logic seeks “fundamental knowledge, research freedom, rewards in the form of peer recognition, and open disclosure of research results” (Sauermann and Stephan, 2012, p. 889), the commercial logic “is thought to entail different and partially conflicting practices and norms, including bureaucratic control, restrictions on disclosure, and the private appropriation of financial returns” (Sauermann and Stephan, 2012, p. 889). This heterogeneity creates a fruitful basis for developing new innovations and accessing complementary knowledge across institutional boundaries. Larger distances in cognition between firms and alliance partners have a positive effect on novelty creation (Nooteboom et al., 2007), and firms that cooperate with universities achieve greater success with market novelties. However, transferring technology and knowledge across dissimilar actors is challenging. Innovation projects in collaboration with public research organizations are more likely to fail (Lhuillery and Pfister, 2009), university spin-offs meet significant barriers when they enter the business world (Colombo and Piva, 2012; Vohora et al., 2004) and university licenses are typically related to embryonic technologies (Jensen and Thursby, 2001).

The challenges inherent in U–I technology transfer have been extensively studied; however, there is a lack of theory development on how these challenges are mitigated. The proximity perspective appears to be a fruitful starting point to understand how such barriers can be overcome. The term *proximity* was originally used in the area of economic geography to denote geographical closeness; however, in the innovation literature, it is used as a concept covering a number of proximity dimensions (Boschma, 2005). Different types of proximity are viewed as important pre-conditions for innovation and inter-organizational collaboration (Knobens and Oerlemans, 2006; Marrocu et al., 2013; Geldes et al., 2015). For example, cognitive, organizational, and social proximity are viewed as drivers of learning and innovation (Balland, 2012; Boschma, 2005). Actors that are cognitively proximate perceive, interpret, understand, and evaluate the world in similar ways (Wuyts et al., 2005). Organizations with similar routines and rules may collaborate more easily because of organizational proximity. Actors that have developed trust, friendship, kinship, and common experiences are socially proximate (Boschma, 2005). While the literature has defined multiple, partially overlapping, proximity dimensions, we take into account cognitive, geographical, organizational, and social proximity (Broekel and Boschma, 2012), as summarized in Table 1.

A minimum level of cognitive proximity is required for collaboration to take place. In cognitively distant collaborations, the collaborating parties less efficiently recognize and absorb external knowledge because it is grounded in norms, principles, and concepts that differ from their own (Rosenkopf and Almeida, 2003). Hence, effective and efficient communication and transfer of knowledge depend on some degree of similarity in collaborating partners’ frames of reference. Although cognitive proximity seems necessary for fruitful collaborative outcomes, other proximity dimensions may compensate for cognitive proximity when actors are distant in cognitive terms (Huber, 2011).

More recently, scholars have analysed the interplay among different types of proximity and whether they can serve as substitutes for each other (Geldes et al., 2015; Hong and Su, 2013; Huber, 2011). According to Huber (2011, p. 1171), “rather than simply stating proximity matters, there is a great need to substantiate how and why which type of proximity matters” in inter-organizational collaborations (Marrocu et al.,

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