Geography of knowledge sourcing, heterogeneity of knowledge carriers and innovation of clustering firms: Evidence from China's software enterprises

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A B S T R A C T

The increasing complexity of innovation has triggered a plenty of studies on external knowledge sourcing and innovation performance of clustering firms. While existing economic geography literature places much emphasis on the geographical dimension of knowledge flows, the relative importance of different types of knowledge sources and their geographical identity in innovation have been largely undervalued. Drawing upon a firm-level questionnaire survey and face-to-face interviews on the software firms in a Chinese regional economy, we reveal that, contrary to the conventional wisdom of distance decay and geographical proximity, no significant difference is found between local and non-local suppliers, customers, and rivals as the external sources of knowledge for firm innovation. Local universities and research institutions are identified by firms as the better and more effective sources of knowledge than others outside of the region. Whereas suppliers and rivals make no significant difference to firm innovation, knowledge obtained from customers is reported to be highly significant to the innovation performance of software firms. Findings of this research cast doubts over the prevailing uncritical and undifferentiated perception of the functioning of geography and inter-firm linkages in the processes of firm innovation as well as the under-socialized understanding of knowledge flows between different agents.

1. Introduction

In the perennial debate about the nature and dynamics of technological innovation, the issue of externality has never ceased to capture scholarly imagination and arouse competing interpretations. It is now widely accepted that firm innovation cannot be completed solely by internal R&D activities and instead must be facilitated by the knowledge obtained from relevant firms and organizations externally (Sun & Zhou, 2011; Trippl, Tödtling, & Lengauer, 2009). In the studies of externality, attention has been overwhelmingly paid to the geographical dimension of knowledge production and spillover based on the cases of advanced economies. By contrast, relatively less is understood about the functioning of various agents in the process of innovation, such as partners, rivals and universities and research institutes (URIs) in developing countries (Zeng, Xie, & Tam, 2010). Identification of the roles played by the different kinds of agents involved in knowledge production and transfer is important not only because the constraints on time, energy and resources do not allow the firms to heavily and deeply seek external knowledge without selection but also because the knowledge affiliated with different agents tends to be in different scientific or applied nature and associated with technology, market or organizational aspects (Grillitsch, Tödtling, & Höglinger, 2015). It is the heterogeneous nature of the knowledge associated with different types of agents that has intrigued debates over their spillover effects on innovation (Caloghirou, Kastelli, & Tsakanikas, 2004; Tomlinson, 2010).

Against the backdrop of current theoretical advancement, this study attempts to investigate the roles played by the knowledge obtained from several main sources (suppliers, customers, rivals and URIs) and their geographical identity in the process of firm innovation, taking China's software industry as a case. External knowledge sourcing is of particular importance for the indigenous firms in many developing countries where firms are normally characterized by inferior technological capability and inadequate internal R&D investment (Lin et al., 2011; Zhou & Tong, 2003). As the “heart of the information society”, the software industry has experienced rapid growth in China over the recent two decades to warrant itself an interesting and significant case for serious investigations. In particular, we attempt to address the following questions. What exactly is the role played by geographical proximity between a firm and external knowledge sources in the process of innovation? What specific type of knowledge sources is central to the innovation of the firms, and why?

The rest of the paper is structured as follows. It starts with a critical

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evaluation of the extant literature on external knowledge sourcing and firm innovation based upon which two research hypotheses are made. This is followed by a clarification of our own research design and methodology. Attention is then turned to China where the software industry has experienced such a dramatic growth that it becomes an interesting case for the study of how geographical proximity and different types of knowledge sources affect the innovation performance of the firms. Major findings of this research and their implications are summarized and discussed in the end.

2. External knowledge sourcing, heterogeneity of knowledge carriers and firm innovation: the devil in the details?

2.1. Geography in knowledge sourcing and innovation

Over the last decade, technological innovation is increasingly understood as a result of some complex, collective and cumulative processes of knowledge production involving many different kinds of agents from within and outside of a firm (Asheim, Boschma, & Cooke, 2011; Fu, Revilla Diez, & Schiller, 2013). In recognition of the importance of external knowledge for innovation, economic geographers have devoted much of their attention to the geographical dimension of external knowledge sourcing and generated significant insights (Grillitsch & Tripple, 2014; Howells, 2012; Hu & Lin, 2013). On one hand, it has been observed that, since the generation, utilization and distribution of knowledge depend on the frequency and density of interaction among firms, geographical proximity makes these processes more easily and smoothly (Caloghirou et al., 2004; Lin, Yang, & Hu, 2012). On the other hand, while geographical proximity may foster face-to-face contacts and smooth the process of knowledge exchange, it brings along a risk of creating a locally closed mentality that may inhibit innovation (Munari, Sobrero, & Malipiero, 2012). Knowledge from non-local scales, although culturally, cognitively and technologically distant, is believed to be a significant complement of the existing knowledge stock (Sidhu, Commandeur, & Volberda, 2007). The multi-scale nature of knowledge interactions and the different role they play in the process of innovation have been well-recognized and extensively documented (Asheim et al., 2011; Bathelt, Malmberg, & Maskell, 2004; Cooke, Boekholt, & Tödtling, 2000; Tödtling, Grillitsch, & Höglinger, 2012). It is believed that a combination of the knowledge of different scales (local and nonlocal), different forms (codified and tacit) and different kinds (analytical, synthetic, symbolic) would enhance the innovative performance of firms (Halkier et al., 2012; Manniche, 2012; Strambach & Klement, 2012).

What has not been well elucidated is, however, from whom (clients/suppliers/customers etc.) a firm tends to obtain valuable knowledge for innovation. In reality, firms tend to seek specific knowledge through contacting with many knowledge carriers, formally or informally, with little concern over the geographical scale of these particular knowledge providers. We argue, therefore, that identification of the specific types of knowledge sources/providers is no less important, if not greater, than the location of knowledge sources to our understanding of the processes of innovation. The impact of geographical proximity depends upon specific characteristics of different knowledge sources. It is claimed that knowledge sourcing from URIs tend to occur more often at the local scales whereas knowledge sourcing from customers and suppliers are frequently located outside of the region (Grillitsch et al., 2015). As Boschma (2005) has pointed out, geographical proximity per se is neither a necessary nor a sufficient condition for learning and knowledge exchange to take place. Its importance is related to other dimensions of proximity such as cognitive and relational proximity. As it stands, the larger cognitive distance between firms and URIs may entail geographical proximity for a better knowledge exchange. By contrast, the relatively higher cognitive and relational proximity between firms and their customers/suppliers makes geography much less important.

In addition, existing theoretical and empirical studies have been based primarily upon the practices of developed countries, leaving us to wonder how geography and the heterogeneous nature of knowledge carriers in developing economies would affect technological innovation of a firm. For instance, unlike the situation of industrial clusters in many advanced economies where firms interact among themselves intensively and extensively to engage in ground-breaking innovations, many software firms in China have been preoccupied by the simple task of imitations, modification, and application of the technology originating from advanced economies to improve efficiency in production and expand market penetration. These firms are clustered simply to share the costs of regional infrastructure or the benefits of externality (Lin et al., 2011). They are located close-by for convenience and not for cooperation in innovation. Under this circumstance, the notion of geographical proximity or local scale that is central to the theoretical literature of industrial clustering may not work in the same way in China as it has been in many Western advanced economies. Because these firms are mainly involved in a “fine-tuning” of the existing technologies, cognitively distant knowledge from non-local scales is not as significant as what it has been observed from many advanced economies. In a word, geographical scales of knowledge sources make much less sense to the firms in a developing economy such as China. This noticeable gap in the existing literature leads us to formulate the first research hypothesis.

Hypothesis 1. Location or geography of knowledge sources is less important than the heterogeneous nature of the knowledge carriers to the innovative performance of firms in the case of China.

2.2. Agents in knowledge sourcing and innovation

Ever since the concept of “open innovation” was introduced, there have been strong scholarly interests in how cooperative ties and networks or cooperation partnerships could facilitate firm innovation (Segelod & Jordan, 2004; Tomlinson, 2010). Research in this vein has generated mixed and contradictory results, however. Some researchers have identified suppliers as the key sources of knowledge because they have better expertise and a more comprehensive understanding of the supplied parts and components that are necessary to fix particular technical problems (Nieto & Santamaria, 2007; Tsai, 2009). It is empirically confirmed that co-operation with suppliers enables firms to reduce lead times of product development and enhance flexibility, product quality and market adaptability (Chung & Kim, 2003). Nevertheless, others maintained an insignificant relationship between co-operations with suppliers and innovation (Ledwith & Coughlan, 2005). For instance, by investigating 597 firms in the UK, Freel (2003) has found that there is no significantly important relationship between cooperation with suppliers and product innovation.

It has been argued that cooperation with customers are theoretically significant for product innovation simply because only customers can provide user friendly technical know-how and market information, and the debate continues (Tether, 2002). It is observed that close linkages between software firms and their customers are crucial in the innovation process (Bettencourt, Ostrom, Brown, & Roundtree, 2002). In particular, customers, by virtually integrating into a company’s innovation process could provide valuable inputs for new product development (Füller and Matzler, 2007). Segelod and Jordan (2004) have demonstrated that linkages with customers are the most important ones during the whole process of product innovation from the idea proposal, decision to investment in innovation, development and commercialization of the new product. However, Romijn and Albaladejo (2002) have shown that interactions with customers do not enhance the innovative performance of the firms in southeast England.

Evaluation of the role played by interactions with rivals is even more controversial because, on one hand, rivals may share common problems and can be teamed up to reduce cost and increase technological efficiency, but on the other hand, collaborations with rivals are potentially
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