



The more interactions the better? The moderating effect of the interaction between local producers and users of knowledge on the relationship between R&D investment and regional innovation systems



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ABSTRACT

Under the fierce pressures of the rapidly changing environments, regional innovation systems are important in regional economy and national competitiveness. This study examines how R&D Investment from firms, universities and research institutes (Core component of Triple Helix Innovation) helps build regional innovation systems and its contingencies in China's emerging economy. A panel dataset from thirty provincial level regions in China from 2002 to 2011 indicates R&D investment from firms, universities and research institutes is an important driver of regional innovation systems. The effectiveness of R&D Investment is contingent on the interaction between local producers and users of knowledge. When the interaction between local producers and users of knowledge becomes increasingly active, R&D investment from firms, universities and research institutes has a stronger effect on the building of regional innovation system. Moreover, the interaction between local producers and users of knowledge has an inverted U-shaped relationship with the building of regional innovation systems.

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1. Introduction

Regional innovation systems is defined as an interactive learning engagement among a network of various actors underpinned by an institutional framework with embeddedness since the early 1990s (Cooke, 1992). They play important roles in regional sustainable development. In detail, the concept of regional innovation systems was developed and divided into two parts: the regional production structure or knowledge exploitation subsystem which consists mainly of firms, and the regional supportive infrastructure or knowledge generation subsystem which consists of public and private research laboratories, universities and colleges, technology transfer agencies, vocational training organizations, and other research organizations (Autio, 1998).

To some degree, the whole system is important for the regional economy not only in developed countries but also in emerging countries (Cooke et al., 1998; Leydesdorff and Zhou, 2014). Recently, Chinese President Xi Jinping called for the integrated and coordinated development of Beijing and the two neighboring provincial areas during a symposium after listening to work reports delivered by officials from Beijing, Tianjin and Hebei provinces. The Beijing–Tianjin–Hebei region's coordinated development of the Bohai Bay area will be an engine for

China's economy. Moreover, the increasing globalization of markets, characterized by turbulence and uncertainty, has changed the competitive environment of most companies drastically, not only on foreign markets but also on their domestic market where they are confronted with intensive price, time and quality competition (Jiao et al., 2013; Teece, 2007). To stay competitive they have to restructure their business organization and collaborate with the government, universities and research institutes, including innovation activities as well as consumer and supplier relationships (Dosi, 1988; Li, 2012). This kind of need leads to urgent requirements for building regional innovation systems.

Many scholars conduct research on how to build regional innovation systems with perspectives from different disciplines, such as the institution perspective (Freeman, 1995; X. Li, 2009), interactive learning perspective (Lundvall, 2009), knowledge management perspective (Asheim and Coenen, 2005; Asheim and Isaksen, 2002), systematic perspective (Liu and White, 2001), and co-evolution perspective (Hekkert et al., 2007). These studies adopt a holistic approach, emphasizing the structures of innovation systems, the institutions within the system, as well as the interactions and linkages among the institutional actors. This approach allows for the inclusion of organizational, social, and political factors, as well as economic ones (Hsu et al., 2013). However, these perspectives also have weaknesses. One example of the weaknesses is that they do not indicate what exactly should be included in

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an innovation system, and they do not specify the boundaries of the system. As a result, it is important to increase the rigor and specificity of the regional innovation system approach by clarifying the key components as well as the relations among them, and specifying the boundaries of regional innovation systems, so as to provide the micro-foundations for further research in this field.

Based on the research on innovation systems, the Triple Helix model emphasizes interactions among the institutions to drive regional innovation systems (Etzkowitz and Leydesdorff, 1997, 2000; Rho, 2014). Taking into account the Triple Helix model, it functions as a facilitator to support the development of local innovation (Ivanova and Leydesdorff, 2014; Phillips, 2014). Following the narrow definition of regional innovation systems (Asheim and Gertler, 2005; Etzkowitz and Leydesdorff, 2000), we want to explore the mechanisms of different patterns of R&D investment from firms, universities and research institutes (Core component of Triple Helix Innovation Model) on the building of regional innovation systems in the context of China, with the moderating effect of the interaction between local producers and users of knowledge.

The paper is organized as follows: Section two introduces key hypotheses on different channels of R&D investment from firms, universities and research institutes. Moreover, their influences on the building of regional innovation systems are the focus of our analysis. Section three details the methodology of our study, describing the conceptual design, and the data collection and analysis. Section four presents the evidence from our analysis, identifying the key influential factors in building regional innovation systems. Section five concludes, highlighting some policy implications of our findings.

2. Development of hypotheses

As is well known, in order to improve a firm's competitive advantage, the government pays more attention to independent innovation of different regions in China. According to innovation system theory (Lundvall, 2009; Nelson, 1993), various organizations – firms, universities, research institutes and technology transfer agencies interact with one another in a systematic way and jointly contribute to the build-up of innovation capacity. Therefore, the following factors are, among others, regarded as critical in determining the innovation capacity of regional innovation systems: (1) The innovation effort contributed by each of the major innovation actors including firms, universities and research institutes; (2) the interactions among the actors in the innovation process.

A conceptual framework formulated in this way is consistent with the previous studies. Therefore, we will explore the role of firms, universities and research institutes and the interaction between local producers and users of knowledge on building regional innovation systems. In developed countries, the research and development of firms

plays a leading role in the construction of regional innovation systems. In the process of technological innovation, firms will respond quickly and timely to meet the demands of rapidly changing environments. Based on market signals and internal plans, they can reorganize factors of production in line with the needs of the market.

In China, the role of firms in economic development and regional innovation has always been emphasized. Therefore, the firms' investment in science and technology has obvious effects on regional innovation systems. Because market competition is strong, firms need to formulate the development plan of science and technology by themselves, conduct continuous investment in science and technology, and determine development strategies to guide the behavior of different subsidiaries.

Therefore, in light of the above logic and empirical evidence, this study hypothesizes:

H1. *Firms' R&D investment is positively related to the building of regional innovation systems.*

Universities and research institutes play an important role in the process of regional innovation development. Cooke (2002) found that the success of biotechnology clusters in Cambridge, Massachusetts, USA and Cambridge, England depended on exceptionally strong supporting infrastructures complementing strong local science bases (Cooke, 2002). Therefore, the organizational innovation supporting infrastructure in a given region is clearly necessary to promote firms' technological innovation.

Following Autio (1998), the regional innovation systems can be divided into two key sub-systems: the knowledge application and exploitation subsystem and the knowledge generation and diffusion subsystem (Autio, 1998). Public organizations such as universities and research institutes are mainly engaged in knowledge generation, and technology transfer agencies. Regional and local governance bodies are responsible for innovation support practices. Therefore, the importance of knowledge generation from universities and research institutes has increasingly been acknowledged and stressed and university and research institutes, in particular, are seen as crucial for assisting local firms in their innovation activities (Diez, 2000).

Based on the preceding rationale, the hypothesis regarding the building of regional innovation systems is stated as below.

H2. *R&D investment from universities and research institutes is positively related to the building of regional innovation systems.*

The current research indicates that regional and external innovation interaction among firms and other innovation organizations are important for regional innovation promotion in biotechnology clusters in Cambridge, Massachusetts, USA and Cambridge, England (Cooke, 2002). Network links among actors of firms, universities and research

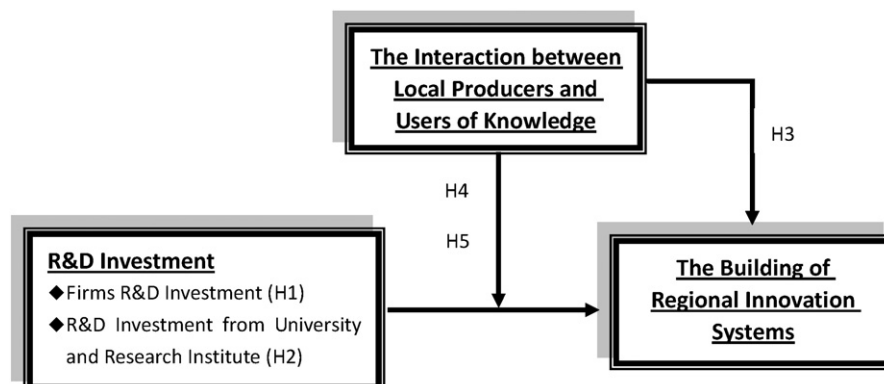


Fig. 1. The conceptual model.

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