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## Do emerging countries prefer local knowledge or distant knowledge? Spillover effect of university collaborations on local firms

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## ABSTRACT

This study compares the university spillover effect of two types of knowledge, localized knowledge from domestic collaboration and distant knowledge from international collaboration, and investigates their spillover effect on local firms' innovation. The findings of this study challenge the conventional idea that international collaboration, especially collaboration with developed countries that possess frontier knowledge, better promotes innovation in developing countries. For the period from 1999 to 2004, only in first-tier regions of China do domestic and international university collaborations show a positive relation with local corporate innovation. In the period from 2005 to 2012, the positive spillover effect of both types of collaboration spreads to second-tier regions. However, international collaboration is negatively associated with firms' innovation in the least developed regions. Furthermore, domestic collaboration has shown a larger positive impact on corporate innovation than international collaboration in recent years. In our paper, the regional absorptive capacity was identified to explain this puzzle. We argue that the universities of relatively developed regions should build research collaborations with both local and global universities to promote local innovation. Conversely, for underdeveloped regions, universities should emphasize local technological demand rather than blindly pursue international collaboration.

## 1. Introduction

The role of science is to create new knowledge and enhance humans' understanding of the nature and its laws (Bush, 1945). However, with the rise of knowledge-driven economies, the role of science and, concomitantly, the role of universities and public research institutes (PRI) are no longer accepted as "pure science" for an "endless frontier (Bush, 1945)"; instead, they are increasingly recognized as an important driver of economic growth and industrial development (Solow, 1957; Romer, 1986, 1990; Saxenian, 1996; Etzkowitz and Leydesdorff, 2000).

In emerging economies, scientific research in universities and PRI has been given high expectations related to technological catch-up and local industrial innovation development (Nelson, 2005). Following that, the use of a series of intermediate processes is encouraged, including science parks, technology transfer offices and university spin-off companies, usually stimulated by governments, to economically utilize scientific discoveries (Armanios et al., 2017). Moreover, since firms in emerging countries are less likely to directly tap into the international frontier knowledge base (Ponds, 2009), university collaborations, especially international collaborations, are expected to be

important not only for academic purposes but also as knowledge transfer pipelines that connect local firms and global research networks: advanced technologies developed in global research networks are expected to be transferred to local industry via universities and benefit local firms' innovation (Barnard et al., 2012; Hong and Su, 2013; Nelson, 2005). We argue that the spillover effect from inter-university collaborations to local firms, which is rarely considered by scholars and policy makers in developed countries, is an important research subject in the context of emerging economies.

There are many channels for university knowledge flowing to local firms. It can be unintentionally leaked to local firms through one-way and passive channels, such as publication and graduates, or diffused to local firms through bidirectional university-industry (U-I) interactions, such as joint research (Agrawal, 2001). Many studies (e.g., Adams, 1990; Salter and Martin, 2001; Marchi and Rocchi, 2000; Pavitt, 2001; Audretsch and Feldman, 1996, 2004; Bercovitz and Feldman, 2006; Agrawal, 2001; Liu 2013) have revealed the positive impact of university scientific research on local firms' innovation, known as the knowledge spillover effect of university research. From the perspective of emerging economies, our interest is in to what extent can the

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knowledge created by inter-university collaboration research flow to local firms and benefit firms' innovation?

We divide inter-university collaboration into domestic collaboration and international collaboration in terms of geographic proximity (Moodysson and Jonsson, 2007). We propose that knowledge created by the two types of collaborations have different strengths: taking advantage of geographic proximity, universities in domestic collaborations can have continuous face-to-face interactions and reach shared understandings of the tacit and dynamic local context (Jeong et al., 2013). Therefore, domestically created knowledge can be more localized and more cater to local firms' demand, and thus easier for local firms to understand and absorb. On the other hand, knowledge generated from international academic collaborations is usually distant and advanced. It may lead to radical innovation and technological catch-up, but absorbing such distant knowledge requires the assistance of local ecosystems. Therefore, a fundamental question is does localized knowledge (Zucker et al., 1998; Breschi and Lissoni, 2001) or distant knowledge (Lin et al., 2009a,b) have a greater spillover effect on local firms' innovation?

Prior research on the spillover effect (e.g., Mowery et al., 1996; Szulanski, 1996; Cockburn and Henderson, 1998; Tsai, 2001; Escribano et al., 2009; Eapen, 2012) have often been related to receivers' absorptive capacity, namely the capability to recognize the value of external knowledge, to assimilate it and to apply it to commercial ends (Cohen and Levinthal, 1990). In those studies, absorptive capacity was regarded as a precondition for firms to benefit from external knowledge.

In the context of emerging countries, we extend absorptive capacity to regional level and proposed that regional absorptive capacity is a very important perspective for comparing the spillover effect of the two types of university collaboration. Advanced knowledge spillover, compared to domestically generated knowledge, requires a higher level of the regional absorptive capacity. Some scholars (Pack, 2000; Barnard et al., 2012) have worried that for emerging countries that lack absorptive capacity, a large investment in international scientific research could create global research excellence or 'pockets of high capacity' but yield limited local diffusion in those regions. Some scholars (Mazzoleni and Nelson, 2007) even argue that with increasing involvement in international collaborations, excellent scientists from emerging countries will increasingly disengage from their local academic community, rather than assist in local upgrading.

Therefore, we propose that one type of collaboration spillover is not unconditionally better than another. It will be very important to investigate the contingent effect of the regional absorptive capacity on knowledge spillover. China is a good case country for this study because the levels of absorptive capability vary in different regions in China. This context enables us to test the spillover effect of two types of knowledge: localized knowledge from domestic collaboration and distant knowledge from international collaboration, which type prevails in different regions?

Our findings provide evidence for the contingent effect of the regional absorptive capacity. We find that in more developed regions with higher absorptive capacity, inter-university collaborations show a more significant positive relation to local firms' innovation. In least developed regions with low absorptive capacity, international collaboration is negatively associated with firms' innovation.

The remainder of this paper is organized as follows. First, a brief description of inter-university academic collaborations in China is presented in Section 2. Following that, Section 3 introduces the theoretical framework and develops the testable hypotheses of this study. The research design, data and model adopted for the empirical analysis are provided in Section 4. We subsequently present and discuss the results of our analysis in Section 5. Finally, the implications of our findings are illustrated in Section 6.

## 2. Inter-university research collaboration in China

In China, there are two main types of inter-university research collaborations. One is domestic collaboration between universities and PRIs within the same province or in different provinces across different levels of economic development. The other is international research collaboration, especially between universities and research institutes in advanced countries.

During our investigating period (1999–2012), the number of domestic university co-authored papers has increased from 49,115 to 141,350, with an average annual growth rate of 8.47%.<sup>1</sup> Besides, the collaborations are unevenly distributed between regions: Beijing, Jiangsu, Guangdong, Shanghai and Shandong count for the largest five shares, about 41% in total. The data is consistent with Liang and Zhu (2002)'s argument: In China, universities located in regions of middle and low development prefer to cooperate with more developed regions. It is a process of scientific resource redistribution within the country: undeveloped provinces though with very limited scientific resources (such as good universities, scientists and lab equipment) are able to absorb newly created knowledge from developed regions. Domestic collaboration could enhance complementary knowledge exchange across provinces and promote the driving effect of leading regions, such as Beijing and Shanghai, to undeveloped regions (Liang and Zhu, 2002).

Chinese universities have sought collaborations with universities in developed countries since 1978, much earlier than business-to-business collaborations. Because universities and public research institutes (PRIs) are motivated to be more international, the pace of globalization of universities and PRIs<sup>2</sup> is increasing. International co-authored papers in China have increased by 45.4% from 1999 to 2012, with most partners coming from developed countries. Co-authors from the US, the UK and Japan account for the three largest shares, which are 10.78%, 2.69% and 2.10% respectively, followed by Australia, Germany and Canada. The most focused fields of international collaboration are engineering, physics, math and physics, accounting for 16.03%, 12.98%, 12.16% and 4.86% respectively. Except engineering, the other three are basic sciences. Therefore, we regard that international collaborations are more science oriented, mostly targeting frontier technologies and radical innovation (Frame and Carpenter, 1979). The cutting-edge scientific knowledge spillover from developed countries is expected to help local firms become innovators and to gain insights into the frontier fields.

In the following sections, we will compare the two types of university collaboration through an empirical analysis of a panel dataset containing information on university collaborations in Chinese provinces over the period from 1999 to 2012.

## 3. Theory and hypotheses

Knowledge spillover has long been regarded as a source of innovation and regional economic growth (Audretsch and Feldman, 1996). Fallah and Ibrahim (2004) distinguished between knowledge spillover and knowledge transfer: the former refers to unintentional knowledge flow, whereas the latter refers to intentional knowledge exchange. However, the concepts of knowledge spillover, knowledge transfer, and knowledge diffusion are often mixed together because they similarly emphasize "the flow of knowledge". In this research, the broader concept is adopted here.

<sup>1</sup> The data used for analysis for this session is based on the Statistical Yearbook of China Science and Technology Papers Statistics and Analysis

<sup>2</sup> In China, there is a team of scholars that is adept at international publications in public research institutes (PRIs), especially the Chinese Academy of Sciences. In the following context, when we say inter-university research collaboration, it also includes public research institutes.

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