Research Policy 45 (2016) 830–843

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

Urban innovation, regional externalities of foreign direct investment and industrial agglomeration: Evidence from Chinese cities

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ARTICLE INFO

Article history:
Received 23 July 2014
Received in revised form 14 January 2016
Accepted 19 January 2016
Available online 1 February 2016

Keywords:
Urban innovation
Spillovers
Industrial agglomeration
FDI
China
Emerging economies

ABSTRACT

This paper examines how urban industrial agglomeration interacts with the intra- and inter-regional externalities resulting from foreign direct investment (FDI) in city innovation in an emerging economy. It adds to the existing literature by highlighting the importance of considering both spatial proximity and urban industrial structures in understanding FDI knowledge spillovers in urban areas. Using a unique and manually collected city-level dataset for the period from 2005 to 2011 in China, our empirical results confirm the role of FDI as an important external knowledge source in the context of a developing country. The spatial externalities of FDI, however, are limited to the city of investment. We further show that FDI spatial spillovers are contingent upon the intensity of industrial agglomeration within and across cities. Specialized industrial structures absorb FDI knowledge spillovers within the cities and also facilitate their dissemination to nearby cities, while diversified ones provide a vibrant environment for local innovation. Our empirical evidence has important implications for both theories and policy making.

1. Introduction

Innovation and urban setting are closely intertwined. Early studies have considered the process of innovation almost exclusively as occurring within the boundaries of firms. It is now understood that innovation is an open process. Innovators do not work in isolation, but rather interact with one another, drawing upon their environment for idea creation, unintentional contacts and learning opportunities (Chesbrough, 2013; Enkel et al., 2009). The scale and compactness of cities engender an energetic environment that intensifies such interpersonal interactions and the flow of information exchange, creating knowledge externalities and nurturing innovation (Ó Huallacháin and Lee, 2011; Rosenthal and Strange, 2004; Tappeiner et al., 2008). Variations in urban settings can lead to different environments and a varying extent of knowledge spillovers for urban innovation.

Nevertheless, previous studies overwhelmingly focus on the effect of industrial agglomeration on productivity growth in developed countries along the dimensions of specialization in particular industries and the diversity of related and mutually supporting industries. Relatively little research explores these two important urban externalities on local innovation and in the emerging economy context (Beaudry and Schiffauerova, 2009). Moreover, as opposed to developed countries, where indigenous R&D capabilities are strong, FDI is often the major source of advanced knowledge and technology in developing countries, and has played a significant role in local industrial upgrading and economic growth (Fu and Gong, 2011). An array of previous studies have delineated the contingencies, such as regional absorptive capability and openness, which allow knowledge spillovers from FDI in the host regions (Crespo and Fontoura, 2007; Iršová and Havránek, 2013; Meyer, 2004). Despite that, our understanding of industrial agglomeration as an important urban setting in diffusing knowledge from FDI remains relatively limited.

To this end, we examine how urban industrial agglomeration economies, namely, specialization and diversity, influence the extent to which FDI externalities affect city innovation both within and across cities in an emerging economy. This paper makes two important contributions to the literature. First, we contribute to the literature by exploring the possible effect of FDI spillovers on urban innovation, contemplating both their inter- and intra-regional spatial dimensions. It highlights the importance of FDI as a key external knowledge source in the developing country context, where domestic technological capabilities are weak. The economic geography literature has long suggested that the

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http://dx.doi.org/10.1016/j.respol.2016.01.014
0048-7333/

effects of neighboring regions might spill over onto each other, resulting in a correlation across space and time (Acs et al., 2002; Elhorst, 2014). The majority of current research does not generally consider this spatial effect (Doh and Hahn, 2008; Driffield, 2004; Ouyang and Fu, 2012). We build upon this spatial perspective to examine the existence of interdependence of regional knowledge spillovers as well as the spatial externalities of FDI simultaneously and directly on urban innovation.

Second, we bridge the literature on the aforementioned spatial externalities of FDI and industrial agglomeration in explaining urban innovation with a contingency perspective. Previous literature has treated these two as separate issues and has primarily focused on their determinants and growth implications, which can result from forces other than innovation. We move beyond these views and conjecture that FDI as an external knowledge source is contingent upon the host cities' industrial structure to exhibit further spillovers. We intend to reveal the types of urban industrial agglomeration that drive both intra- and inter-regional innovation dynamics and promote FDI and to provide new empirical evidence on the disputed effects of both FDI and industrial agglomeration. Because industrial agglomeration is a result of firms' needs for spatial proximity within and across regions, we essentially provide an understanding of the inter- and intra-regional spatial dimensions of knowledge spillovers stemming from FDI.

To our knowledge, this paper makes the first attempt to provide an integrated perspective as well as new empirical evidence on the role of industrial agglomeration in urban innovation associated with FDI spillovers. Clearly, an understanding of the intra- and inter-regional mechanisms that ease knowledge spillovers is critical for regional policy makers to promote and coordinate innovation activities, make decisions on local technology choices and facilitate how regions benefit from FDI spillovers. The remainder of this paper is organized as follows. We first present a literature review on FDI externalities and agglomeration in light of urban innovation. This is followed by research methodology, data and variable measurements. We then present our empirical results and conclude the paper with a discussion of policy implications and research limitations.

2. Literature review

2.1. Knowledge spillovers and urban innovation

Knowledge spillovers (or externalities) have long been seen as playing a key role in shaping the regional conditions for innovation (Audretsch and Feldman, 1996; Tappeiner et al., 2008). They occur when an organization's newly created knowledge cannot be fully appropriated by itself. This surplus of knowledge then spills over to other organizations that interact with it. Innovation in an organization also depends on the extent of its interaction with different external sources, such as other firms, customers and public institutions, to integrate and recombine existing and new knowledge because organizations do not process all resources and capabilities for sustainable knowledge generation (Chesbrough, 2013; Enkel et al., 2009; Fu et al., 2013). As the tacit and contextual nature of knowledge sharing and technological learning, knowledge transmission need to take place through direct, unintended and repeated interpersonal contacts (Audretsch, 2003; Simmie, 2003). Knowledge externalities therefore are often bounded geographically and decay with distance as the strength of interactions attenuates, despite the improvement in communication technologies[1]. The need for spatial proximity to benefit from localized knowledge spillovers when innovating generates an impetus for firms and industries to agglomerate (Boschma, 2005; Ó Huallacháin and Lee, 2011).

2.1.1. Intra-city externalities

Previous literature emphasizes that cities, where the majority of industrial activities agglomerate, are particularly important loci for knowledge externalities and innovation as they offer industries and firms spatial proximity. This line of research has explored three key intra-city mechanisms that manifest spillovers as a result of industrial agglomeration. First, cities facilitate the colocation of businesses and geographic proximity, enlarging the scale and scope of interactions within and between industries and with the characteristics of the region to generate knowledge externalities (Combes et al., 2012; Storper and Venables, 2004). Second, a larger and denser city enables more efficient sharing of indivisibilities (e.g., urban infrastructure, production facilities, institutions and marketplaces) and a wider variety and availability of differentiated production inputs, providing firms with cost advantages not only in production, transportation and distribution but also in reducing the cost of innovation and facilitating its market realization (Ciccone and Hall, 1996; Helsley and Strange, 2004). Third, cities allow better matching between economic agents (e.g., workers, firms and patent holders) and greater learning opportunities by bringing together a large number of workforces, thus intensifying the interactions between them and facilitating the creation, spread and accumulation of tacit knowledge for innovation (Audretsch and Feldman, 1996; Rosenthal and Strange, 2004). Historically, cities are at the forefront of innovation. Their role in economic growth and the generation of knowledge has been well documented, as observed in many developed country cases (Bettencourt et al., 2007; Shearmur, 2012)[2].

2.1.2. Inter-city externalities

However, the underpinning assumption of these generic urban benefits that cities draw entirely upon their own resources to innovate has long been challenged (Shearmur, 2012). Another strand of burgeoning literature has noted that cities are not isolated but integral to a greater and complex geographic system or so-called 'regional/national innovation system' which enables inter-regional spillovers (Simmie, 2003). In order words, cities depend on the knowledge stock available in the whole economy for innovation and economic growth. They are connected through many inter-regional "pipelines" to facilitate knowledge flow. The pecuniary channels include, for example, backward and forward supply chain linkages for goods, services and investment; and the nonpecuniary ones often contain labor mobility, organizational collaborations and geographic expansion, individual social networks and transportation links and privileged communication across regions (Bathelt et al., 2004; Moreno et al., 2005). Knowledge generated in one region can spill to others through spatial interactions and become a source of local innovation that does not originate in its own effort (Usai, 2011). Such interregional spatial interactions are also truncated by distance due to the tacit nature of knowledge exchange that requires interaction and experience. Previous studies (e.g., Audretsch and Feldman, 1996; Acs et al., 2002; Tappeiner et al., 2008; Gonçalves and Almeida, 2009) have already found the innovation output of one location can be affected by neighboring localities and lead to spatial autocorrelation. Inter-city knowledge spillovers therefore are an important source to be considered in explaining urban heterogeneity of innovation.

[1] Knowledge externalities here refer to spillovers from tacit knowledge rather than in the form of patents and transfer that is ready for purchase.

[2] For example, Bettencourt et al. (2007) have indicated that larger metropolitan areas have disproportionately more patents than smaller ones, using US data from 1980–2001.