Geographic Proximity, Foreign Presence, and Domestic Firm Innovation: The Micro-Level Evidence

ABSTRACT

The question as to whether foreign presence benefits or harms domestic firm innovation is yet to reach a definitive answer. This paper provides micro-level evidence to shed light on this topic. By incorporating insights from economic geography into the literature on foreign presence, we developed a geography-based foreign presence, defined as foreign presence weighted by geographic proximity between a focal domestic firm and each foreign firm in the same region. Based on theoretical reasoning and informed by the literature on geographic proximity and foreign presence, we proposed an inverted U-shaped relationship between a domestic firm's geography-based foreign presence and its innovation performance in the context of the world's largest emerging economy, China. We argue that such relationship is steepened for domestic state-owned firms and when the foreign firms within the region present a high level of innovation performance. By analyzing a sample of Chinese firms in manufacturing industries between 1998 and 2014, we found support for our propositions.

Keywords: foreign presence; emerging market; geographic proximity; foreign direct investment spillover; innovation performance

JEL Code: F23; O30; R12

INTRODUCTION

Innovation in emerging economies has become an increasingly important component of the global economy (e.g., Howell, 2020; Mudambi, Narula, & Santangelo, 2018). This is partly attributable to knowledge spillovers arising from the presence of foreign firms (also called "foreign presence") in emerging economies (Li, Chen, & Shapiro, 2013; Zhang, Li, & Li, 2014). However, evidence remains inclusive as to whether foreign presence benefits or harms emerging market firm innovation. Some studies report a positive effect of foreign presence on innovation (e.g. Nuruzzaman, Singh, & Pattnaik, 2019), whereas others show a negative or nonsignificant effect (e.g. Zhang, Li, Li, & Zhou, 2010).

These contradictory findings highlight the need for sound reconciliation research. Previous studies on foreign presence have focused primarily on the national (Zhang et al., 2014) or the regional level (Aitken & Harrison, 1999; Chang & Xu, 2008), and often assume that a domestic firm is influenced equally by all foreign firms within a specific country or region. This assumption is dubious because it fails to consider the uniqueness of each foreign firm, their diverse knowledge, and heterogeneous interactions with local firms, such as variations in geographic distance. Neglecting this heterogeneity could lead to an incomplete or even erroneous understanding of the relationship between foreign presence and domestic firm innovation.

This study unpacked the heterogeneity of foreign firms in relation to a domestic firm within the same region. Specifically, we examined how the dyadic geographic relationship between a domestic and foreign firm within the same region may affect the extent to which the foreign firm influences the domestic firm and consequently its innovation performance. By incorporating the literature on geographic proximity (Boschma, 2005; Pouder & St. John, 1996) into the literature on foreign presence (e.g., Spencer, 2008; Zhang et al., 2010), this paper developed a new form of foreign presence: geography-based foreign presence that weights foreign presence by geographic proximity between a domestic firm and each foreign firm in the same region.

Economic geographers have long recognized the significance of geographic proximity in affecting knowledge spillover and innovation (Lychagin, Pinkse, Slade, & Reenen, 2016). Following this,

geographic proximity between domestic and foreign firms is expected to be an important factor influencing the extent to which a domestic firm would benefit or suffer from the presence of their foreign counterparts within the same region. Considering the benefits and detriments of foreign presence, as well as the perspectives of the distance decay effect (Oerlemans & Meeus, 2005) and the proximity paradox (Boschma, 2005; Broekel & Boschma, 2011), we anticipate that a domestic firm's geography-based foreign presence presents an inverted U-shaped relationship with the firm's innovation performance, such that domestic firm innovation performance first increases with geography-based foreign presence and then declines once such presence reaches a certain level. We further investigated boundary conditions on the relationship between geography-based foreign presence and domestic firm innovation performance, and posited that such a relationship is contingent on the characteristics of both domestic firms and foreign firms. Particularly, we expected that the inverse U-shaped relationship becomes more steepened when the domestic firm is surrounded by more innovative foreign firms in a region or when it has a higher level of state ownership.

By analyzing a sample of 410,140 Chinese firms in the manufacturing industries between 1998 and 2014, we found support for our hypotheses. Our paper makes three primary contributions to the related literature. First, prior research mainly examines foreign presence at the macro-level and assumes that foreign firms within a regional cluster exert equal influence on a domestic firm. Going beyond this, our study provides a refined analysis in the context of an emerging market and illustrates that a domestic firm is affected differently by each foreign firm in the same region depending on their diverse geographic distances. As such, our study extends the literature on foreign presence by considering foreign–domestic firm dyadic geographic relations and providing new micro-evidence to substantiate the complex influences of foreign presence on domestic firm innovation.

In addition, our analysis shows that the new form of foreign presence—geography-based foreign presence—presents an inverted U-shaped relationship with a domestic firm's innovation performance. This finding goes beyond the prior research, which recognizes only the benefits or the detriments associated with foreign presence, and highlights that the net effects of (the new form of) foreign presence

on domestic firm innovation are nonlinear. As such, our study provides a more complete picture of how foreign firms influence domestic firm innovation in emerging markets, shedding light on the inclusive findings in the literature.

Last, after considering the dyadic geographic relationships between foreign and domestic firms, the two identified boundary conditions highlight the importance of jointly considering the characteristics of both foreign and domestic firms. These contingency effects advance our understanding of the factors that can drive change in the nonlinear relationship between foreign presence and domestic firm innovation, further corroborating the complex impacts of foreign presence on domestic firm innovation in emerging markets.

THEORETICAL BACKGROUND

Innovation is crucial for firms to gain a competitive edge. To foster innovation, firms need to learn and integrate knowledge and resources from diverse sources, including internal R&D and external collaborations and acquisitions (Zhou, Gao, & Zhao, 2017). For firms from emerging markets, co-locating with foreign firms offers an important path to developing innovation capabilities, as foreign firms typically have advanced technologies and managerial skills (e.g., Li et al., 2013).

Indeed, the notion of *foreign presence,* which generally refers to the total number of foreign firms at a location (e.g., a nation, a city, or a cluster; Li et al., 2013), has been a central concept for economy, strategy, and international business scholars to examine its impacts on domestic firm innovation (Wang, Ning, Li, & Prevezer, 2016). Notwithstanding the topic's multidisciplinary nature, scholars acknowledge the benefits and costs associated with the presence of foreign firms (Blomström & Kokko, 1998; Spencer, 2008). In Appendix A, we provide a synopsis of the main studies on the foreign presence – innovation relationship.

The Benefits and Detriments of Foreign Presence for Domestic Firms in Emerging Markets

Domestic firms from emerging markets can benefit from the presence of peer foreign firms in the same region in several ways: via the demonstration effect, domestic business linkages, employee turnover, and positive competition (e.g., Li et al., 2013; Spencer, 2008). The *demonstration effect* suggests that

foreign firms with advanced products, services, or managerial practices operating in an emerging host country are largely observable to domestic firms, stimulating them to imitate these advanced foreign peers (Blomström & Kokko, 1998). Studies found that, through observation and imitation of foreign firms' products and technologies, domestic firms can develop innovative products for the market (Huang, Liu, & Xu, 2012;). Notably, foreign firms did not purposely "teach" domestic firms in emerging markets; in contract, they often endeavored to shield their knowledge from domestic firms' imitation, in light of the insufficient intellectual property protection there (Zhang et al., 2014). Therefore, the type of knowledge derived from foreign presence is more likely to be production-related and incremental rather than new knowledge-creation-related and radical (e.g.,Lee, 2019).

In addition, when foreign and domestic firms use the same local suppliers and distributers, foreign firms' technologies and know-how can be transmitted through *domestic business linkages* (Liu, Wang, & Wei, 2009; Spencer, 2008). For example, Hatani (2009) found that Chinese firms can tap into the supply chain of Japanese carmakers, generating technology spillovers. Furthermore, when employees who have worked in foreign firms are hired by domestic firms, they are likely to take the technologies and managerial know-how acquired from the foreign firms with them (Nuruzzaman et al., 2019; Spencer, 2008).

Last, growing competition due to increased foreign presence stimulate domestic firms to develop innovative products and compete with technologically advanced foreign counterparts (Blomström & Kokko, 1998). For example, Nuruzzaman et al. (2019) confirmed that exposure to foreign competition at home is positively associated with imitative innovation.

Contrary to the above line of reasoning, other studies suggested that foreign presence has detrimental effects on domestic firms (Li et al., 2013). This is due to the competitive *crowding-out effect*, which leads to a loss of market share and intensified competition over necessary resources, including labor, talent, and raw materials (Li et al., 2013; Spencer, 2008). As a result, domestic firms face resource constraints that impede their ability to invest in innovation. For example, Li et al. (2013) showed that the detrimental impact of a high level of competition overweighs the benefits of foreign presence, resulting in reduced

domestic firm innovation.

Taking both the benefits and detriments into consideration, existing studies are inconclusive regarding the relationship between a domestic firm's innovation and the presence of surrounding foreign firms (e.g. Jin, García, & Salomon, 2019; Wang et al., 2016). A refined level of analysis can be helpful to resolve inclusive findings. For example, geographic proximity has been recognized as an important factor affecting both the knowledge spillover and competition of foreign firms in the same localities (e.g., Hatani, 2009). The extant research has operationalized foreign presence as the density of foreign firms within a specific locality (e.g., cities, regional clustering). However, this approach assumes that all domestic firms in the location are equally affected by each foreign firm present. This assumption is problematic because it overlooks the fact that domestic firms and foreign firms within the same region may have different geographic distances from one another. As a result, the impact of each foreign firm on domestic firms is likely to vary. This heterogeneity, resulting varying geographic distances has not been adequately studied in the literature.

To fill this gap, we drew on the geographic proximity literature (e.g., Boschma, 2005) to examine how the geographic proximity between domestic and foreign firms within the same region affects the extent to which the domestic firm is exposed to the benefits and detriments of each foreign firm. Consequently, we examined how well this exposure relates to the firm's innovation performance. Examining such micro-level heterogeneity can sheds light on the inconsistent findings regarding the relationship between foreign presence and domestic firm innovation (e.g., Jin et al., 2019; Wang et al., 2016). Our overall theoretical framework is built on the assumption of knowledge flow and information exchange among co-located firms. Such an assumption is reasonable in our study for two reasons. First, domestic firms in emerging markets like China are often less technologically proficient than foreign firms, making them keen to learn from those foreign firms with a technology advantage (e.g., Kotabe & Kothari, 2016; Luo & Tung, 2007). Second, previous studies have provided empirical evidence to validate the flow of knowledge from foreign firms to local firms (e.g., Liang, 2017).

Geographic Proximity to Foreign Presence and Domestic Firm Innovation

Economic geographers have offered great insights into whether and how firms benefit from their spatial locations (Pouder & St. John, 1996). The notion of *geographic proximity* has been widely researched in the context of knowledge spillover (Li et al., 2013) and research and development (R&D) activity (Broekel & Boschma, 2011; Lychagin et al., 2016).

Two perspectives allow us to understand how geographic proximity facilitates knowledge transfer and innovation, namely *distance decay* (e.g., Oerlemans & Meeus, 2005) and *proximity paradox* (e.g., Boschma, 2005). The distance decay perspective suggests that geographic distance slows down the mobility of resources and the transfer of knowledge and information (Oerlemans & Meeus, 2005). Considering that knowledge is localized, knowledge diffusion is sensitive to geographic distance and tends to spread more easily to firms located nearby before reaching those located further away (Li et al., 2013). Geographic distance creates two types of costs in knowledge diffusion (Funk, 2014): explicit costs, such as transportation costs, and implicit costs, such as time, interaction, and coordination costs (Oerlemans & Meeus, 2005). Geographic proximity between firms enable frequent and informal interaction and communication (Funk, 2014; Saxenian, 1996), facilitating efficient knowledge transfer (Broekel & Boschma, 2011) and reducing both types of costs.

The other perspective, the proximity paradox, suggests that excessive proximity may cause knowledge overload and spatial lock-in, both of which can be harmful for firm innovation (Funk, 2014; Uzzi, 1996). *Knowledge overload* occurs when firms acquire diverse knowledge but struggle to effectively absorb and utilize it for innovation (Funk, 2014). The myriad ways that acquired knowledge might be combined impose resource and cognitive constraints, limiting firms' innovative capabilities. *Spatial lock-in* occurs when firms become inward-focused within the region and disregard knowledge outside a spatial locale (Boschma, 2005). This spatial lock-in effect suppresses firm innovation as firms within a geographic cluster often grow "blind" to the information beyond the cluster (Pouder & St. John, 1996). The literature on innovation search (Rosenkopf & Almeida, 2003) and organizational learning (Levinthal & March, 1993) reinforces that firms tend to engage in local rather than distant search, leading to incremental rather than breakthrough innovation.

Considering both the distance decay and proximity paradox perspectives, an important question arises: *Do domestic firms located close to or far from foreign firms within the same region demonstrate differences in innovation performance?* To address this question, we develop a new form of foreign presence: *geography-based foreign presence.* Unlike the conventional method of counting foreign firms in the same location, this new presence measure considers the weighted geographic proximity between a focal domestic firm and each foreign firm in the region. By doing so, it captures firm-specific variances in how domestic firms are (geographically) related to foreign firms, providing valuable micro-level information beyond the traditional count-based approach. Incorporating this new form of micro-level foreign presence sheds light on the intricate influence of foreign firms on domestic firm innovation performance[1]. Figure 1 provides an overview of the relationship between geography-based foreign presence and domestic firm innovation by building on the existing literature on foreign presence and geographic proximity.

Figure 1 goes about here

HYPOTHESIS DEVELOPMENT

Geography-Based Foreign Presence and Domestic Firm Innovation in Emerging Markets

As noted previously, foreign presence can yield both positive and negative effects on domestic firms. In this paper, we argue that these two concurrent, opposing forces are shaped by geographic proximity, but in a different way, and jointly influence domestic firm innovation.

The benefits of geography-based foreign presence increase at a decreasing rate. When the

[1] Notably, research has shown that strong foreign firms tend to avoid agglomeration with domestic firms, resulting in weak domestic firms having limited opportunities to locate closely to and learn from them (Alcacer & Chung, 2007; Mariotti, Mosconi, & Piscitello, 2019; Shaver & Flyer, 2000). However, this explanation may not fully apply in our context, as domestic firms have greater freedom to choose their locations compared to foreign firms, which often face more regulatory constraints in their location decisions (Hu, Natarajan, & Delios, 2021). Also, there is substantial evidence indicating that foreign firms in China generally possess more advanced technologies than the majority of domestic firms (e.g., Li, Xia, &Zajac, 2018).

geography-based foreign presence is high, it means that a domestic firm is geographically close to peer foreign firms in the same region. Geographic proximity enables the domestic firm to access knowledge spillovers from foreign firms, fosters its innovation, and increases its innovation performance.

First, the benefits derived from the demonstration effect of foreign firms are stronger for nearby domestic firms than for distant ones. Studies in economic geography have revealed that being near to knowledge sources like industrial counterparts, universities, or R&D centers exposes firms to diverse knowledge, facilitates technological diffusion, and stimulates innovation (Carrincazeaux, Lung, & Rallet, 2001). In the context of foreign presence, geographic proximity facilitates interactions between domestic and foreign firms, increasing the transfer of information and advanced technologies and practices. Studies have found that in emerging countries, domestic firms benefit most from co-locating with foreign firms (Zhang et al., 2010).

Second, the benefits via business linkages tend to be greater for domestic firms located more closely to foreign firms in a region. In emerging countries, foreign firms are often required to collaborate with domestic suppliers/distributors to reduce cost or comply with host country regulations (Liu et al., 2009; Xia & Liu, 2017; Zhang et al., 2010). Co-located foreign and domestic firms often share the same suppliers and distributors (Li et al., 2013), enabling the transfer of advanced knowledge from foreign firms to other connected domestic firms. This stimulates product innovation across all domestic firms in the region (Albino, Garavelli, & Schiuma, 1998). Consequently, domestic firms located near foreign firms benefit more from foreign firms' knowledge spillovers via such business linkages (e.g. Stojčić & Orlić, 2020).

Furthermore, labor mobility tends to occur more frequently among neighboring firms. This is because short distances bring people together and facilitate information exchange (Funk, 2014; Saxenian, 1990). For example, Saxenian (1990) found that knowledge diffuses locally because of network relationships sustained by geographic proximity.

Last, proximity to foreign firms in a region also triggers the positive effects of competition because, compared to those located farther away, domestic firms located closer to foreign firms are more likely to

sense this competition and respond by increasing investment in innovation (Liu, Hodgkinson, & Chuang, 2014).

Aggregating these benefits, we expect that domestic firms that are closer to foreign firms in a region, indicated by a higher level of geography-based foreign presence, tend to innovate more and generate better innovation performance. However, we expect such benefits will increase at a decreasing rate, with diminishing marginal benefits. This is mainly due to knowledge overload and spatial lock-in occur (Boschma, 2005; Funk, 2014).

As noted previously, geographic proximity to foreign firms exposes domestic firms to foreign firms' advanced technologies and practices. But excessive proximity can be harmful, especially for emerging market firms with limited absorptive capacity to assimilate such knowledge and drive innovation (Funk, 2014; Xia & Liu, 2017). Moreover, the spatial lock-in effect becomes more pronounced with increasing geographic proximity. When surrounded by numerous foreign companies with cutting-edge technology and practices, a domestic company may become more inward-looking, limiting their exploration of new knowledge and opportunities beyond its vicinity (Boschma, 2005; Levinthal & March, 1993). Consequently, domestic firms may rely heavily on local search, neglecting other sources of innovative knowledge (Li, Zhang, & Lyles, 2013; Stuart & Podolny, 1996). When geography-based foreign presence reaches a certain level, we expect the negative impacts of knowledge overload and spatial lock-in tend to level out the benefits. More importantly, once geography-based foreign presence exceeds this threshold, the opposing effects may escalate exponentially.

In contrast to the beneficial effects, *the detrimental effects of geography-based foreign presence on innovation increase at an increasing rate.* This countervailing force of geography-based foreign presence refers to the increasing crowding-out effect associated with the competition from foreign firms. We argue that this countervailing force will grow at an increasing rate as *geography-based foreign presence* increases beyond a certain threshold. This is likely to decrease domestic firm innovation at an accelerated rate as the geography-based foreign presence increases.

Although a certain level of competition can drive domestic firms to innovate, geographic proximity

intensifies the crowding-out effect of foreign presence. Prior studies have shown that foreign firms often displaced domestic firms in product and labor markets (Spencer, 2008). This crowding-out effect is particularly strong for domestic firms with significant market overlaps with foreign firms such as in land, utility services, skilled labor, and immediate goods. When a domestic firm is geographically proximate to foreign firms in a region, it is more likely to compete for resources in the same or highly overlapping input and output markets compared to firms located farther away. This is especially evident in emerging countries like China, where firms compete in fragmented regional markets (Boisot & Meyer, 2008). Localized competition often triggers price wars, driving up input costs and reducing output prices in local markets (Li et al., 2013; Spencer, 2008). In response, domestic firms allocate more resources to combat price wars with local competitors, leading to resources depletion for productive activities like innovation. Therefore, we argue that as the geographic proximity between a domestic and foreign firm increases, the detrimental effects of such resource crowding-out intensify exponentially, leading to a diminishing innovation performance for domestic firms at an increasing rate.

Considering that the benefits associated with geography-based foreign presence increase at a decreasing rate and the detriments due to the crowding-out effects rise at an increasing rate, we posit the two opposing forces produce an inverted U-shaped relationship between a focal domestic firm's innovation performance and its geography-based foreign presence. That is, as the geography-based foreign presence increases to a moderate level, the benefits of foreign presence, driven by the four already noted mechanisms (i.e., demonstration, domestic business linkages, employee mobility, and positive effect of foreign competition), outweigh the detriments of the crowding-out effect, resulting in an overall positive net effect on domestic firm innovation performance. However, once geography-based foreign presence exceeds this moderate level, the detriments of the crowding-out effect increase significantly, outweighing the benefits and driving an overall negative effect on domestic firm innovation. Figure 2 illustrates the inverted U-shaped relationship. We thus hypothesize:

Hypothesis 1. There is an inverted U-shaped relationship between a domestic firm's geography-based foreign presence in a region and domestic firm innovation.

Figure 2 goes about here

The Moderating Effect of Regional Foreign Firm Innovation

Building on the above arguments, we further submit that the impacts of geography-based foreign presence on domestic firms are influenced by the average innovation performance of foreign firms in a region, resulting in a steeper inverted U-shaped relationship. Research has shown that foreign firms often possess technological superiority in emerging markets (Jin et al., 2019; Zhang et al., 2010). When foreign firms in a region exhibit a high level of innovation performance, domestic firms in the same region are exposed to more advanced technologies. In this context, we anticipate that the four mechanisms increasing domestic firm innovation become more pronounced.

First, we expect a stronger demonstration effect. When foreign firms in a region are more innovative, their advanced technologies or products become more visible to domestic firms. Consequently, domestic firms are more likely to learn from these foreign firms in order to upgrade their own technologies and products (Jin et al., 2019). Second, the business linkages effect is strengthened because more innovative foreign firms transmit a greater amount of advanced technologies to their domestic suppliers and distributors, who then pass them on to domestic firms. Third, the employee mobility effect strengthens, because highly innovative and technologically advanced foreign firms are more likely to train their employees to maintain a competitive edge (Wang et al., 2016; Zhang et al., 2014). As a result, when these trained employees transition to local domestic firms, they bring with them the technology and expertise acquired from the foreign firms (Hatani, 2009). Fourth, the competition effect intensifies. As foreign firms in a region achieve higher levels of innovation performance, co-located domestic firms perceive greater threats and are compelled to innovate in response to heightened competition (Jin et al., 2019; Li et al., 2013).

Last, the likelihood of a domestic firm experiencing knowledge overload increases when its nearby foreign firms are highly innovative. This occurs because domestic firms may become overwhelmed by the

highly advanced knowledge embedded in foreign firms (Funk, 2014), preventing them from effectively absorbing the advanced knowledge. Moreover, the spatial lock-in effect becomes more pronounced in regions with a higher level of foreign firm innovation. The strong innovation performance of surrounding foreign firms directs domestic firms' attention towards these firms and the advanced knowledge they possess, rather than searching new knowledge outside the region (Chang & Xu, 2008).

In contrast, the strong innovation performance of foreign firms in a region may intensify the crowding-out effects of geography-based foreign presence in two ways. First, it may impose a stronger restriction on domestic firm innovation activities. Highly innovative foreign firms have a greater demand for local inputs, such as skilled technicians and specialized intermediate goods which can lead to restricted supply or increased costs for domestic firms (Li et al., 2013; Nuruzzaman et al., 2019). These will reduce domestic firms' access to necessary resources for innovation. Second, the strong innovation performance of foreign firms may also intensify competition in the output market because these innovative foreign firms have the ability to attract market demand away from their co-located domestic competitors (Aitken & Harrison, 1999). This increased rivalry between foreign firms and domestic competitors within the local market often leads to pricing wars and heightened competition (Chang & Xu, 2008). In response, co-located domestic firms may invest substantially in advertising and promoting their existing products, crowding out the resources and efforts allocatable to innovation.

Taken together, the benefits and detriments of geography-based foreign presence are both strengthened when foreign firms in a region have higher levels of innovation performance, causing the inverted U-shaped relationship between geography-based foreign presence and domestic firm innovation performance to be steeper.

Hypothesis 2. The inverted U-shaped relationship between geography-based foreign presence in a region and a domestic firm innovation performance is intensified (more steepened slopes at both sides of the curve) when the foreign firms, on average, present a high level of innovation performance in a region.

The Moderating Effect of Domestic Firm State Ownership

We further submit that both the benefits and detriments of geography-based foreign presence are stronger for domestic state-owned firms (SOEs) than for domestic private firms, thereby contributing to a steeper inverted U-shaped baseline relationship. SOEs are defined as firms in which the government holds a partial or whole ownership stake (Cuervo-Cazurra, Inkpen, Musacchio, & Ramaswamy, 2014; Zhou, Gao, & Zhao, 2017). Governments are recognized as a powerful stakeholder in fostering firm innovation, particularly in emerging economies like China (Zhou et al., 2017).

In emerging economies like China, the presence of institutional voids, characterized by information asymmetry, weak legal enforcement, and shortages of independent financial intermediaries, significantly impede firm development, including innovation (Zhou et al., 2017). Under this context, domestic SOEs hold certain advantages in learning and innovating relative to private firms (Benassi & Landoni, 2019). On the one hand, emerging-market governments often play a powerful role in allocating critical resources such as funding, land, and technical infrastructure (Chen, Li, Shapiro, & Zhang, 2014). The natural connection with the government enables SOEs to overcome institutional voids and obtain advantages in policy support and resource allocation (Zhou et al., 2017), while private firms lack these privileges for innovation (Ahlstrom, Bruton, & Yeh, 2008).

On the other hand, having state ownership in an emerging economy sends a positive signal indicating a firm's status and legitimacy, and enables the firm to obtain resources from other market players such as suppliers, investors, and employees (Li, Li, & Wang, 2019). Studies have found that private firms from emerging markets face mounting legitimacy-related challenges to secure resources from other market actors (Ahlstrom et al., 2008).

In line with this logic, we submit that the benefits of foreign presence in a region, facilitated by geographic proximity and the four aforementioned mechanisms, are more pronounced for SOEs than for private firms. First, the demonstration effect is stronger for SOEs than for private firms. State ownership lends SOEs a competitive advantage in monitoring and adapting to changes in the business environment, as well as accessing resources that are typically unavailable to private firms, such as exclusive operating

rights in specific geographical locations and substantial capital resources (Aguilera et al., 2021). With the abundant resources and privileged information, SOEs are better positioned than private firms to observe and absorb knowledge embedded in foreign firms.

Second, the business linkages effect is strengthened for SOEs. Unlike private firms, SOEs are more likely to build backward and forward linkages with partners that work with nearby foreign firms (Li et al., 2019). These linkages enable domestic SOEs to access valuable knowledge on new technologies, practices, and products more easily and extensively. In addition, the employee mobility effect is more salient for SOEs than for private firms. Research indicates that, all else equal, working in SOEs offers greater job stability, often called the "iron rice-bowl" (Liu, Huang, Wang, & Liu, 2019). As such, SOEs are more likely to attract employees who left foreign firms and carry that knowledge and experience with them. Furthermore, the positive competition effect is strengthened for SOEs. Motivated by their resource advantages and government agenda, SOEs strive to catch up with and compete against foreign firms (Genin, Tan, & Song, 2021). In contrast to private firms, SOEs typically bear the responsibility of becoming the "national glory" or "exemplars" by governments in emerging markets (Cuervo-Cazurra et al., 2014).

Last, domestic SOEs generally encounter less knowledge overload and spatial lock-in than private firms. This distinction arises from the fact, unlike private firms, SOEs generally possess advanced capabilities and ample resources, enabling them to effectively handle the advanced knowledge embedded in foreign firms (Funk, 2014). Private firms, instead, are more prone to being overwhelmed by such knowledge overload, hindering their absorption and subsequent innovation. Moreover, because of information and resource constraints, private firms tend to engage in narrow searches for new knowledge, whereas SOEs, equipped with advanced capabilities and sufficient resources, tend to conduct broader searches for new knowledge beyond the region (Benassi & Landoni, 2019). As such, the spatial lock-in effect is likely to be stronger for domestic private firms than for SOEs.

Regarding the detriments, we submit that the crowding-out effects are stronger for domestic SOEs than for domestic private firms. This is largely because SOEs are stronger and more resourceful than

private firms, making them more likely to compete with foreign firms for resource inputs and also in the output market (Genin, Tan, & Song, 2021). In an emerging economy such as China, the presence of numerous foreign firms in close proximity creates significant competitive pressure on resources needed for business operation. These resources are more likely to overlap with the resource base of SOEs than that of private firms. For example, prior research has shown that foreign firms exert a stronger negative effect on the performance, growth, and survival of SOEs than private firms (Buckley, Clegg, & Wang, 2002).

In addition, geography-based foreign presence tends to induce a stronger competition effect to crowd out SOEs' product offerings than private firms in the emerging market. The substantial presence of co-located foreign firms intensifies competition in the output market, because these innovative foreign firms have competitive advantages that attract customers away from less competent domestic competitors (Aitken & Harrison, 1999). Yet, such rivalry is arguably stronger between foreign firms and domestic SOEs than between foreign firms and domestic private firms. In emerging markets such as China, SOEs are generally more competitive than domestic firms, and introduce more innovative products and value-added services into the market, especially after SOEs' restructuration (Collinson & Wang, 2012). Therefore, SOEs are more likely to become direct competitors of foreign firms and are thus subject to a higher level of competitive crowding-out effect. Therefore, we expect state ownership exacerbates the detriments, as reflected in the crowding-out effects of geography-based foreign presence.

Taken together, both the benefits and the detriments of geography-based foreign presence are more intense for SOEs than for private firms, which leads us to hypothesize the following:

Hypothesis 3. The inverted U-shaped relationship between the geography-based foreign presence in a region and a domestic firm innovation is intensified when the domestic firm is state-owned (more steepened slopes on both sides of the curve).

METHODOLOGY

Sample and Data Sources

We tested our hypotheses in the context of China between 1998 and 2014. Since the late 1990s,

especially after the relaxation of foreign direct investment (FDI) regulations on China's World Trade Organization accession in 2001 (Lu, Tao, & Zhu, 2017), China has become the largest recipient of FDI in the world, and numerous studies have used China to examine FDI spillover effects (e.g. Lu et al., 2017; Zhang et al., 2010). At the same time, the Chinese government has increasingly focused on promoting domestic firm innovation, such as setting up goals to transform China into a technology powerhouse by 2020 and a global leader by 2050 in *China's National Medium- and Long-Term Plan for the Development of Science and Technology and liberalize FDI regulations* (Howell, 2020). There is considerable evidence that foreign firms in China had more advanced technologies than domestic firms over the sample period (e.g., Li et al., 2013; Xia & Liu, 2017). In addition, China is a suitable context for testing our hypotheses because it has a vast tract of territorial land with a large number of fragmented provincial regions, allowing us to observe the complex influences of foreign presence at the subnational level (Chang & Xu, 2008).

We sourced our data from China's Annual Census of Industrial Enterprises (ACIE), compiled by the National Bureau of Statistics (NBS) of China. The annual census data cover almost all industrial firms in China, including both domestic and foreign firms, with annual sales of at least 5 million RMB. Specifically, each manufacturing plant in China is required to have an independent legal entity and tax account. Our data provide detailed information about each firm, including its industry, ownership structure, and financial conditions. The data have been used extensively to examine Chinese firms' strategies (e.g. Xie & Li, 2018). We tested our hypotheses using the census data between 1998 and 2014. Setting the starting time from 1998 is to avoid the Asian financial crisis in 1997. The census data after 2014 are no longer publicly available through the China Statistics Bureau.

We followed prior studies (Li et al., 2013; Zhang et al., 2010) in defining foreign firms as those business entities owned by one or more foreign shareholders in which 100% of the equity is owned by one or more foreign owners. We also used other cutoff points (e.g., 50% and 25%) to test the robustness of our findings. Domestic firms are defined as those that are wholly controlled by domestic investors and have 0% foreign ownership. After eliminating observations with missing values, our final sample included

410,140 domestic firms and 1,277,139 firm-year observations.

Measures

Dependent variable. We measured *Innovation performance* as the ratio of a domestic firm's new product output to its total output, which has been widely used in prior studies (e.g., Xia & Liu, 2017; Zhou et al., 2017). New product output is considered an appropriate indicator of the commercial success of a firm's innovation activities, specifically in China (e.g., Li et al., 2013; Xie & Li, 2018). The NBS defines new products as those that have been on the market for less than 3 years and encompass either completely new technical principles, new designs, or substantial improvements in structure, materials, or manufacturing processes capable of achieving that could achieve better performance and function than existing products (National Bureau of Statistics, 2006). Therefore, new product output is a comprehensive indicator to capture not only knowledge application but also knowledge creation, such as bricolage, frugal innovation, and reverse innovation, which are particularly prevalent in the context of emerging economies such as China (Agarwal, Grottke, Mishra, & Brem, 2016).

Independent variables. To measure *Geography-based foreign presence (GFP)* at the micro level, we followed Funk (2014) and Sorenson and Audia (2000) to construct the variable using the following equation:

$$GFP_{\alpha t} = \sum_{\beta}^{n} \frac{1}{(1 + d_{\alpha\beta})} \quad (1)$$

where α denotes a domestic Chinese firm, β denotes a foreign firm in the same industry, n is the total number of such foreign firms in the same province, t indicates the year of time, and $d_{\alpha\beta}$ is the geographic distance between α and β. For a focal Chinese firm, the measure represents the sum of pairwise geographic proximity between this focal firm and a foreign firm in the same industry (SIC 2 digits) and in the same region. Hence, a higher value of $GFP_{\alpha t}$ indicates that the firm is overall geographically closer to all foreign firms in the same region. We calculated the pairwise geographic distance $d_{\alpha\beta}$ between a domestic firm and a foreign firm as the following:

$$d_{\alpha\beta} = R\{arccos[sin(lat_\alpha)sin(lat_\beta) + cos(lat_\alpha)cos(lat_\beta)cos(|long_\alpha - long_\beta|)]\} \quad (2)$$

where lat and $long$ denote the latitude and longitude of the firm's headquarter locations (α and β), and R is a constant based on the radius calculation of the Earth by converting the result in units of 10 miles ($R = 343.7$) (Sorenson & Audia, 2000).

Moderating variable. Following prior studies (Li, Chen, & Shapiro, 2010), we calculated the variable *Regional foreign firm innovation* in industry i in province *j* with a total N firms by using the following equation:

$$Regional\ foreign\ firm\ innovation_{ijt} = \frac{\sum_{k=1}^{N} foreign\ firm\ innovation_{kijt}}{N} \quad (3)$$

where $foreign\ firm\ innovation$ was constructed as the value of foreign firm *k*'s new product output in year *t*. Thus, a high value of the variable indicates a high level of average innovation performance of foreign firms in a region. In addition, we used natural logarithm transformation to correct for adverse skewness. For the second moderator, *State ownership*, we created a dummy variable to indicate whether a firm's equity is held by the state (Li et al., 2010).

Control variables. Appendix B describes the measures of all control variables included in our analyses.

Estimation Method

Because our sample has a panel-data structure, we conducted the Hausman test, and the results suggested that fixed effects are preferred over random effects ($p = 0.000$). The normal ordinary least squares estimator with fixed effects may contain sources of unobserved heterogeneity. We thus adopted the high-dimensional fixed effects (HDFE) model that was widely used in previous studies (e.g., Correia, 2019; Nguyen, Mickiewicz, & Du, 2018). Using the command "reghdfe" in Stata, we could control for multiple levels of fixed effects, including year, industry, and region (Guimarães & Portugal, 2010).

RESULTS

Tests for Hypotheses

Table 1 presents the descriptive statistics and correlations for all variables included in our analyses.

The results show that most correlations between any two variables are below 0.5. We further calculated the variance inflation factors (VIFs) and found that the mean VIF was around 2.42, substantially below the rule-of-thumb cutoff of 10 (Ryan, 1997). Therefore, multicollinearity is not a serious concern in our analyses.

Table 1 goes about here

Table 2 summarizes the empirical results of the HDFE estimator. Model 1 is the baseline model, including only moderating and control variables. The results for this model show that the coefficients on firm-specific characteristics including *Firm size*, *Firm age*, *Firm profitability*, *Intangible assets*, *Export intensity*, *Local agglomeration externalities*, and *Foreign presence in other industries* were positive, consistent with our prediction. However, *Regional border* had a negative and significant impact on domestic firm innovation performance, which may be because firms prefer to interacting within provinces; thus firms located in provincial border regions may have greater difficulty receiving spillover effects from foreign firms in the core regions of the province than regions outside the borders. For industry-level variables, an interesting result is that the coefficient on *Industrial concentration* was positive, indicating that firms may have more resources for product innovations in highly concentrated industries. For the regional-level factors, we found the unexpected result that *Regional economic development* had no significant impact on innovation performance, indicating that domestic firms in different regions endowed with different levels of economic development did not show any differences in their innovation performance.

Tables 2 goes about here

Hypothesis 1 predicts an inverted U-shaped relationship between a domestic firm's geography-based foreign presence in a region and its product innovation. As shown in Model 2, the coefficient for the linear

term of *Geography-based foreign presence* ($\beta = 0.435,\ p \leq 0.001$) was positive, whereas the coefficient for the square term was negative ($\beta = -0.300,\ p \leq 0.001$), indicating an inverted U-shaped relationship. To ensure the correct interpretation of the inverted U-shaped relationship, we followed the suggestions from Lind and Mehlum (2010) and Haans, Pieters, and He (2016) to estimate the inflection point and calculate confidence intervals based on Fieller's standard error. The inflection point of *Geography-based foreign presence* was 0.725, with [0.605, 0.825] at the 95% confidence interval, which was located well within the data range (0–4.293). This suggests a valid inverted U-shaped relationship, strongly supporting Hypothesis 1.

Hypothesis 2 predicts that the development of *Regional foreign firm innovation* can intensify the inverted U-shaped relationship between geography-based foreign presence and a domestic firm's innovation performance. In Model 3, the interaction term between *Geography-based foreign presence* and *Regional foreign firm innovation* was positive and significant ($\beta = 0.076,\ p \leq 0.001$), whereas the interaction term between *Geography-based foreign presence squared* and *Regional foreign firm innovation* was negative and significant ($\beta = -0.041,\ p \leq 0.001$).

Hypothesis 3 predicts an intensified moderating effect of state ownership on the inverted U-shaped relationship. We found similar result patterns in Model 4 that the interaction between *Geography-based foreign presence* and *State ownership* was positive and significant ($\beta = 2.104,\ p \leq 0.001$), whereas the interaction term between *Geography-based foreign presence squared* and *State ownership* was negative and significant ($\beta = -0.213,\ p \leq 0.01$). Thus, both Hypotheses 2 and 3 received strong support.

To illustrate our results, we plotted the inverted U-shaped relationship and the moderating effects. Figure 3 shows that domestic firm innovation performance first increases and then decreases as the geography-based foreign presence increases. We found that a 1% increase in *Geography-based foreign presence* is associated with a 0.44% increase in domestic firm innovation performance. Yet, after *Geography-based foreign presence* reaches its threshold (i.e., 0.725), we found that with any additional 1% increase, innovation performance decreases by 2.14%.

Figures 3 goes about here

Furthermore, we plotted the marginal effects of *Geography-based foreign presence* on innovation performance at varying levels of *Regional foreign firm innovation* as well as *State ownership* to illustrate the moderating effects. In Figure 4, with a higher level of regional foreign firm innovation in the location of domestic firms (i.e., one standard deviation above the mean value), we found that the inverted U-shaped relationship becomes steeper, confirming an intensified moderating effect of *Regional foreign firm innovation*. Figure 5 shows a similar pattern for SOEs. Both figures further support the moderating effects posited in Hypotheses 2 and 3.

Figures 4 and 5 go about here

We conducted additional analyses to test whether our main analyses were robust. Please see Appendix C for more details.

DISCUSSION AND CONCLUSION

In this paper, we proposed a new form of foreign presence, geography-based foreign presence, and explored its impact on the innovation performance of domestic firms in China, the world's largest emerging economy. Analyzing a sample of Chinese manufacturing firms between 1998 and 2014, we found that geography-based foreign presence has an inverted U-shaped relationship with domestic firm innovation performance. Furthermore, we found that this relationship is steeper for SOEs than for private firms, as well as when foreign firms in the region displayed a high level of innovation performance. By integrating insights from economic geography and foreign presence, this study makes three primary contributions to the related literature.

First, despite the prolonged debate on the impact of foreign presence on domestic firms, the empirical evidence remains inconclusive (e.g., Li et al., 2013). Our study addresses this gap by providing a nuanced examination at the micro-level. Going beyond prior research that assumed all domestic firms as equally

influenced by foreign firms within a region (e.g., by country or city), we relaxed such assumptions and developed a new form of foreign presence (i.e., geography-based foreign presence), to unpack why domestic firms from emerging economies benefit differently from each foreign firm within the same locality or clustering. This research offers valuable insights into the complexities of the relationship between foreign presence and domestic firm innovation.

Second, our findings of an inverted U-shaped relationship between geography-based foreign presence and domestic firm innovation performance confirmed that the dyadic geographic relationship between each domestic and foreign firm is a significant factor in determining the impact of foreign presence on domestic firms, even within the same region. Specifically, the inverted U-shaped relationship indicated that domestic firms derive the greatest benefits from foreign presence when they are located at an optimal distance from foreign counterparts ─ not too far and not too close. As such, our paper extends the literature on foreign presence by providing micro evidence and highlighting the importance of geography-based foreign presence as a distinct form of foreign influence. By integrating economic geography with foreign presence, we offer a comprehensive understanding of how the spatial dimension of foreign presence shapes the ability of domestic firms to benefit from foreign firms and foster innovation. Such integration opens up promising avenues for future research that have yet to attract sufficient attention from scholars.

Furthermore, we demonstrated that a firm's ownership type (i.e., state ownership) and innovation performance of foreign firms within a region serve as important boundary conditions for the relationship between geography-based foreign presence and domestic firm innovation performance. Both boundary conditions influence the nature and extent of the benefits and detriments associated with geography-based foreign presence. Consequently, we found that the inverted U-shaped relationship between geography-based foreign presence and domestic innovation performance becomes more pronounced for SOEs and in regions where foreign firms have a high level of innovation performance. As such, our findings highlighted the complexity of the impact of foreign presence on domestic firms, which is overlooked in existing research that fails to adequately consider the nuanced characteristics of both domestic and foreign

firms (e.g., Liu et al., 2014). By considering the attributes of both parties, our findings contribute to a deeper understanding of the intricate influence of foreign presence on domestic firms, and offers fresh insights to reconcile the diverse findings observed in the literature.

Practical Implications

The findings of our paper have important implications for managers and policy makers in emerging markets. One implication for managers of domestic firms is the need to consider their spatial relationships with surrounding foreign firms and carefully evaluate the implications of their location on innovation. Before surpassing the threshold, proximity to foreign firms can provide a valuable and unique advantage for enhancing a domestic firm's innovation performance. However, once the threshold is exceeded, geographic proximity may have a negative effect on a domestic firm's innovation. Therefore, finding an appropriate location becomes crucial, allowing domestic firms to leverage knowledge spillover while safeguarding against the disadvantages of foreign presence. In addition, domestic managers should also recognize the influence of ownership type and foreign firm innovation capability within a region on the effectiveness of learning from foreign firms. These factors should be factored into innovation strategies to optimize the learning process.

Policy makers in emerging economies should also consider the spatial dynamics of foreign presence when formulating policies to promote domestic firm innovation. Local governments in emerging economies often aim to create industrial clusters with high geographic concentration and use preferential policies to attract both foreign and domestic firms. Our findings suggest the importance of paying attention to specific locations of domestic firms within these clusters. Governments should actively leverage policies to reduce the negative impacts of foreign presence on domestic firms. Also governments should support domestic firms in establishing strategic spatial relationships with foreign firms, so the positive spillover benefits created by foreign firms within the region are not outweighed by the detrimental effects on domestic firms.

Limitations and Future Research

This paper has several limitations that can inform future research. First, we focused on one outcome of innovation: new product output. Although this is a commonly used easure in studies on domestic firm innovation performance in emerging economies (e.g., Xia & Liu, 2017; Xie & Li, 2018), it is important to acknowledge that innovation encompasses other dimensions, such as process innovation and managerial innovation (Zhou & Li, 2008). There, future studies should test our arguments in the context of other types of innovation performance.

Additionally, due to the limitation on data, our research, like many previous studies, did not measure the actual knowledge flow. Moving forward, it would be valuable to collect more data on the actual knowledge exchange between foreign and domestic firms, such as through citations, employee mobility, and technology license transfer, to further validate our propositions.

It is worth noting that our analysis was based solely on data from China. While this focus provides valuable insights, it may restrict the generalizability of our findings to other countries. It would be beneficial for future research to replicate our study in different emerging economies and compare the results.

Furthermore, to understand the impact of foreign presence on domestic firms, we built on existing literature and developed mechanisms from the perspective of domestic firms. However, it is important to acknowledge that foreign firms may have reservations about sharing knowledge with local competitors, thus limiting domestic firms' chance to imitate their foreign counterparts (Mariotti et al., 2019). Although such negative effect is not prominent in our context, given the weak institutional environment in China, it would be valuable for future research to explore this aspect in more depth over a longer time period so as to extend our findings.

Finally, to ensure an in-depth conceptualization and empirical analysis, we focused on geographic proximity as an important weight for developing geography-based foreign presence. We are also aware that different proximities may have different implications for innovation. In light of data availability, we believe alternative proximities (e.g., cognitive, organizational, social, and institutional proximity), warrant future research to test whether the proximity paradox in these dimensions holds true (Boschma, 2005).

Table 1 Descriptive statistics and correlation matrix

	Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1.	Innovation performance	2.328	11.327	1.000									
2.	Geography-based foreign presence	0.606	0.663	0.019	1.000								
3.	Geography-based foreign presence squared	0.807	1.491	0.016	0.931	1.000							
4.	Regional foreign firm innovation	4.796	4.001	0.063	0.437	0.335	1.000						
5.	State ownership	0.122	0.327	0.049	-0.174	-0.124	-0.185	1.000					
6.	Firm size	9.649	1.427	0.184	0.063	0.072	0.026	0.137	1.000				
7.	Firm age	10.269	11.458	0.080	-0.105	-0.078	-0.109	0.373	0.198	1.000			
8.	Leverage	0.056	0.141	0.013	-0.143	-0.105	-0.120	0.173	0.123	0.148	1.000		
9.	Firm profitability	0.082	0.443	-0.009	-0.014	-0.014	0.014	-0.065	-0.082	-0.051	-0.033	1.000	
10.	Intangible assets	4.285	3.804	0.133	0.018	0.018	0.020	0.112	0.552	0.144	0.097	-0.061	1.000
11.	Export intensity	0.165	0.336	0.019	0.216	0.171	0.080	-0.100	0.035	-0.059	-0.075	-0.024	0.041
12.	Local agglomeration externalities	7.743	1.904	0.128	0.253	0.225	0.401	-0.136	0.096	-0.042	-0.090	-0.000	0.079
13.	Foreign presence in other industries	6.253	1.554	-0.005	0.555	0.402	0.471	-0.26	0.039	-0.147	-0.166	0.021	-0.007
14.	Regional border	0.192	0.394	-0.015	-0.088	-0.055	-0.054	0.024	-0.040	-0.009	0.030	0.007	-0.042
15.	Industrial concentration	0.003	0.003	0.042	-0.103	-0.042	-0.091	0.078	0.131	0.028	0.036	-0.015	0.088
16.	Macro-level foreign presence	0.051	0.020	0.047	0.286	0.268	0.265	-0.108	-0.029	-0.071	-0.094	0.001	0.012
17.	FDI regulation change	0.111	0.315	0.004	-0.070	-0.054	-0.086	0.076	0.081	0.056	0.050	-0.015	0.041
18.	Language diversity	0.187	0.208	0.002	-0.292	-0.245	-0.124	0.112	-0.031	0.051	0.074	0.024	-0.038
19.	Regional economic development	9.145	0.707	-0.012	0.416	0.318	0.458	-0.286	0.055	-0.169	-0.128	0.041	0.002
20.	Intellectual property protection	9.584	9.529	0.045	0.515	0.440	0.407	-0.196	0.044	-0.116	-0.130	-0.017	0.010
21.	Transportation infrastructure	10.942	0.852	-0.025	-0.217	-0.193	0.086	-0.087	0.013	-0.084	0.018	0.053	-0.014
22.	Regional FDI stock	8.444	1.102	-0.006	0.511	0.360	0.459	-0.24	0.030	-0.137	-0.147	0.012	-0.017

Note: N = 1,277,139; correlations greater than |0.002| are significant at 0.05.

Table 1 Descriptive statistics and correlation (Continued)

	Variables	11	12	13	14	15	16	17	18	19	20	21	22
11.	Export intensity	1.000											
12.	Local agglomeration externalities	-0.031	1.000										
13.	Foreign presence in other industries	0.157	0.237	1.000									
14.	Regional border	-0.077	-0.034	-0.114	1.000								
15.	Industrial concentration	-0.067	0.194	-0.010	0.002	1.000							
16.	Marco-level foreign presence	0.146	0.194	0.154	-0.066	-0.008	1.000						
17.	FDI regulation change	-0.072	0.017	-0.038	0.013	0.171	-0.223	1.000					
18.	Language diversity	-0.120	-0.101	-0.213	0.044	-0.008	-0.074	0.005	1.000				
19.	Regional economic development	0.102	0.242	0.798	-0.153	-0.053	0.154	-0.043	-0.115	1.000			
20.	Intellectual property protection	0.149	0.241	0.602	-0.092	-0.047	0.170	-0.050	-0.308	0.592	1.000		
21.	Transportation infrastructure	-0.059	0.014	-0.002	-0.115	-0.062	-0.021	-0.004	0.207	0.428	-0.056	1.000	
22.	Regional FDI stock	0.158	0.223	0.931	-0.118	-0.019	0.144	-0.037	-0.179	0.808	0.556	0.084	1.000

Note: N = 1,277,139; correlations greater than |0.002| are significant at 0.05.

Table 2 Main results: Geography-based foreign presence and domestic firm innovation performance

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
	DV: Ratio	DV: Ratio	DV: Ratio	DV: Ratio	DV: Ratio	DV: Amount	DV: Amount	DV: Amount	DV: Amount
Hypothesis 1:									
Geography-based foreign presence		0.435***	0.247***	0.219**	-0.014	0.072***	0.021	0.024	-0.038**
		(0.059)	(0.060)	(0.066)	(0.068)	(0.013)	(0.014)	(0.013)	(0.015)
Geography-based foreign presence squared		-0.300***	-0.251***	-0.175***	-0.105***	-0.073***	-0.044***	-0.060***	-0.026***
		(0.022)	(0.022)	(0.029)	(0.029)	(0.005)	(0.006)	(0.005)	(0.006)
Hypothesis 2:									
Geography-based foreign presence × Regional foreign firm innovation			0.076***		0.094***		0.017***		0.022***
			(0.013)		(0.013)		(0.003)		(0.003)
Geography-based foreign presence squared × Regional foreign firm innovation			-0.041***		-0.049***		-0.009***		-0.011***
			(0.006)		(0.006)		(0.001)		(0.001)
Hypothesis 3:									
Geography-based foreign presence × State ownership				2.104***	2.198***			0.551***	0.573***
				(0.153)	(0.153)			(0.033)	(0.033)
Geography-based foreign presence squared × State ownership				-0.213**	-0.253**			-0.076***	-0.086***
				(0.077)	(0.077)			(0.017)	(0.017)
Moderating and control variables:									
Regional foreign firm innovation	0.043***	0.043***	0.042***	0.042***	0.043***	0.012***	0.012***	0.012***	0.012***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
State ownership	0.613***	0.626***	0.623***	1.160***	1.163***	0.260***	0.259***	0.387***	0.387***
	(0.035)	(0.035)	(0.035)	(0.040)	(0.040)	(0.008)	(0.008)	(0.009)	(0.009)
Firm size	1.252***	1.255***	1.257***	1.253***	1.255***	0.437***	0.438***	0.437***	0.437***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.002)	(0.002)	(0.002)	(0.002)
Firm age	0.039***	0.039***	0.039***	0.040***	0.040***	0.014***	0.014***	0.014***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.261***	-0.262***	-0.268***	-0.244***	-0.251***	-0.071***	-0.072***	-0.066***	-0.068***
	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.016)	(0.016)	(0.016)	(0.016)
Firm profitability	0.328***	0.328***	0.327***	0.324***	0.323***	0.106***	0.106***	0.105***	0.105***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.005)	(0.005)	(0.005)	(0.005)
Intangible assets	0.080***	0.080***	0.080***	0.079***	0.079***	0.023***	0.023***	0.022***	0.022***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Export intensity	0.590***	0.622***	0.632***	0.635***	0.648***	0.208***	0.210***	0.211***	0.214***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.007)	(0.007)	(0.007)	(0.007)
Local agglomeration	0.327***	0.335***	0.337***	0.328***	0.330***	0.096***	0.097***	0.095***	0.095***

externalities	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.002)	(0.002)	(0.002)	(0.002)
Foreign presence in other industries	0.895***	0.738***	0.736***	0.736***	0.735***	0.265***	0.264***	0.264***	0.264***
	(0.064)	(0.065)	(0.065)	(0.065)	(0.065)	(0.014)	(0.014)	(0.014)	(0.014)
Regional border	-0.291***	-0.288***	-0.292***	-0.264***	-0.268***	-0.079***	-0.080***	-0.073***	-0.074***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.006)	(0.006)	(0.006)	(0.006)
Industrial concentration	69.970***	78.576***	78.124***	79.626***	78.857***	18.086***	17.988***	18.334***	18.154***
	(7.981)	(7.995)	(8.004)	(7.993)	(8.002)	(1.742)	(1.744)	(1.742)	(1.744)
Macro-level foreign presence	21.111***	26.445***	28.294***	25.972***	28.017***	4.461***	4.891***	4.344***	4.825***
	(1.365)	(1.397)	(1.437)	(1.396)	(1.437)	(0.303)	(0.312)	(0.303)	(0.312)
FDI regulation change	-0.105**	-0.102**	-0.101**	-0.107**	-0.107**	-0.023**	-0.023**	-0.025**	-0.025**
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.008)	(0.008)	(0.008)	(0.008)
Language diversity	2.008***	1.933***	1.914***	1.938***	1.916***	0.534***	0.530***	0.535***	0.530***
	(0.055)	(0.056)	(0.056)	(0.056)	(0.056)	(0.012)	(0.012)	(0.012)	(0.012)
Regional economic development	0.411	0.356	0.346	0.788**	0.783**	-0.246***	-0.248***	-0.137*	-0.138*
	(0.249)	(0.251)	(0.251)	(0.252)	(0.252)	(0.055)	(0.055)	(0.055)	(0.055)
Intellectual property protection	0.064***	0.072***	0.070***	0.077***	0.075***	0.022***	0.021***	0.023***	0.022***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Transportation infrastructure	-0.907***	-0.890***	-0.895***	-0.903***	-0.909***	-0.281***	-0.282***	-0.284***	-0.285***
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.009)	(0.009)	(0.009)	(0.009)
Regional FDI stock	0.387***	0.344***	0.352***	0.319***	0.329***	0.097***	0.098***	0.090***	0.093***
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.009)	(0.009)	(0.009)	(0.009)
Constant	-18.300***	-17.113***	-17.097***	-20.572***	-20.613***	-2.307***	-2.305***	-3.181***	-3.192***
	(2.319)	(2.336)	(2.336)	(2.340)	(2.341)	(0.509)	(0.509)	(0.510)	(0.510)
F	2,659.67***	2,433.06***	2,232.51***	2,262.94***	2,091.70***	5,864.53***	5,378.44***	5,418.70***	5,005.35***
Adjusted R^2	0.068	0.069	0.069	0.069	0.069	0.130	0.130	0.131	0.131
Number of observations	1,277,139	1,277,139	1,277,139	1,277,139	1,277,139	1,290,038	1,290,038	1,290,038	1,290,038

Notes: $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$. Standard errors are in parenthesis. Year-, province- and industry-fixed effects were included in all models.

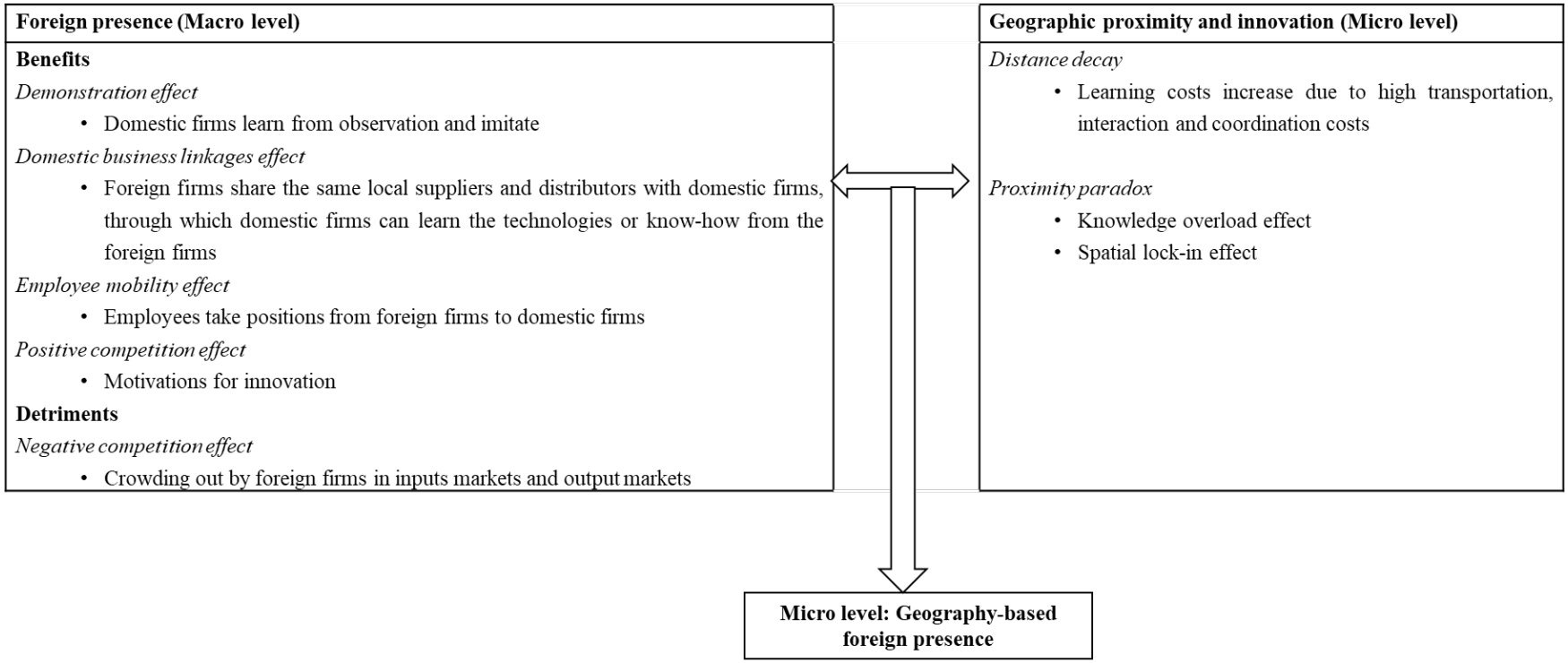

Figure 1 Caption: Summary of literature and the concept of geography-based foreign presence

Figure 1 Alt Text: Theoretical Framework derived from foreign presence literature and the geographic proximity literature

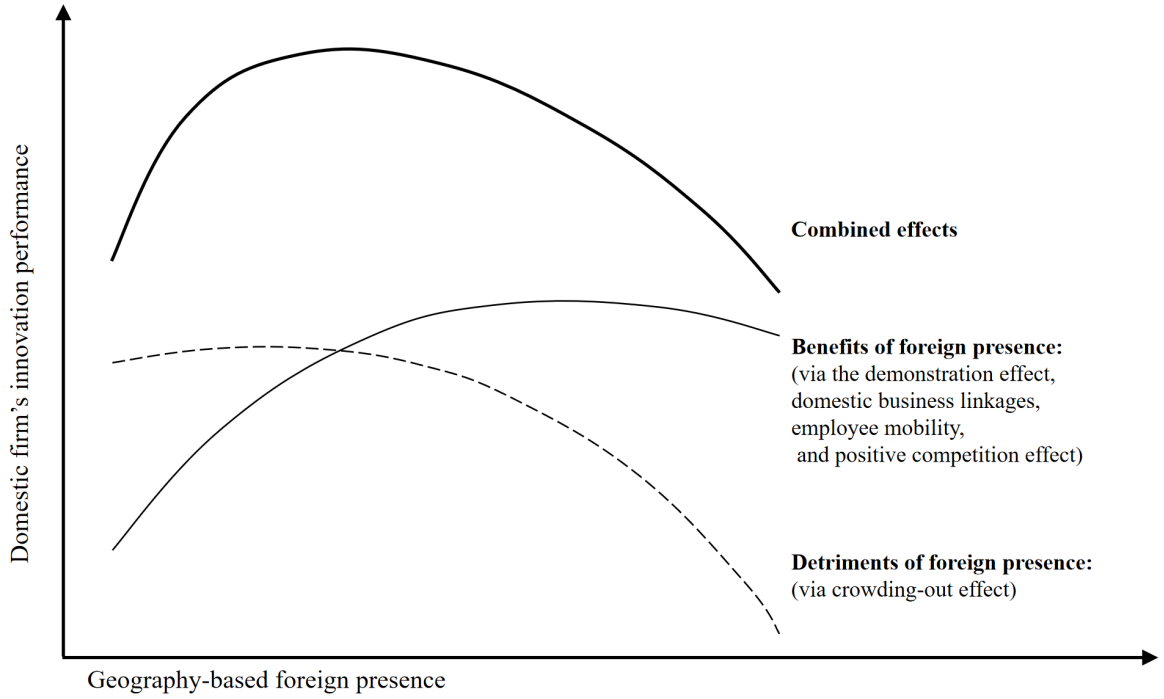

Figure 2 Caption: The inverted U-shaped relationship between geography-based foreign presence and domestic firm innovation performance

Figure 2 Alt Text: An inverted U-shaped simulation curve is formed by combining the benefits and detriments of foreign presence to reflect the relationship between geography-based foreign presence and domestic firm innovation performance

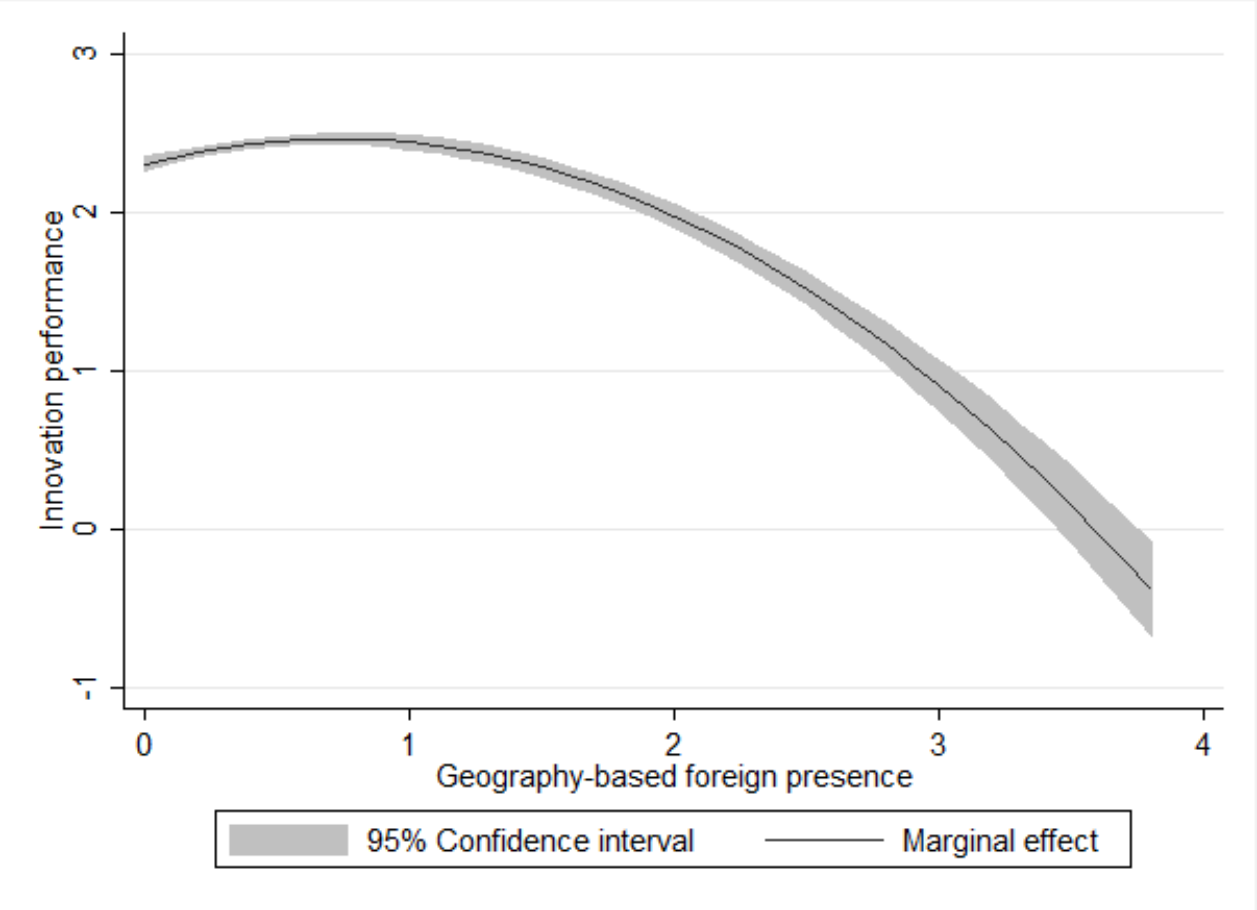

Figure 3 Caption: The effect of geography-based foreign presence on innovation performance

Figure 3 Alt Text: An inverted U-shaped curve is plotted by Stata software to show that domestic firm innovation performance first increases and then decreases as the geography-based foreign presence increases

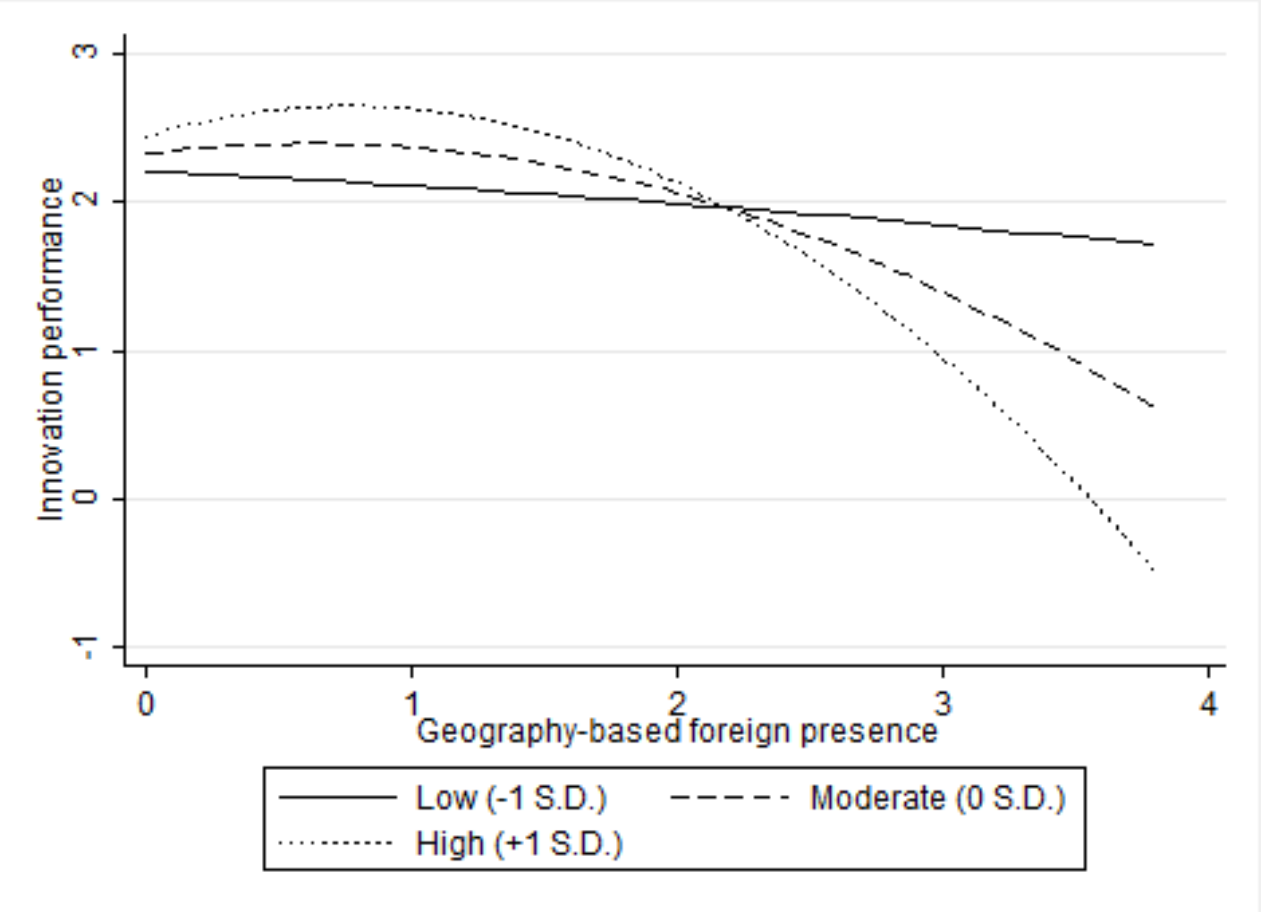

Figure 4 Caption: The moderating effect of regional foreign firm innovation on the inverted U-shaped relationship between geography-based foreign presence and innovation performance

Figure 4 Alt Text: The inverted U-shaped curve changes with the varying levels of regional foreign firm innovation

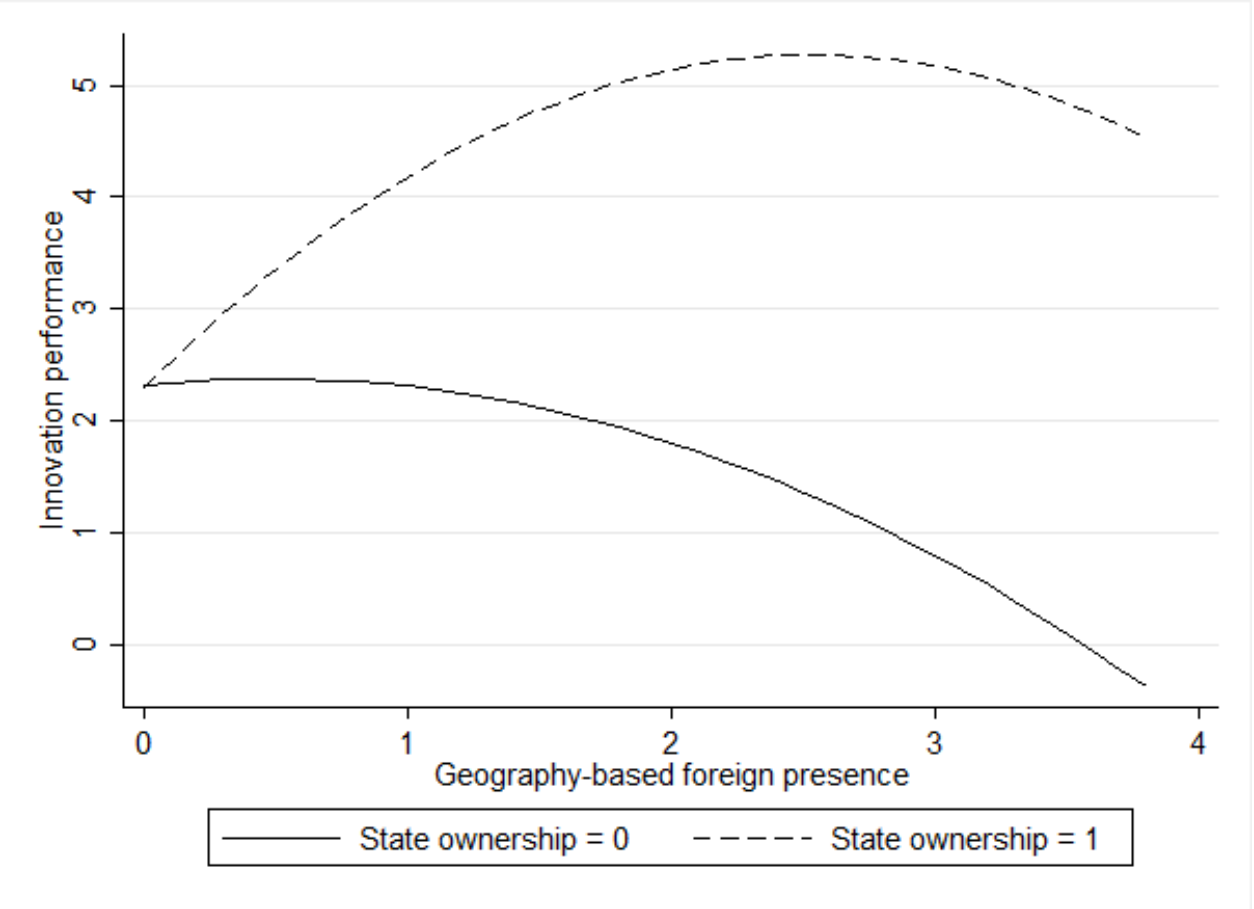

Figure 5 Caption: The moderating effect of state ownership on the inverted U-shaped relationship between geography-based foreign presence and innovation performance

Figure 5 Alt Text: The inverted U-shaped curve changes with the varying values of state ownership

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