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Turning a curse into a blessing: Contingent effects of geographic distance on startup–VC partnership performance

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ABSTRACT

This study aims to unravel the dynamic effect of geographic distance on startup–VC partnership performance by incorporating the possibility of accessibility improvement triggered by China's high-speed railway (HSR) during the partnership. We find that the negative effect of geographic distance is significantly weakened when HSR becomes available after the startup–VC partnership formation. We draw on the relational view to explore what types of geographically distant startup–VC partners can benefit more from HSR technology advancement. Results indicate that startup–VC partners that rely heavily on knowledge-sharing, have more complementary resources, or have more complex governance structures can better leverage the improved accessibility from HSR to transform the disadvantages of the long-distance to advantages.

Executive summary

The entrepreneurship literature has emphasized the role of geographic distance in venture capital (VC) firms' investment relationship with startups (Stuart and Sorenson, 2003; Guler and Guillén, 2010a). Despite the challenges imposed by geographic distance, such as uncertainty and information asymmetry (Gupta and Sapienza, 1992; Cumming and Dai, 2010), VCs are increasingly reaching far across geographic boundaries to seek partnership opportunities and improve investment prospects (Sorenson and Stuart, 2008; Jääskeläinen and Maula, 2014).

A key factor leading to the spatial radius expansion of partnership formation is technology advancement, such as breakthroughs in the transportation system (Kolko, 2000; Bernstein et al., 2016). While prior studies have highlighted that technology and modern transportation may change the accessibility and interfirm exchange between geographically distant partners (Petersen and Rajan, 2002; Forman and van Zeebroeck, 2019), they often treat technology as static in the course of a partnership. The possibility of technology improvement *after* partnership formation has been largely neglected (for rare exceptions, see Bernstein et al., 2016). We consider this neglect as an important limitation in studying the impact of geographic distance on startup–VC partnership development and continuous performance, especially for entrepreneurial partners in emerging economies where the pace of technological advancement has substantively increased (Hoskisson et al., 2000; Zheng and Kahn, 2013). Although partners may initially benefit from their physical proximity, these benefits may disappear when more distant counterparts bridge the physical gap owing to rapidly developing infrastructure and transportation systems. Accordingly, we aim to explore two important questions in this study: First, do

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the advantages from geographic closeness remain resilient following transportation technology advancements? Second, what types of geographically distant startup–VC partners can benefit more from such advancements?

To address these questions, we draw on the relational view for insights on the partnership development process (Dyer and Singh, 1998), and identify three crucial contingencies underlying partnership performance based on the relational view (i.e., *knowledge-sharing effectiveness*, *complementary resources and capabilities*, and *relational governance mechanisms*) (Mesquita et al., 2008; Weber et al., 2016). To unravel the dynamic effects of geographic distance on startup–VC partnership performance, we incorporate the possibility of substantive technology improvement during the partnership in our research design. Specifically, we exploit the phased introduction of China's high-speed railway (HSR) system as an exogenous shock to the accessibility between startups and their lead VC investors. Our results indicate that the negative effect of geographic distance is significantly weakened when HSR becomes available after partnership formation. Surprisingly, we find that when HSR connects formerly distant startups–VC partners, the "curse" of long distance would not only become insignificant, but also turn into a "blessing" for startup–VC partnership performance.

This study contributes to the understanding of startup–VC relationships by relaxing the dominant assumption that the effect of geographic distance is static during the startup–VC partnership. As an important departure, we suggest that technology advancements may turn the disadvantages of long geographic distance around by allowing startups and VCs to better leverage the know-how and complementary resources of distant partners. Our finding that the presence of HSR access changes the relationship between geographic distance and partnership performance from negative to positive provides nuanced and important insights to the role of modern technology in the dynamics of interfirm relationships. Second, we are among the first to systematically examine how the partnership-specific contingencies proposed by the relational view function between entrepreneurial firms and their partners. By theorizing and demonstrating how these mechanisms interact with geographic distance and accessibility, we provide valuable insights on the startup–VC relationship that has been commonly characterized by high outcome variability (Mason and Harrison, 2002; Gulati and Higgins, 2003). Third, our study suggests that although foreign and government VCs have unique advantages in emerging economies, their facilitating role is likely geographically bounded unless technology advancement improves their accessibility to the startups. These findings offer a plausible explanation for the ambiguous roles of government or foreign firms in their partnership with entrepreneurial firms.

1. Introduction

Geographic distance, often referred to as the spatial or physical distance between entities (e.g., business partners), is considered a proxy for costs related to information, transactions, and coordination (Stuart and Sorenson, 2003; Reuer and Lahiri, 2014; Wang and Zhao, 2018). Previous research has highlighted the important role of geographic distance on the partnership between startups and their VCs partners, one of the most widely studied interfirm relationships in the entrepreneurship literature (Vedula and Matusik, 2017; Colombo et al., 2019).

A longer geographic distance between startups and their lead VCs has been traditionally associated with a higher level of uncertainty, information asymmetry, and thus worse partnership performance (Gupta and Sapienza, 1992; Dai et al., 2012). The disadvantages of geographic distance, however, can be mitigated with the rise of technology advancement which facilitates knowledge-sharing and benefiting the relationship with partners in remote cities (e.g., Lutz et al., 2013; Bernstein et al., 2016; Forman and van Zeebroeck, 2019). For example, high-speed railway (HSR) — among the most significant technological transportation breakthroughs in the 20th century (Campos and De Rus, 2009; Zheng and Kahn, 2013) — has significantly reduced travel costs, thus substantially facilitating resource exchange between partners and generating relational rents. The pace of infrastructure and technology development is especially fast in emerging economies, which could "kill space," "shrink the land" (Dowling, 2018), and change the accessibility between geographically distant partners.

In this study, we seek to examine the dynamic effects of geographic distance on startup–VC partnership performance by drawing on the relational view as the theoretical foundation and employing the phased introduction of China's HSR system as an exogenous shock to the accessibility between startups and their lead VC investors. In the rest of the article, we first give an overview of geographic distance and explain the importance of considering accessibility for a more comprehensive understanding of the "puzzle" related to distance and partnership performance. We then present a literature review on the relational view which has been increasingly applied in entrepreneurship research (Marion et al., 2015; Weber et al., 2016). Second, we develop our theory and hypotheses related to geographic distance, improved accessibility, and three partnership-specific contingencies (i.e., knowledge-sharing effectiveness, resource complementarity, and relational governance mechanisms). Third, we introduce our unique research setting and data sampling procedure, followed by an in-depth empirical analysis. Lastly, we conclude with a discussion of important implications of our theory and findings.

2. Literature review

2.1. Geographic distance: part of a complex puzzle

The idea of geographic distance is intuitive and straightforward in its common usage. It refers to the physical distance between two points on the earth's surface, as given by latitudinal and longitudinal coordinates. A growing body of literature highlights the critical role of geographic distance between business partners on various innovation and entrepreneurship activities, such as innovation and knowledge appropriation (Rosenkopf and Almeida, 2003; Wang and Zhao, 2018), entrepreneurship ecosystems (Letaifa and Rabeau, 2013), and VC investments (Stuart and Sorenson, 2003; Colombo et al., 2019). Most current studies demonstrate a negative relationship between geographic distance and partnership performance (e.g., Stuart and Sorenson, 2003; Cumming and Dai, 2010). However, there is also empirical evidence of a positive or insignificant impact of geographic distance (e.g., Letaifa and Rabeau, 2013).

We argue that a plausible reason for the mixed findings is overlooking distance as a complex, time-variant concept (Beugelsdijk et al., 2018). Prior studies have used distance as a theoretical metaphor and/or empirical proxy of multiple related concepts (Shenkar et al., 2008),[1] yet has rarely been differentiated from geographic distance, a traditional measure based on physical distance along the surface of the earth (e.g., Guler and Guillén, 2010a; Gu and Lu, 2011; Chen et al., 2018; Husted et al., 2016). However, another important part of the puzzle, *spatial accessibility* (Giroud, 2013; Lutz et al., 2013), and its role on partnership performance, are often neglected or treated as identical to geographic distance. Following Forslund and Johansson (1995), we refer to spatial accessibility as the travel impediment (i.e., travel time given transportation conditions between two locations). Unlike geographic distance, which is time-invariant, spatial accessibility can change substantively owing to technological advancements (Beugelsdijk et al., 2018). Evidence based on patent citation data shows that digital technology could weaken the effect of geographic distance on cross-location knowledge flows (Forman and van Zeebroeck, 2019). Moreover, given the fast-developing infrastructure and technology in modern society, transportation technology could decouple geographic distance from spatial accessibility (Luz et al., 2013; Bernstein et al., 2016; Catalini et al., 2020). For instance, the geographic distance from Oklahoma City to Boston is 2420 km and from San Francisco to Boston is 4344 km. However, the actual travel time by plane for either of these routes is only 6 h.

The fast-changing infrastructure and the technology developments are especially prominent in emerging economies (Hoskisson et al., 2000). Their rapid technological advancements will redefine spatial accessibility during the development of partner relationships. However, thus far, it is unclear whether the benefits from geographic closeness remain resilient in the presence of rapid technology changes, and whether the disadvantage of geographic distance can be mitigated considering the effects of transportation improvements on partnership development. Therefore, a more comprehensive examination is required of the performance implications of geographic distance in a dynamic manner.

2.2. *Relational view on startup–VC partnership*

The relational view focuses on interfirm relationship and considers it an important determinant of partnership performance (Dyer and Singh, 1998; Weber et al., 2016; Dyer et al., 2018). It advances the understanding of how interfirm relationships can help alleviate the geographic barrier and its negative impact on partnership performance (Singh, 2005; Jääskeläinen and Maula, 2014). For example, based on observations on mutual fund companies, Bell and Zaheer (2007) find that interpersonal ties are superior conduits for knowledge flow and thus serve to span "geographic holes." Further, interfirm relationships in the VC community enable information diffusion across boundaries and therefore expand the spatial radius of exchange (Sorenson and Stuart, 2001).

The relational view is increasingly applied in entrepreneurship research because interfirm relationships are crucial to new ventures who have limited internal resources and are heavily dependent on external partners for resources (Stuart et al., 1999; Weber et al., 2016). Interfirm relationships enable startups to discover, develop, and commercialize new products (Marion et al., 2015). They also help startups signal values and enhance the success of their initial public offering (IPO) (Gulati and Higgins, 2003). Among the various interfirm relationships that startups form, partnership with VC firms acts as an endorsement to help startups acquire resources and is considered a key interfirm relationship for entrepreneurial success (e.g., Stuart et al., 1999; Gulati and Higgins, 2003; Busenitz et al., 2004). Pahnke et al. (2015) compare the performance implications of interfirm relationships between startups and VC firms and argue that the influences of interfirm relationships differ across various types of VC firms.

The relational view suggests that interfirm relationships are heterogeneous based on their knowledge-sharing effectiveness, resource complementarity, and relational governance mechanisms (Dyer and Singh, 1998). First, effective knowledge utilization between partners generates relational rents because the transfer of tacit knowledge and know-how can translate to an advantage for partners (Vasudeva and Anand, 2011). Second, complementarity exists when two partners have congruent resources and capabilities that can create value jointly and enhance each other synergistically (Kim and Finkelsten, 2009; Ennen and Richter, 2010). Third, relational governance mechanisms include both formal contracts and informal agreements that powerfully affect firms' behaviors in dealings with other partners (Baker et al., 2002). For example, when buyer–supplier relationships are highly complex, informal agreements can help safeguard tacit knowledge and coordinate complementary resources, thus generating additional performance gains (Mesquita et al., 2008). Building upon the three mechanisms suggested by the relational view, we explore what types of VC partners can benefit more after geographic distance is bridged with transportation technology advancements.

3. Hypotheses

3.1. *Revisiting the performance implication of geographic distance*

The negative impact of geographic distance on startup–VC partnership performance is widely documented (Sorenson and Stuart, 2001; Cumming and Dai, 2010; Dai et al., 2012; Lutz et al., 2013). Despite the geographic challenges, VC firms are increasingly reaching far to pursue new investment opportunities and beat competition (Sorenson and Stuart, 2008; Jääskeläinen and Maula, 2014). While prior studies provide valuable insights on how technology facilitates interfirm relationship formation (Reuer and Lahiri,

[1] Prior studies provide various interpretations of the meaning and measures of distance and extend the concept of distance parallel to other dimensions, such as cultural, social, and technology distance.

2014; Chakrabarti and Mitchell, 2016), the possibility of technology improvement after the partnership is formed has largely been ignored. To remedy this limitation, we take a dynamic approach in this study, and examine the contingent effect of technology advancement on the relationship between geographic distance and startup–VC partnership performance.

In the absence of advanced transportation technology, a large geographic distance constrains the VC firm's ability to advise startups. Apart from providing financial capital, VC firms enhance the resource base of their portfolio firms through various value-adding functions, such as coaching and mentoring entrepreneurs (Pahnke et al., 2015), advising on the company's board of directors (Lerner, 1995), and improving governance (Hsu, 2004). A large geographic distance between the VC and the startup impedes the former's frequent interpersonal interactions with the latter through formal or informal occasions, such as board meetings and onsite visits (Lutz et al., 2013; Bernstein et al., 2016). Thus, geographic distance is a crucial determinant in VCs' value-adding functions during their partnership with startups (e.g., Lerner, 1995; Cumming and Dai, 2010).

Moreover, a large geographic distance between a startup and its lead VC partner increases governance and monitoring costs. The entrepreneurial setting is typically associated with high information asymmetries and uncertainties (Aboody and Lev, 2000). In the absence of frequent onsite monitoring, VC firms may lack firsthand information about the startup (Bernstein et al., 2016). Entrepreneurs could misappropriate VCs' investments and shirk job responsibilities (Hsu, 2006; Bell and Zaheer, 2007). Therefore, we propose the following baseline hypothesis:

Baseline hypothesis*: Geographic distance between a startup and its lead VC is negatively related to partnership performance.*

While geographic distance traditionally reduces spatial accessibility between two firms, advanced technology could decouple these two factors. Technology improvements enhance accessibility by functionally bringing distant partners "closer" (Petersen and Rajan, 2002; Morgan, 2004). Although a large geographic distance between partners impedes their ability to transfer knowledge and govern the partnership effectively, spatial accessibility stemming from advanced technology enables them to overcome regional boundaries and more effectively leverage distant partners' complementary resources and capabilities.

In our context, HSR substantially reduces travel time between distant startups and their lead VC firms. Scholars find that transportation technology advancements (e.g., airlines, railways, and shipments) can effectively lower transaction costs between partners (Bernstein et al., 2016; Bernard et al., 2019). Transportation advancements facilitate onsite visits that augment information flows, build relational trust, and enable effective governance. A recent study validates the critical role of face-to-face business meetings in managing partnership relationships and improving firm performance (Cai and Szeidl, 2018). Moreover, the introduction of direct flights facilitates frequent physical visits and in-person information exchange (Bernstein et al., 2016). It allows fine-grained information transfer and effective monitoring between VCs and startups, and thus substantively improves partnership performance.

When HSR connects two distant startup–VC partners, the VC firm could better utilize its location-specific resources by introducing its distant startup to a wider range of customers and markets (Gupta and Sapienza, 1992) or to more diversified suppliers and strategic partners (Lindsey, 2008). Consider the partnership of Sequoia Capital and Jinshi Liangyuan (a matchmaking and dating site based in Jinan, the capital city of Shandong province) as an example. A VC partner in the Beijing branch office of Sequoia Capital commented that with the advent of HSR, "I can travel to the company in an hour and a half, which is even closer than arriving at some companies in Beijing … therefore it's convenient to bring and introduce other business partners (from Beijing) to the venture, and leverage the market and skillsets there…".[2]

To summarize, when travel barriers between two distant partners are reduced, the negative impact of geographic distance on partnership performance can be weakened. Moreover, the mobilization of complementary resources from distant partners generates additional performance gains for the startup–VC partnership. Therefore, we predict that HSR access mitigates the negative impact of geographic distance on startup–VC partnership performance:

Hypothesis 1. *HSR access weakens the negative effect of startup–lead VC geographic distance on partnership performance.*

3.2. Relational view: contingent effects of startup–VC relationship

In the previous section, we argue that improved accessibility stemming from modern transportation advancements may alter the relationship between geographic distance and partnership performance. However, the extent to which technology advancement can weaken the geographic distance effects varies based on partnership heterogeneity. Drawing from the relational view, we identify three key contingencies underlying the heterogeneity of interfirm relationships: *knowledge-sharing effectiveness*, *complementary resources and capabilities*, and *relational governance mechanisms* (Dyer and Singh, 1998; Mesquita et al., 2008). In this section, we theorize how each of these mechanisms shapes the effects of geographic distance and spatial accessibility on partnership performance, and what types of geographically distant partnership may better benefit from transportation technology advancements.

3.2.1. Foreign VC and knowledge-sharing effectiveness

The relational view suggests that partners can generate relational rents by developing effective interfirm knowledge-sharing mechanisms that allow the transfer, recombination, or development of specialized knowledge. Dyer and Singh (1998) posit that compared with codified information, tacit know-how is more likely to generate relational rents and sustainable advantage. Knowledge-sharing effectiveness is critical for partnership performance because it captures the extent to which partners can maximize knowledge-

[2] The quote is from our interview with a fund partner of Sequoia Capital (Beijing branch office) in February 2019.

sharing and learning (Vasudeva and Anand, 2011).

In this regard, foreign VCs play the role of knowledge providers who possess advanced industry expertise and business know-how in promoting successful ventures in the Chinese market (Ahlstrom and Bruton, 2006). Foreign VC firms, and in particular VCs from North America and Western Europe, are often equipped with technological and management experience that would be valuable knowledge sources to startups in emerging economies (Kim and Li, 2014). In addition to technical expertise, foreign VC firms provide useful insights and knowledge of global product markets, allowing startups to exploit larger resource pools. Moreover, foreign VC firms possess more understanding of the overseas exit process and can guide startups to formulate successful exit strategies, especially overseas IPOs (Gu and Lu, 2014).

Although foreign VCs possess valuable experience and know-how, their ability to effectively share knowledge with the local startups is dependent on the incentive alignment between the two (Szulanski et al., 2004). Foreign VC firms have different cultural backgrounds from that of local startups, and these cultural differences create challenges for them in building relationships with domestic startups (Guler and Guillén, 2010b). For example, the cultural barriers between foreign VCs and local startups may create communication challenges, and thus higher costs of screening, negotiating, and monitoring (Chemmanur et al., 2016). Further, foreign and local firms are often rooted in different institutional norms (Hamel, 1991; Dai et al., 2012; Gu and Lu, 2014). They may lack a mutual understanding of implicit and explicit rules, which can impede trust, cause conflicts, and induce moral hazard problems (Guler and Guillén, 2010a; Liu and Maula, 2016).

In the absence of HSR, the communication barrier is likely to loom larger for distant partnerships formed between local startups and foreign VCs than those between local startups and local VCs. Compared with explicit information, tacit know-how is particularly sensitive to geographic distance (Kogut and Zander, 1992; Von Hippel, 1994) because it is mainly communicated through in-person exchanges in which non-verbal cues can be perceived (Nonaka, 1994). A large geographic distance makes it more difficult for these partners to interact for aligning interests and forming effective knowledge-sharing routines (Myles Shaver and Flyer, 2000). Hence, although foreign VCs may have a broad range of knowledge and know-how to offer, geographic distance limits its potential benefits to partnership performance.

In contrast, when HSR becomes accessible, foreign partners can enhance knowledge-sharing effectiveness with domestic startups and the partners can better realize relational rents. Improved accessibility makes frequent onsite visits and face-to-face meetings feasible. Such intimate connections help the partners collect timely firsthand information and solve potential conflicts (Cai and Szeidl, 2018). It increases the foreign VC's ability, willingness, and commitment to share tacit knowledge with local startups (Madhok and Tallman, 1998). Therefore, HSR access is particularly beneficial to local – foreign partners in overcoming geographic barriers, synergistically combining tacit knowledge, and attaining the true partnership potential.

Taken together, we argue that HSR access and partnership formed between a local startup and a foreign lead VC can better mitigate the negative impact of a large geographic distance. Accordingly, we propose the following hypothesis:

Hypothesis 2. *There is a three-way interaction among foreign partnership, HSR access, and geographic distance on the partnership performance, such that the mitigating effect of HSR access on the relationship between geographic distance and partnership performance is stronger when a startup partners with a foreign lead VC.*

3.2.2. *Resource complementarity*

Complementarity between business partners is one of the most significant factors in partnership success (Wang and Zajac, 2007). In its most general form, complementarity exists when two business activities reinforce each other in such a way that increasing the magnitude of one resource generates superior returns from another (Milgrom and Roberts, 1995). Research on the relational view defines partner complementarity as a combination of mutually reinforcing resources or capabilities that enable the partner to create value that it cannot create alone (Dyer and Singh, 1998; Ennen and Richter, 2010). Besides physical assets, complementary know-how accumulated through relevant business activities is crucial to the production and delivery of new products and services (Teece, 1986; Helfat, 1997).

Following prior research, resource complementarity between the startup and the lead VC is likely to occur when they can recombine each other's resource for joint value creation (Fan and Lang, 2000). Specifically, when the VC has accumulated substantive experiences in an industry sector that contributes critical inputs to the focal startup (Vedula and Matusik, 2017), the latter can benefit from leveraging the former's industry-specific resources to reconfigure its mix of products and services and expand its product offerings (Helfat, 1997). VC firm's access to output-related resources, such as marketing and distribution channels, also enables joint value creation by allowing startups to increase market presence and exploiting better customer service options in their relative markets (Henderson and Cockburn, 1996).

Complementarity brings together startup–VC partners with heterogeneous and compatible resources. To leverage complementary resources, partners must have a thorough understanding of each other's input and output repertoire, product offerings, market strategy, and strengths and weaknesses in business operations (Lim et al., 2020). Partners with common frames of reference (Porac et al., 1999), compatible standard procedures (Henderson and Clark, 1990), and effective communication channels (Madhok and Tallman, 1998) will be much more likely to recombine resources and realize the value of complementarity (Chang and Singh, 2000). To do so, startups and their lead VCs need to engage with each other in intensive, ongoing in-person interactions (Chang, 2004). For example, Tao Feng, a successful venture capitalist from Xuanyong Capital, highlighted the complementary resources the VC offers to its portfolio firms[3]: "We started from VC investments in the mining and energy sector, and have accumulated 20 years of industry experience. We expand the investments to the vertical related fields such as solar energy, optical instruments, and medical devices, giving startups better access to customers and partnership opportunities in the related sectors." He also emphasized the importance of personal interactions in transferring complementary resources: "We have fairly strict advising and monitoring system in terms of information on daily operations that goes much beyond the quarterly board meetings. Frequent visits to the company also enable a more productive discussion in terms of changes in business strategies and other initiatives. Those are things that the management team at the entrepreneur's end would welcome, and we would take some collective action."[4]

The ability of a firm to realize complementarity in a partnership depends significantly on whether the partners can combine or reconfigure resources and capabilities in a congruent manner (Capron et al., 1998; Harrison et al., 2001), which is contingent upon flexibility, quick adjustment, and reduction of uncertainty between partners (Tallman and Phene, 2007). Although compatible resource configurations between the startup and the lead VC offer opportunity for joint value creation, they do not guarantee the partners can successfully reconfigure the resources to realize benefits from complementarity (Kim and Finkelsten, 2009). Without HSR, long geographic distance unleashes considerable uncertainty and hinders the partners to exploit each other's resources for mutual gain (Henisz and Delios, 2001). Distant startup–VC partners may find interactions too costly and time-consuming owing to low spatial accessibility. A lack of intimate exchange jeopardizes the synergies of industry specific resources, networks, and human capital (Helfat, 1997). In contrast, when HSR becomes available, VC investors with more complementary resources could actively participate in startups' business activities and generate more relational rents by recognizing the signs of problems at an early stage and by sharing and introducing useful industry contacts and connections to the startups (Stuart et al., 1999; Sorenson and Stuart, 2001). Bo Qu, cofounder and CEO of XinGuang Optoelectronics Technology Co., Ltd., highlighted the crucial role of frequent and in-person exchange in allowing the startup to leverage the complementary resources provided by the lead-VC partner Xuanyong Capital: "We saw that (VCs) visiting a company day-to-day made a real difference. Meeting constantly allows us to know each other better, and combine the investor's strength and guanxi with important customers in related sectors. For example, Tao Feng (the venture capitalist from Xuanyong Capital) introduced us to several big firms in the energy industry. Tao often accompanied these industry contacts and customers to visit our labs. These lead customers expand our market (to the energy sector), and more importantly, the user feedback helps us improve our product design in the early stage.[5]"

Thus, we posit that HSR access and high resource complementarity represent a better combination to mitigate the negative impact of a large geographic distance. Accordingly, we propose the following three-way interaction:

Hypothesis 3. *There is a three-way interaction among resource complementarity, HSR access, and geographic distance on the partnership performance, such that the mitigating effect of HSR access on the relationship between geographic distance and partnership performance is stronger when there is a higher level of resource complementarity between a startup and its lead VC.*

3.2.3. Government VC and relational governance

Governments play an important role in emerging economies. In China, the past 20 years have witnessed a drastic growth of the government-backed VC (Bruton and Ahlstrom, 2003). In 2015, China raised about $231 billion in government venture funds (Shen, 2016), which is the biggest pot of money worldwide for startups. Government VCs in China are often operated as Government Guidance Funds, a matchmaker that aims to attract and bond other VCs to support the portfolio startup (White et al., 2005).

On the one hand, government VCs provide unique advantages to startups. In the emerging economy context, regulations are generally ambiguous and entrepreneurial firms are often discriminated (Peng and Luo, 2000). The relationship with government VCs provides entrepreneurs with access to public equity markets (Wang and Wu, 2020) and expedites favorable policy decisions (Dixit, 1998). Startups may leverage their political relationships to reduce regulatory scrutiny and enhance firm performance (Hillman et al., 2004; Du et al., 2016; Stuart and Wang, 2016).

On the other hand, the governance of the government VC – startup relationship presents unique challenges. Unlike private VCs—which generally raise money from limited partners, are subject to contractual pressures, and are primarily driven by financial goals (Florin, 2005)—government VCs mainly operate with public funds (Lerner, 2009; Alperovych et al., 2015) and are managed by government officials who lack professional skills and industry expertise (White et al., 2005). The compensation structure of government VC firms is not entirely based on management fees and carried interest, but largely determined by the ranks of government officials. Compared to other VCs, government VCs may have rigid organizational structures and insufficient professional skills, constraining their ability to bring value to startups. To address this liability, government VCs tend to co-invest with other VCs that collocate with the startups to leverage the other VCs' expertise and capability.[6] Consider Jiangsu Hi-Tech VC (a VC firm backed by Jiangsu government) as an example. In 2009, it syndicated with Hidea Capital Group (a VC firm based in Tianjin) to co-invest in a mold design and manufacturing company based in Tianjin (i.e., Tianqimo company). However, the co-investment relationships between government VCs and other VC firms increase the governance complexity since their objectives and incentives may not be consistent, and they may follow different organizational structures and operation practices (Pahnke et al., 2015). Therefore, effective governance is crucial for government VCs to manage such complex relationships.

[3] http://capital.people.com.cn/n1/2018/1229/c423643-30496028.html.
[4] The quote is from our interviews with Tao Feng in May 2020.
[5] The quote is from our interviews with Bo Qu in May 2020. XinGuang Optoelectronics, based in Harbin, had its IPO in 2019.
[6] http://www.gov.cn/ztzl/kjfzgh/content_883848.htm.

Effective governance generates relational rents by facilitating knowledge-sharing and the integration of complementary resources (Dyer and Singh, 1998). According to the relational view, informal relational governance mechanisms (e.g., goodwill, trust, and embeddedness) are more effective and less costly means of managing complex exchange relationships than formal governance mechanisms (e.g., contracts) (Uzzi, 1997; Gulati and Nickerson, 2008). The reason is that contracts cannot list all forms of opportunism that may occur during the partnership, and tacit knowledge and complementary resources are often challenging to price. Thus, informal governance mechanisms, such as trust and embeddedness, can reduce the potential costs of coordination and negotiation (Dyer and Singh, 1998; Weber et al., 2016).

We argue that the distinct challenges of the government VC – startup relationships loom large when there is a long geographic distance and low spatial accessibility between the partners, making it arduous for them to build trustful relationships, govern complex interfirm relationships, and obtain desirable partnership performance. First, given the asymmetric power between government partners and entrepreneurial firms, trustful relationships between them are especially critical and vulnerable (Zhu and Chung, 2014). Without frequent interpersonal interactions and constant site visits, startups may find it difficult to coordinate with the government VCs' goals and to adapt to the latter's bureaucratic operational practices. The startups may be concerned about their resources being misappropriated and returns being divided unfairly, thus less committed to the relationship. Therefore, the long distance and the lack of personal interactions impede government VCs from developing informal governance mechanisms and building trustful relationships with startups. Second, government VCs that co-invest with other VCs must expend substantial time and effort to develop trust and other informal governance routines in managing the co-investment relationships given their different goals and operation practices (Adler and Kwon, 2002; Pahnke et al., 2015). These in-person interactions are particularly important in maintaining high-trust relationships (i.e., guanxi) in the Chinese context (Park and Luo, 2000; Burt and Opper, 2020), where many business deals are made at the dinner table, especially for government officials (Chen and Chen, 2004). Put together, the lack of proximity makes it more difficult for government VCs than other lead VCs to govern and maintain their relationships, both with startups and with other VC firms, thus posing a more severe threat to the partnership performance.

However, these challenges can be effectively addressed with the presence of HSR, which allows the advantages of the government VC – startup relationships to be realized and thus significantly improves the partnership performance. HSR helps in reducing the costs of interfirm cooperation and coordination, developing informal governance mechanisms, and integrating firms' nonmarket resources (Peng and Luo, 2000; Marquis and Raynard, 2015). The startup can better leverage the guanxi with the government VCs to grow business, such as ratifying projects, allocating resources and materials, and arranging bank loans and distribution (Park and Luo, 2000). Moreover, with effective informal governance mechanisms, such as trust and embeddedness, the lead government VCs can compensate for their professional incompetency by bridging other VCs' resources and capabilities for the startups, to better utilize their location-specific expertise and add significant value to the partnership (Liu and Wang, 2001). Therefore, we argue that HSR access and the partnership between a local startup and a lead government VC can better mitigate the negative impact of a large geographic distance. Accordingly, we propose the following:

Hypothesis 4. *There is a three-way interaction among partnership with a government VC, HSR access, and geographic distance on the partnership performance, such that the mitigating effect of HSR access on the relationship between geographic distance and partnership performance is stronger when a startup partners with a lead government VC.*

4. Methods

4.1. Research setting

This study exploited the phased introduction of the HSR in China as an exogenous shock to the spatial accessibility between startups and their lead VC investors. HSR is regarded as one of the most significant technological breakthroughs in passenger transportation developed in the second half of the 20th century (Campos and De Rus, 2009). In the 1990s, the average speed of conventional trains in China was less than 60 km/h. The speed was increased several times in the late 1990s and early 2000s but did not exceed 150 km/h. The Ministry of Railway announced an ambitious HSR plan in 2006. Since then, the HSR transportation system has expanded rapidly across China, becoming its dominant means of transportation. For example, the Beijing West – Zhengzhou East HSR service offers an average station-to-station speed of 289 km/h with a journey time of 2 h 24 min for the 693 km trip. The average speed for the Beijing–Shanghai route is 307 km/h, and a 1318 km journey takes just 4 h 18 min.

The Ministry of Railway's criteria for selecting the cities to connect by HSR have not been publicly stated. One possibility is that the Ministry sought to build HSR lines between megacities and the cities that they knew would boom, because introducing such links would maximize their ridership. Another possibility is that HSR lines were built to connect weak cities to help them grow. Prior studies compared several growth indicators between the cities with HSR stops and their adjacent cities have revealed no significant difference between the means for these two groups with respect to the gross domestic product (GDP) growth, wage growth, and distance to the closest megacity (Zheng and Kahn, 2013).

HSR carries twice the volume of the entire domestic airline network, and traffic has grown 28% annually since 2011 (Bullock et al., 2014). HSR has a substantial speed advantage over conventional trains (Chen et al., 2020). Compared to expensive, unreliable air travel—seven of the airports experiencing the most delays worldwide are in China—HSR offers reliability (Bradsher, 2013). It is also cost-effective, often comparable to, or cheaper than, the equivalent air flight or road travel (The Economist, 2017). For example, a World Bank report (Ollivier et al., 2014: 5) posited that Chinese companies were now able to reach tens of millions of customers and other business partners within a few hours of travel on HSR, bringing "a change in the way a lot of companies are doing business". The significant transportation improvements in China enable a more comprehensive understanding of how geographic distance influences business activities. Fig. 1 shows the phased introduction of HSR lines in China from 2007 to 2016.

Traditional studies have tended to examine geographic distance with a static approach. By contrast, this study leveraged a unique research setting and adopted a dynamic approach. Specifically, we incorporated a time-variant indicator for HSR-related transportation improvement between the startup and its lead VC firm. Adopting the quasi-natural experiment approach (e.g., Bernstein et al., 2016; Chen et al., 2020), we examined and compared the effects of geographic distance 1) between startup–VC pairs before and after the intervention (i.e., with and without HSR access), and 2) between startup–VC pairs without intervention throughout the observation time window. This dynamic approach allowed us to capture the possibility of accessibility change triggered by HSR establishment after the partnership was formed, and to unravel the causal mechanisms underlying the relationship between geographic distance and startup–VC partnership performance.

4.2. Data sources and sampling

We tested our hypotheses using data on partnerships between startups and VC firms in China over a 17-year period from 1999 to 2015. The primary data source on startups and their lead first-round VC firms was CVSource, which was further supplemented by Zero2IPO; these are two leading VC data providers that tracked the entire range of VC firms and their investments in China. We used January 1, 1999 as the starting point when VC investment in China started to take off (for a detailed review on China's VC industry, see Ahlstrom et al., 2007), and used 2015 as the closing point for our sampling to eliminate other policy shocks such as the mass entrepreneurship policy introduced in 2015.

For each startup that received VC funding within our observation window, we paired it with the lead VC from the initial financing round. The lead VC was typically the first and most active investor, which played a critical role in the startup's survival and success (Gupta and Sapienza, 1992; Stuart et al., 1999; Zheng and Xia, 2018). We identified the first-round lead VC investor for each startup using two criteria. First, in cases where only one VC firm invested in the startup's first financing round, we considered it the lead VC. Second, in cases where multiple VCs invested in the first round, we treated the firm that invested in the first round and every subsequent round as the lead VC (Sorenson and Stuart, 2008; Zhelyazkov and Gulati, 2016).[7] The final data set contained 12,810 startups that received first-round funding from 2956 VC firms, spanning 331 prefectural cities connected by the inter-city transportation grid.[8]

We collected data on inter-city travel time, which changes on a yearly basis, from public historical timetables for highways, trains, and airlines. China's highway routes and travel information were obtained from the Asian Spatial Information and Analysis Network Data Center (Faber, 2014). HSR data were from quarterly timetables on Smskb, an aggregator of the national railway schedules. Conventional train (slow train) data were collected from the historical hard-copy timetables produced by the government's Ministry of Railways, which were corroborated using government reports and public media sources to verify the date when HSR was introduced in each city dyad. Historical flight travel time were collected from OpenFlights, a tool for mapping global flight routes and calculating related statistics.

HSR has precipitated a significant drop in inter-city travel time since 2009, two years after the HSR system was established. The average travel time across all city dyads decreased from 7.06 h in 1999 to 6.11 h in 2015, as shown in Fig. 2. Of the 331 prefectural cities in our sample, 132 were eventually connected by HSR by the end of 2015.

Our data comprised an unbalanced time-series panel constructed at the startup-year level. For each startup, observations began in the year of the first observed financing round of the startup, which established the startup – lead VC partnership. Observations continued either to the end of our time window or to the year when the startup reached a follow-on funding event. Each startup-year combination was a spell, and the data set was divided into 38,285 spells. The sample was limited to startups who received their first-round investments from the lead VC before HSR (if any) was introduced to connect the two partners.[9] This approach eliminated the influence of HSR on the partnership formation between the startup and the lead VC, and allowed us to use HSR as an exogenous treatment on the effect of geographic distance.

Fig. 3a and b demonstrates the sample distribution (cumulative number over the years). Fig. 3 displays the distribution of VC-backed startups across prefectural cities from 1999 to 2015. As shown in Fig. 3, startups were widely distributed across China, such that over 50% of VC-backed startup firms resided outside of the political/economic centers (i.e., Beijing, Shanghai, and Shenzhen). The cities in which startups were most frequently located included Beijing (3222 startups; 25.15% of all startups), Shanghai (1672 startups; 13.05%), and Shenzhen (1136 startups; 8.86%). Fig. 3b visualizes the geographic distribution of VC firms in China. Among foreign VC firms that invested in Chinese entrepreneurial firms, 88.46% had branch offices in China. To reduce potential noise in the result interpretation, we constrained our sample to foreign VCs that had branch offices in China. As shown in Fig. 3b, VC firms were concentrated in major cities, such as Beijing (684 VCs; 23.14% of all VCs), Shanghai (579 VCs; 19.59%), and Shenzhen (297 VCs; 10.05%). Since it is such a large country, the China context demonstrated sufficient geographic diversity of startups and startup–VC dyads. Figs. A.1 and A.2 in Appendix show substantive variations in the geographic distribution of startup–VC dyads.

[7] In all, 6.4% of startups were not paired with a lead VC. We excluded these firms in our main analysis. We also considered the VC participating in the most subsequent rounds as the lead VC. Results demonstrated similar patterns.

[8] A prefectural city, also known as a prefectural-level municipality, is a formal administrative division in China, ranking above a county and below a province in terms of governance.

[9] 2.7% of startups relocated after receiving their first-round of VC investment. We excluded these firms in our sample.

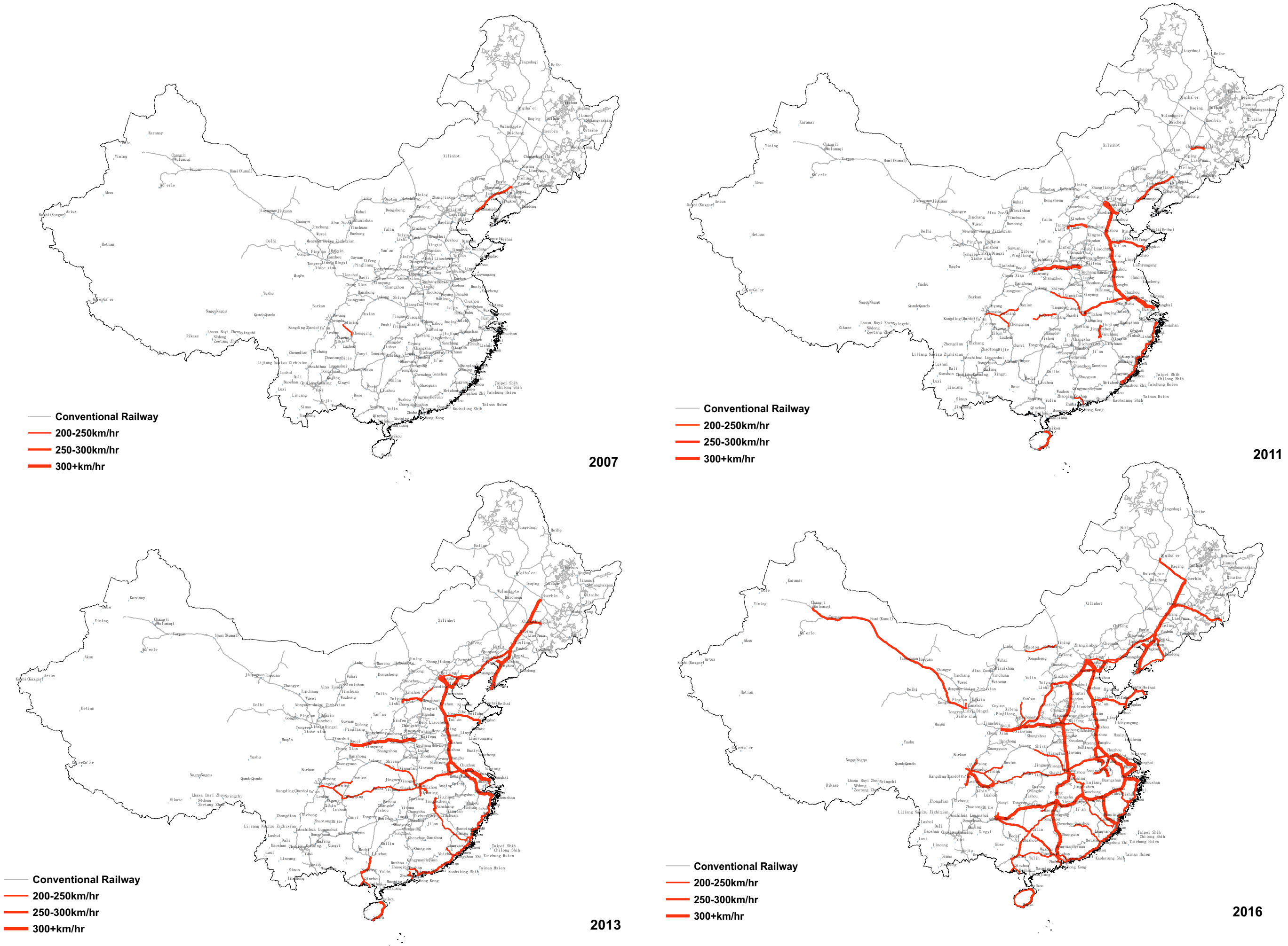


Fig. 1. China HSR network.
Note: this figure shows the Chinese high-speed railway system in 2007, 2011, 2013, and 2016.

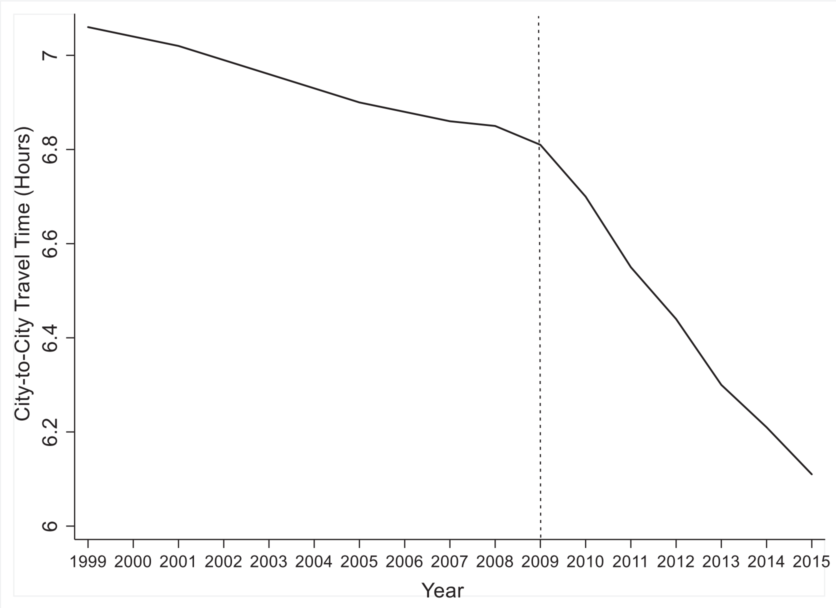


Fig. 2. Prefectural city-dyad average travel time by year.
Note: it shows the average travel time for all city-dyads across China per year. Travel time is calculated at the end of each year.

4.3. Variables

4.3.1. Dependent variable

We measured the startup–VC partnership performance by the focal startup's likelihood of receiving follow-on funding. Given our data setup and the quasi-natural experiment approach used, the success of the first investment round by the lead VC can better reflect the partnership performance of startup – lead VC relationships. Most VC investments were "staged" in the sense that portfolio companies were periodically reevaluated and would receive follow-on funding only if their prospects remained promising (Gompers, 1995). Startups with better performance were more likely to meet the milestones and were hence considered worth refinancing by the VCs (Li, 2008; Shafi et al., 2020). Thus, following previous studies (e.g., Hochberg et al., 2007), we viewed survival to another funding round as a signal of partnership success. We coded *follow-on funding* as 1 if the focal startup received a second-round investment from its lead VC in a given year. Additionally, we tested the robustness of our results with an alternative dependent variable: the occurrence of a successful exit event (i.e., IPO or merger and acquisition (M&A) of the startup). IPO and M&A are commonly used as measures of entrepreneurial success and investment performance (Alvarez-Garrido and Guler, 2018).

4.3.2. Independent variables

Geographic distance captured the physical distance between a startup and its lead VC partner, which was measured as the kilometric distance between the city of the startup and the city of the lead VC investor (in 100 km). For VC firms with multiple offices, we used the distance from the VC's closest office to the startup, because it was likely that the nearest VC employees would be responsible for monitoring and advising the startup.

We constructed *HSR access* to indicate whether and when a new HSR line was introduced and reduced travel time between the startup and the lead VC firm in a given year. Given our focus on how improved accessibility weakens the effects of geographic distance, it is important to consider all alternative travel modes to assess whether HSR, after its introduction, reduced travel time and truly served as a substitute for existing transportation methods. To do so, we compared HSR with other transportation options, such as highways, conventional trains, and airplanes, on an annual basis.[10] When HSR was not established or did not reduce the travel time

[10] To account for time-consuming security checks and remote airport locations, we conservatively augmented flight travel time by 2.5 h. Airplane passengers were required to arrive at airports 2 h in advance, whereas train passengers generally arrived only 30 min before departure. Without considering flight delays and cancellations, 2.5 h was a conservative estimate of additional travel time per flight. For robustness checks, we alternated the augmentations to 1 h, 2 h, and 3 h. Different augmentations of the HSR access variable demonstrate consistent empirical patterns.

between a startup – lead VC pair in the focal year, *HSR access* was coded as 0; when HSR reduced travel time between a startup and its lead VC investor, *HSR access* was coded as 1. This approach allowed us to capture the true accessibility improvement triggered by HSR and eliminate confounding factors, such as HSR construction.[11]

4.3.3. Moderators

We constructed the variable *foreign VC* to indicate the focal VC's country of origin. The rationale was that while foreign VCs possess valuable know-how, they face higher level of knowledge-sharing barriers, given that their cultural background differs from that of their local partners and that they lack knowledge of the local context. *Foreign VC* was coded as 1 for firms registered or headquartered abroad and 0 for those registered in China. Subsidiaries of foreign VC firms operating in China were also considered foreign firms. Furthermore, we constructed *institutional distance* between the VC's home countries and host country (i.e., China), and replaced it with *foreign VC* for a robustness check. We constructed the institutional distance index based on the eight sub-dimensions, including economic, financial, political, administrative, cultural, demographic, knowledge, and global connectedness differences developed by Berry et al. (2010), which measured the difference scores between country dyads using the Mahalanobis method. Following their approach, we calculated institutional distance as the average value of the above eight indicators between the origin country of a VC firm and China. Institutional distance was coded as 0 for local startup–VC partners.

Prior research has assessed complementarity between two firms by examining the degree to which they can share input and/or output resources (Henderson and Cockburn, 1996; Helfat, 1997). When the two firms have higher correlations in their inputs and/or outputs, they are more likely to have complementary resources and are able to jointly create and deliver products and services (Teece, 1986). To measure resource complementarity between a startup and its lead VC partner, we first identified the industry in which each lead VC primarily invested based on the accumulated VC deals. We then adopted the variable *resource complementarity* developed by Fan and Lang (2000), which captured the degree to which the startup's industry and the lead VC's focused industry can jointly create value by recombining their resources. This measurement is calculated based on the average of the input- and output-flow correlations between the two industries, and has been widely adopted by researchers studying industry resource complementarity (e.g., Villalonga, 2004; Kale and Shahrur, 2007). *Resource complementarity* was a continuous variable ranging from 0 to 1. In our context, a lead VC and its paired startup have a higher level of complementarity when they are able to deploy resources more efficiently by jointly sourcing inputs (e.g., human capital or physical assets) or sharing outputs (e.g., marketing and distribution activities). For example, a lead VC that specializes in publishing industry and a startup that is in the filmed entertainment industry demonstrate a higher level of resource complementarity (equals 0.231); while a lead VC that focuses on publishing industry and a startup that is in the cable network industry are considered to have a lower level of resource complementarity (equals 0.052). The variable equals 1 if the focused industries of the lead VC and the startup are identical.

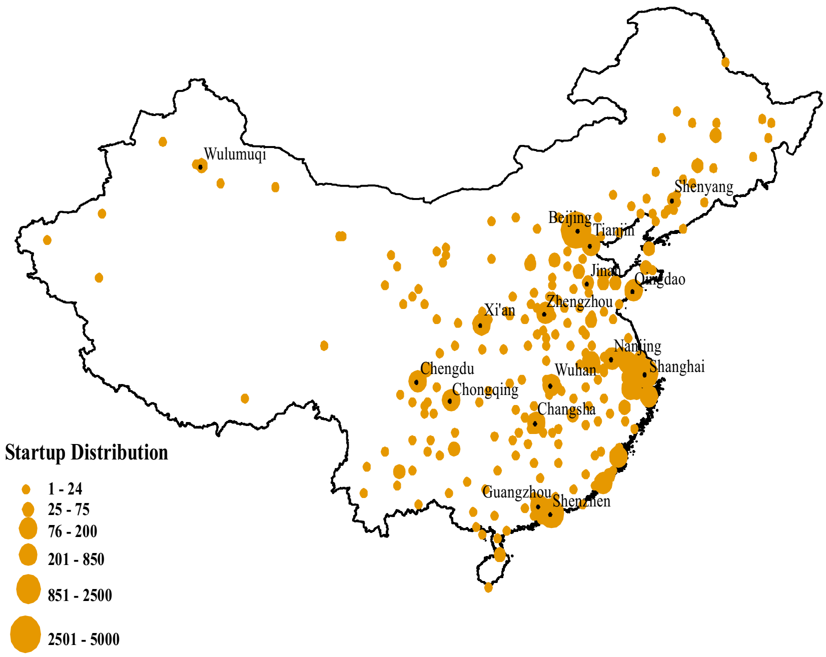
To capture the governance complexity of the startup–VC relationship, we constructed the variable *government VC*, which was an indicator variable equal to 1 if the lead VC firm was owned by the central or local governments in China. Since government VCs typically invite other VCs to co-invest focal startups and these VCs tend to differ in objectives and incentives (Pahnke et al., 2015), the governance of government VC – startup partnership was more complex than that of other VC–startup partnerships.

4.3.4. Control variables

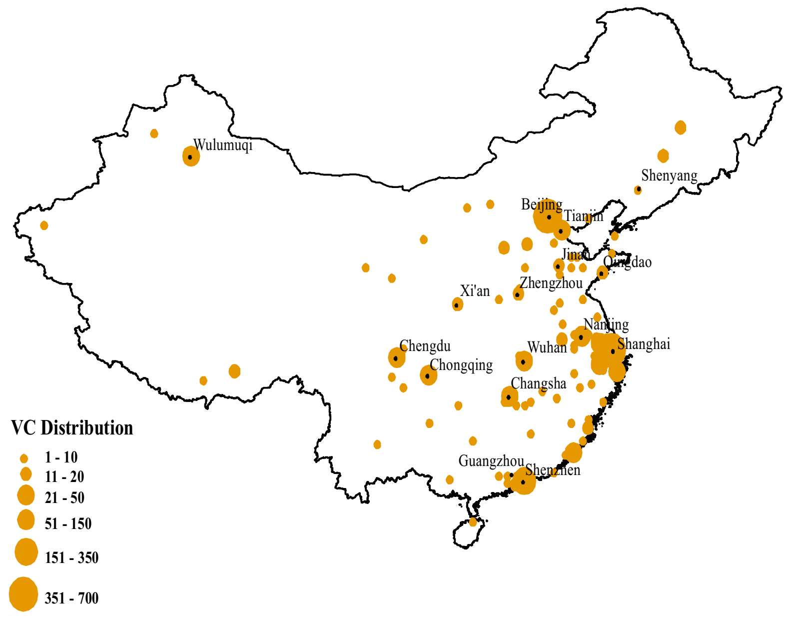
We controlled for the characteristics of the startup and the VC firm that are important for partnership performance. First, we controlled for the *development stage* of the startup based on the information from the databases of CVSource and Zero2IPO which classified the development stage of the startup into four main categories: seed, growth, expansion, and mature stages. It was coded 1 for the seed stage, in which the startup typically operates under unproven business models or in underdeveloped markets; 2 for the growth stage, in which the startup gradually establishes organizational routines, policies, and procedures with some promising prospects in product development; 3 for the expansion stage, in which the startup gains more predictable market growth, cash flow and profitability; and 4 for the mature stage, in which the startup exceeds its capacity-building phase and consistently generates cash from their operations. In addition, entrepreneurial opportunities and business operation activities varied significantly across industry segments. To account for the industry effects of the startup, we added 3-digit Standard Industrial Classification (SIC) segment dummies in the regression models.

We included a set of variables related to the lead VC and its syndicate investors. We created *proportion of successful startups* to account for the capability and quality of the lead VC firm. It was measured by the lead VC's cumulative number of startups with successful exits (i.e., IPO or M&A), divided by the cumulative number of startups in its portfolio since its founding (Gaba and Dokko, 2016). We controlled for *VC experience*, which was measured as the annual cumulative number of startups that the lead VC firm has invested (with natural logarithm transformation). Moreover, we controlled for a lead VC firm's experience to manage distant investment relationships. We constructed *VC distant investment* with the median value of geographic distance between a lead VC and all the startups that it has invested prior to the focal year. Although we focused on the startup – lead VC partnership, other VC firms that followed the lead VC to invest in the same startup may also have affected the probability of follow-on funding. Hence, we constructed

[11] We used the dummy variable to capture HSR access, which better aligns with our arguments to compare the effects of geographic distance between startup–VC pairs before and after the intervention (i.e., with and without HSR access). The dichotomized variable is also easier to interpret for the interaction effects. To capture the extent to which HSR improved the accessibility between startup–VC partners, we ran a robustness check using a continuous variable measured as the difference in travel time (in hours) with HSR vs. without HSR. It demonstrates consistent empirical patterns as presented in the Appendix.



a. VC-backed Startups Geographic Distribution.



b. VCs Geographic Distribution.

Fig. 3. **a**. VC-backed startups geographic distribution.
b. VCs geographic distribution.
Note: selected well-known cities are labeled.

no. investors, which was the total number of VCs that invested in the focal startup (Li and Chi, 2013). In addition to the number of syndicated VC firms, we controlled for *syndicate management funds*, which was the aggregated capital under management by all the other syndicated VC firms.

Table 1
Summary statistics and correlations matrix.

	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Development stage	1.65	0.82														
2. Proportion of successful startups	0.33	0.40	−0.04													
3. GDP per capita	8.16	5.23	−0.05	0.05												
4. Syndicate management funds	14.05	20.16	0.16	0.10	0.07											
5. Local exit condition	0.12	0.34	0.12	−0.02	0.21	0.06										
6. No. Investors	1.27	0.82	0.13	0.05	0.01	0.39	0.01									
7. Foreign VC	0.28	0.45	−0.04	0.04	0.05	0.28	0.03	0.05								
8. VC distant investment	8.96	4.27	−0.02	−0.01	0.03	0.06	0.05	0.10	−0.03							
9. Resource complementarity	0.43	0.18	0.01	0.03	0.01	0.02	0.03	0.02	0.04	0.03						
10. Government VC	0.11	0.25	−0.04	0.01	0.09	0.08	0.01	0.15	0.08	−0.14	0.01					
11. Geographic distance	7.13	2.07	−0.01	0.06	0.07	−0.03	−0.18	−0.02	0.03	0.09	0.02	−0.13				
12. VC experience	17.74	14.11	−0.05	0.17	0.14	0.09	0.02	0.08	0.22	0.03	0.08	−0.09	−0.01			
13. Local startup density	12.54	21.31	0.01	0.01	0.25	0.06	0.14	0.004	0.08	−0.01	0.01	0.004	−0.07	0.06		
14. HSR access	0.11	0.30	−0.09	0.02	0.23	0.05	0.10	0.004	0.03	0.04	0.007	−0.07	−0.12	0.10	0.11	
15. Follow-on funding	0.14	0.37	0.07	0.02	0.02	0.07	0.06	0.08	0.07	0.05	0.06	0.002	−0.03	0.15	0.06	0.13

Note: $N = 38,285$ observations.

We further controlled for the potential environmental effects on the likelihood of follow-on funding. First, to account for the influence of the local resources, we calculated the average *GDP* per capita of the cities of the startup and the lead VC firm in a given year. We constructed *local exit condition* to assess whether the startup was in an industry that enjoyed a hot IPO or M&A market in a given year. It was measured as the number of successful exit events (IPOs and M&As) in the same 3-digit industry and prefectural city as the startup (with natural logarithm transformation) (Sorenson and Stuart, 2008). To account for competition and operating conditions, we included *local startup density* measured as the natural logarithm of the number of other startups in the same 3-digit industry and

Table 2
Cox proportional hazards models predicting a follow-on funding event.

DV: follow-on funding		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Syndicate management funds		0.040+	0.038+	0.034	0.027	0.035	0.022
		(0.021)	(0.021)	(0.022)	(0.020)	(0.024)	(0.023)
No. investors		0.229***	0.231***	0.236***	0.258***	0.233***	0.220***
		(0.053)	(0.053)	(0.051)	(0.056)	(0.052)	(0.053)
GDP per capita		0.261*	0.264*	0.266*	0.207+	0.247*	0.213+
		(0.113)	(0.116)	(0.116)	(0.119)	(0.115)	(0.120)
Local exit condition		0.355*	0.374*	0.329*	0.333*	0.352*	0.311*
		(0.165)	(0.146)	(0.162)	(0.165)	(0.173)	(0.170)
Development stage		−0.091+	−0.078	−0.073	−0.138	−0.058	−0.155
		(0.054)	(0.120)	(0.121)	(0.110)	(0.124)	(0.171)
Local startup density		−0.076	−0.072	−0.075	−0.086	−0.073	−0.083
		(0.094)	(0.091)	(0.095)	(0.097)	(0.096)	(0.099)
Proportion of successful startups		0.059*	0.057*	0.067+	0.049+	0.057	0.044
		(0.024)	(0.024)	(0.036)	(0.026)	(0.037)	(0.032)
VC distant investment		0.103+	0.101+	0.069	0.072	0.063	0.081
		(0.053)	(0.054)	(0.055)	(0.055)	(0.052)	(0.055)
VC experience		0.365**	0.327**	0.311**	0.280**	0.244*	0.203*
		(0.112)	(0.108)	(0.107)	(0.102)	(0.103)	(0.102)
Geographic distance	Baseline	−0.226**	−0.152**	−0.104*	−0.078*	−0.085*	−0.080*
		(0.069)	(0.052)	(0.042)	(0.031)	(0.034)	(0.039)
HSR access		0.455***	0.419***	0.354***	0.358**	0.310**	0.276*
		(0.094)	(0.094)	(0.095)	(0.135)	(0.102)	(0.111)
Foreign VC		0.170**	0.166**	0.118*	0.201*	0.088**	0.148*
		(0.063)	(0.063)	(0.047)	(0.093)	(0.034)	(0.069)
Resource complementarity		0.110*	0.108*	0.106*	0.073+	0.104*	0.083+
		(0.051)	(0.050)	(0.050)	(0.042)	(0.050)	(0.045)
Government VC		0.113*	0.108*	0.110*	0.104+	0.095+	0.076
		(0.052)	(0.051)	(0.054)	(0.056)	(0.057)	(0.060)
Geographic distance × HSR access	H1		0.188***	0.133*	0.147**	0.116*	0.120+
			(0.054)	(0.052)	(0.055)	(0.054)	(0.065)
Geographic distance × foreign VC				−0.141*			−0.105*
				(0.070)			(0.047)
HSR access × foreign VC				0.256*			0.398+
				(0.104)			(0.210)
Geographic distance × HSR access × foreign VC	H2			0.222*			0.219*
				(0.091)			(0.090)
Geographic distance × resource complementarity					−0.083+		−0.071
					(0.048)		(0.059)
HSR access × resource complementarity					0.139*		0.125+
					(0.063)		(0.074)
Geographic distance × HSR access × resource complementarity	H3				0.125*		0.111*
					(0.058)		(0.052)
Geographic distance × government VC						−0.264*	−0.210+
						(0.103)	(0.114)
HSR access × government VC						0.112+	0.105
						(0.065)	(0.066)
Geographic distance × HSR access × government VC	H4					0.277*	0.241+
						(0.120)	(0.135)
Startup industry fixed effect		Yes	Yes	Yes	Yes	Yes	Yes
Startup–VC city-dyads fixed effect		Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effect		Yes	Yes	Yes	Yes	Yes	Yes
N(VC-backed-startup-year)		38,285	38,285	38,285	38,285	38,285	38,285
Log likelihood		−847.63	−820.34	−782.02	−786.34	−788.89	−763.21
AIC		5437.26	5384.68	5314.04	5322.68	5327.78	5278.42
BIC		21,439.57	21,395.55	21,350.56	21,359.21	21,364.30	21,346.26

Note: two-tailed tests. Robust standard errors appear in parentheses.
+ $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

prefectural city as the focal startup in a given year (Stuart and Sorenson, 2003). All control variables were lagged by one year. Finally, we controlled for year fixed effects to account for time effects and included dummies for startup–VC city dyads to control for local factors related to startups–VC partners.

4.4. Model specification

The nature of the dependent variable required a survival analysis. Hazard models were designed to study longitudinal data on the occurrence and timing of events, such as the follow-on funding, in our data set (Cox, 1972; Cameron and Trivedi, 2005; Alvarez-Garrido and Guler, 2018). We adopted Cox regression models using a semi-parametric technique that imposed few assumptions on the shape of the underlying hazard. We clustered robust standard errors at the startup level; clustering at the VC level maintained a consistent empirical pattern.

5. Results

Table 1 shows the correlation matrix and descriptive statistics for the variables used in this study. To facilitate interpretation, variable means and standard deviations are calculated based on the raw data (i.e., without natural logarithm transformation). Table 1 shows that out of 38,285 startup-year spells, 7465 spells had HSR access to the lead VC partner. The variance inflation factor (VIF) test demonstrates that all VIF values are below 3.37, with an average of 1.45. These are considerably below the acceptable upper bound of 10 (Kleinbaum et al., 1988), indicating that multicollinearity is not a problem in the regression analysis.

Table 2 shows the Cox regression on the hazard of a follow-on funding event. Our baseline hypothesis suggests that geographic distance decreases the likelihood of a follow-on funding event. Model 1 in Table 2 includes control variables and the independent variables. The coefficients (log hazard) are interpreted in terms of the hazard ratio (e^{β}), which yields the estimated change in the likelihood of follow-on funding for a one-unit change in the covariate. In Model 1, *geographic distance* is negatively related to the likelihood of follow-on funding ($b = -0.226$, $p = 0.001$), supporting the baseline hypothesis. It indicates that when the geographic distance between a startup and its lead VC increases by 100 km, the hazard of receiving follow-on funding decreases by 20.2%. *HSR access* is positively related to the likelihood of a follow-on funding event ($b = 0.455$, $p = 0.000$), suggesting a 57.6% increase in the hazard of receiving a follow-on funding relative to the introduction of HSR. *Foreign VC* is positively related to the likelihood of a follow-on funding event ($b = 0.170$, $p = 0.007$), which indicates an 18.5% increase in the hazard of receiving a follow-on funding for a foreign lead VC partner. *Resource complementarity* is also positively related to the likelihood of a follow-on funding event ($b = 0.110$, $p = 0.031$). It indicates that when resource complementarity between the startup–VC partners increases by one unit, the hazard of receiving follow-on funding increases by 11.6%. *Government VC* is positively related to the likelihood of a follow-on funding event ($b = 0.113$, $p = 0.030$), which indicates a 12.0% increase in the hazard of receiving a follow-on funding for a government VC lead partner.

Hypothesis 1 argues for the influence of HSR access on the effect of geographic distance. In Model 2, the interaction term of *geographic distance* and *HSR access* is positive and significant ($b = 0.188$, $p = 0.000$), suggesting that HSR access relieves the negative effect of geographic distance on partnership performance. Fig. 4 shows the multiplier of the hazard rate, which provides the marginal effects on one standard deviation below and above the mean of geographic distance (Li and Chi, 2013; Alvarez-Garrido and Guler, 2018). Notably, line 1 demonstrates a negative effect of geographic distance on the multiplier of hazard that receives follow-on funding in the absence of HSR. However, when HSR becomes available, the effect of geographic distance on follow-on funding becomes positive as depicted in line 2. These findings confirm our predictions that the negative effect of geographic distance is significantly

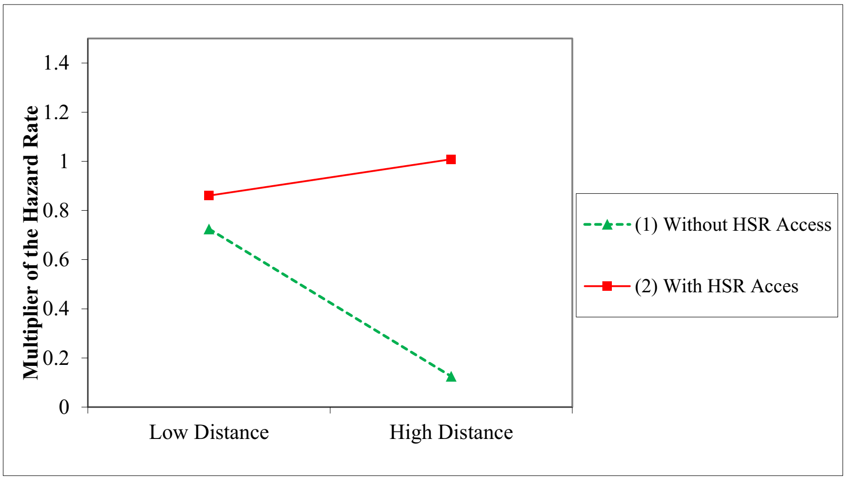


Fig. 4. Interaction effects of geographic distance and HSR access.
Note: the figure is based on point estimates in Model 2 of Table 2. The vertical axis represents the hazard multiplier, the horizontal axis represents one standard deviation below and above the mean of geographic distance between partners.

weakened with the help of HSR.

Models 3–6 in Table 2 report the estimation results of the Cox model that examines how the contingencies we theorized shape partnership performance. Models 3, 4 and 5 in Table 2 test the hypotheses about the contingency effect of foreign VC, resource complementarity, and government VC, respectively. Model 6 in Table 2 is the full model. Consistent with Hypothesis 2, the coefficient for the three-way interaction among *geographic distance*, *HSR access*, and *foreign VC* is positive and significant (Model 3, $b = 0.222$, $p = 0.015$). Fig. 5 visualizes this 3-way interaction effect. To interpret the three-way interaction figure, Table A.1 in Appendix demonstrates the slope difference results (Aiken and West, 1991). It shows that the difference in slopes between 1 and 2 (i.e., with/without HSR access on geographic distance for foreign VCs) is statistically significant. The difference in slopes between 3 and 4 (i.e., with/without HSR access on geographic distance for local VCs) is also significant. Notably, the *t*-test difference between slopes 1 and 2 is the largest among all pairs. Moreover, the multiplier of hazard that receives follow-on funding is highest when foreign lead VCs connect to distant startup partners with HSR access (slope 1). Taken together, the findings support our argument that although HSR access can generally mitigate the negative effect of geographic distance on the follow-on funding, such a mitigating effect becomes more pronounced for startups with a foreign lead VC.

In Model 4 of Table 2, the coefficient for the three-way interaction among *geographic distance*, *HSR access*, and *resource complementarity* is positive and significant (Model 4, $b = 0.125$, $p = 0.031$). Fig. 6 visualizes this 3-way interaction effect. To interpret the three-way interaction figure, Table A.2 in Appendix demonstrates the slope difference results. It shows that the difference in slopes between 1 and 2 (i.e., with/without HSR access on geographic distance for startup–VC partners with higher level of resource complementarity) is statistically significant. The difference in slopes between 3 and 4 (i.e., with/without HSR access on geographic distance for startup–VC partners with lower level of resource complementarity) is marginally significant. Notably, the t-test difference between slopes 1 and 2 is the largest among all pairs. Moreover, the multiplier of hazard that receives follow-on funding is highest when distant startup–VC partners with higher level of complementarity are connected by HSR (slope 1). Taken together, although HSR access can generally mitigate the negative effect of geographic distance on the follow-on funding, such mitigating effect becomes more pronounced for startup–VC partners with higher level of resource complementarity.

In Model 5 of Table 2, the coefficient for the three-way interaction among *geographic distance*, *HSR access*, and *government VC* is positive and significant (Model 5, $b = 0.277$, $p = 0.021$). Fig. 7 visualizes this 3-way interaction effect. To interpret the three-way interaction figure, Table A.3 in Appendix demonstrates the slope difference results. It shows that the difference in slopes between 1 and 2 (i.e., with/without HSR access on geographic distance for government lead VCs) is statistically significant. However, the difference in slopes between 3 and 4 (i.e., with/without HSR access on geographic distance for non-government lead VCs) is marginally significant. Notably, the t-test difference between slopes 1 and 2 is the largest among all pairs. Moreover, the multiplier of hazard that receives follow-on funding is highest when government lead VCs connect to distant startup partners with HSR (slope 1). Taken together, although HSR access can generally mitigate the negative effect of geographic distance on the follow-on funding, such a mitigating effect becomes more pronounced for startups with a government lead VC.

6. Robustness checks

We conducted several sets of sensitivity analyses to check the robustness of our results. First, we considered alternative model specifications. Following prior research, we adopted a piecewise exponential specification to study event hazards (Guler and Guillén, 2010a; Vedula and Matusik, 2017). Moreover, we ran models using a competing risk specification, in which we considered the possibility that VC firms might stop investing (i.e., business failure or closure) during the observation window (Rider and Swaminathan, 2012).

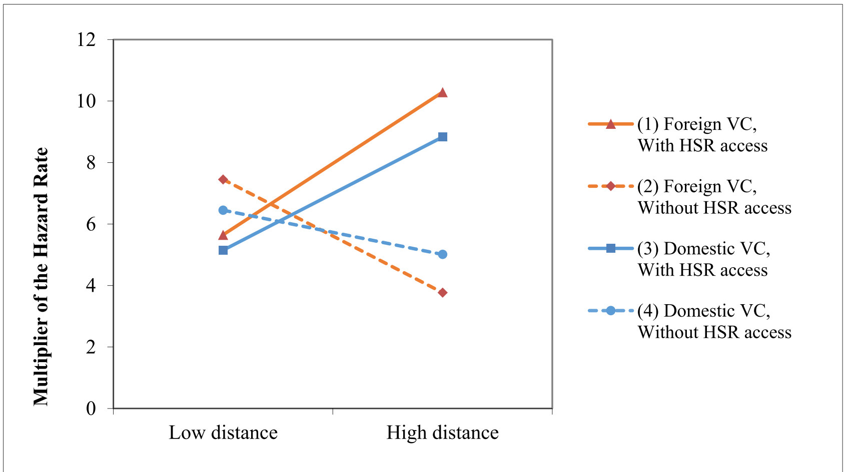


Fig. 5. Joint effect of geographic distance, HSR access, and foreign VC firms.
Note: the figure is based on point estimates in Model 3 of Table 2. The vertical axis represents the hazard multiplier, the horizontal axis represents one standard deviation below and above the mean of geographic distance between partners.

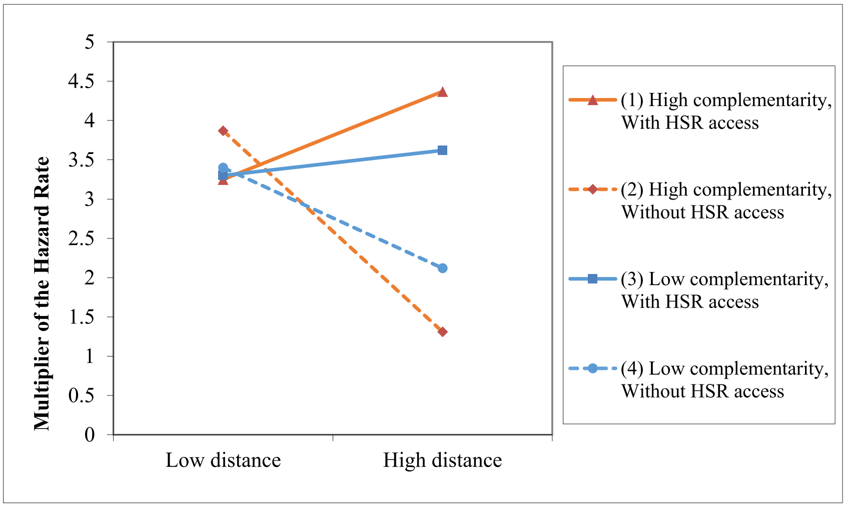


Fig. 6. Joint effect of geographic distance, HSR access, and resource complementarity.
Note: the figure is based on point estimates in Model 4 of Table 2. The vertical axis represents the hazard multiplier, the horizontal axis represents one standard deviation below and above the mean of geographic distance between partners.

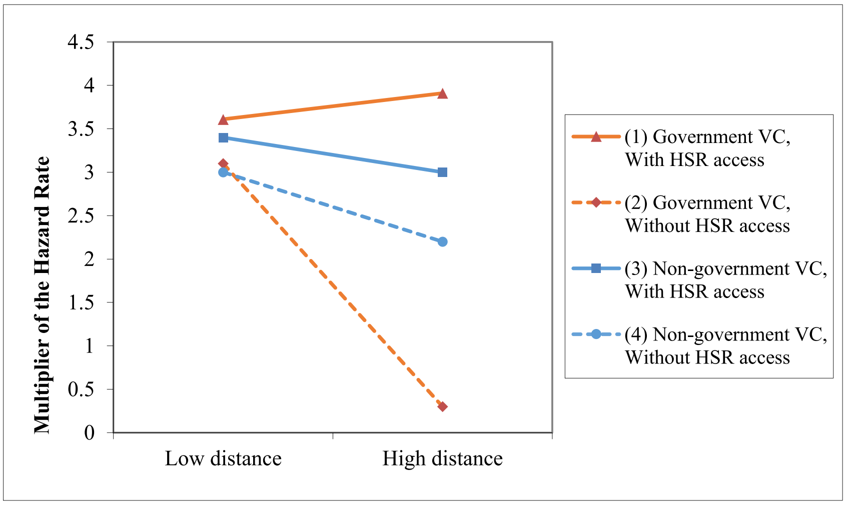


Fig. 7. Joint effect of geographic distance, HSR access, and government VC.
Note: the figure is based on point estimates in Model 5 of Table 2. The vertical axis represents the hazard multiplier, the horizontal axis represents one standard deviation below and above the mean of geographic distance between partners.

Second, we built alternative key variables to test the robustness of our main regressions, adopting different criteria of startup success. Following prior studies, we considered a successful exit event (IPO or M&A) as a measure of entrepreneurial success and investment performance (Alvarez-Garrido and Guler, 2018). Next, to capture the extent of HSR access, we ran a robustness check replacing *HSR access* (a dummy variable) with the *travel time reduction* (a continuous variable). When *HSR access* was treated as 1, *travel time reduction* was measured as the difference in travel time (in hours) with HSR vs. without HSR between the two cities where the startup and the lead VC firm locates, considering the fastest transportation means. To further test the robustness of our operation of HSR access variable, we considered an alternative measure by augmenting the flight travel time by 1 h. Furthermore, in consideration of the heterogeneity of foreign VCs' country origins, we ran a robustness check by replacing the dummy foreign VC variable with the institutional distance between the country origin of a foreign VC and China. As shown in the Appendix, we find consistent results for all the above robustness checks.

Third, to compare the effects of geographic distance with and without HSR access, we present the subsample analysis in Table 3. Model 1 in Table 3 demonstrates the Cox model estimation results of the subsample without HSR access: The coefficient estimate for the *geographic distance* is negative and significant (Model 1, $b = -0.197$, $p = 0.000$). It indicates that without HSR, when the geographic distance between a startup and its lead VC firm increases by 100 km, the hazard of receiving follow-on funding decreases by 17.88%.

Model 2 in Table 3 presents the estimation results of the subsample with HSR access: The coefficient estimate for *geographic distance* is positive and significant (Model 2, $b = 0.136$, $p = 0.002$). In the presence of HSR access, when the geographic distance between a startup and its lead VC firm increases by 100 km, the expected hazard of receiving follow-on funding increases by 14.57%. Taken together, these results indicate that with the help of HSR, not only would the negative impact of long distance become insignificant, but also the long distance may eventually turn to a contributor for the partnership performance.

Fourth, we present several subsample analyses to facilitate the interpretation of our results and rule out alternative explanations. It is possible that HSR is more feasible and relevant for adjacent startup–VC partners. Thus, we ran a robustness check of a subsample that only included startup–VC pairs with 1 to 6 h of travel time. Further, although our sample indicates that startup firms have a wide geographic distribution across the nation, some major cities are the hot spots for startups. To address this concern, we conducted a sensitivity analysis by excluding startups in Beijing, Shanghai, and Shenzhen. Moreover, startups in the internet, information, and software application industries tend to attract more VC investments in China, accounting for 28.1% of the total startups in our sample. To rule out the possibility that our main effect is inflated by the successful entrepreneurial activities in this industry, we ran a robustness check by excluding the internet information and software application segments. Further, regional competition may affect the role of government VC firms and thus partnership performance. To account for this alternative explanation, we split the sample based on the mean level of local startup density, and examined whether the effects of government VC remain robust in the subsamples. In addition, when the lead VC syndicates with other VC firms, the syndicate partners may influence the startup – lead VC partnership performance. While we controlled for the quantity and quality of syndicate partners in the main analysis, we further conducted a sensitivity check using a subsample in which the lead VC invested with syndicate partners. We added a control variable *geographic distance to local partner VC*, which captured the geographic distance from the startup to its closest VC partner. Consistent with the general argument on geographic distance, the control variable *geographic distance to local partner VC* is negatively related to startup–VC partnership performance. All the above sensitivity tests remain consistent with our arguments and predictions, which can be found in the Appendix.

Table 3
Subsamples of startup–VC partners with vs. without HSR access.

		Model 1	Model 2
		Without HSR access	With HSR access
Geographic distance	H1	−0.197***	0.136**
		(0.044)	(0.043)
Syndicate management funds		0.105+	0.042
		(0.059)	(0.034)
No. investors		−0.158	0.326*
		(0.132)	(0.166)
GDP per capita		0.019***	0.129*
		(0.005)	(0.063)
Local exit condition		0.325*	0.069**
		(0.136)	(0.024)
Development stage		−0.016	−0.118
		(0.028)	(0.126)
Local startup density		0.049*	0.010
		(0.023)	(0.008)
Proportion of successful startups		0.277***	0.362***
		(0.051)	(0.083)
VC distant investment		0.106+	0.059*
		(0.059)	(0.028)
VC experience		0.144*	0.289**
		(0.062)	(0.105)
Foreign VC		0.237	0.279*
		(0.202)	(0.133)
Resource complementarity		0.077*	0.136**
		(0.037)	(0.051)
Government VC		0.130+	0.111*
		(0.071)	(0.054)
Startup industry fixed effect		Yes	Yes
Startup–VC city-dyads fixed effect		Yes	Yes
Year fixed effect		Yes	Yes
N (VC-backed-startup-year)		30,820	7465
Log likelihood		−942.51	−799.13
AIC		5605.02	5318.26
BIC		21,109.83	18,185.71

Note: two-tailed tests. Robust standard errors appear in parentheses.
+ $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

7. Conclusion and discussion

Geographic distance has been recognized as a critical determinant that shapes entrepreneurial activities and VC investments (Gupta and Sapienza, 1992; Cumming and Dai, 2010; Vedula and Matusik, 2017; Colombo et al., 2019). This study exploits the phased introduction of the Chinese HSR to unravel the dynamic effect of geographic distance on startup–VC partnership performance, relaxing the assumption that geographic distance is static and technology is unchanged during the partnership development process.

One interesting finding is that when HSR connects formerly distant startup–VC partners, the effect of geographic distance on partnership performance changes from negative to positive. While it is widely documented that geographic distance imposes relational barriers between startup–VC partners, technology advancements (e.g., HSR) can turn the disadvantages of long geographic distance around by allowing startups and VCs to expand their geographic scope and better leverage the know-how and complementary resources of distant partners. These findings challenge the dominant assumption that the effect of geographic distance is static during the course of a startup–VC partnership, and enhance our understanding of the role of geographic distance in interfirm relationships (Kono et al., 1998; Guler and Guillén, 2010a; Vedula and Matusik, 2017). Our findings also suggest that in emerging economies with rapid infrastructure and technology development, it is essential to adopt a dynamic approach to account for the possibility of technology improvement after the startup–VC partnership formation. With our emphasis on the unique role of transportation technology advancements in emerging economies, we broaden the scope of the entrepreneurship literature, which has mainly focused on developed economies to study geographic distance (e.g., Stuart and Sorenson, 2003; Lutz et al., 2013; Ter Wal et al., 2016).

This study also makes several contributions to the literature on the relational view and on entrepreneurial partnership. The relational view literature has argued that interfirm relationships are sources of superior performance and has proposed several mechanisms that create relational rents for business partners (e.g., knowledge-sharing effectiveness, complementary resources and capabilities, and relational governance mechanisms) (Dyer and Singh, 1998; Dyer et al., 2018). A few studies have tested these mechanisms in the context of buyer–supplier relationships in the automotive industry (Mesquita et al., 2008). However, prior studies have rarely systemically examined whether and how these three mechanisms affect the relationships between entrepreneurial firms and their partners (Weber et al., 2016). Thus, our study is among the first to empirically test the three underlying mechanisms in the entrepreneurship field by considering different types of startup–VC partners. Drawing on the relational view, we examine how partnership-specific contingencies influence the dynamic effect of geographic distance on startup–VC partnership performance. Our study enriches the relational view and provides valuable insights for understanding the startup–VC relationship.

Specifically, our findings provide theoretical and practical implications for both startups and VC firms. Given that entrepreneurship is inherently risky, the partnership formed between a startup and its lead VC is commonly characterized by high outcome variability (Mason and Harrison, 2002; Gulati and Higgins, 2003). Our findings suggest several mechanisms that help mitigate the challenges and enhance the chance of startup–VC partnership success. Given that it takes time for foreign VCs to accumulate local experience to overcome knowledge-sharing disadvantages (Guler and Guillén, 2010b; Dai et al., 2012), an easier, more feasible approach is to locate in cities that are either geographically closer or more accessible to startups, because it will allow foreign VCs to conduct frequent face-to-face meetings and facilitate knowledge-sharing in their relationship with local startups. Our results imply that using modern technology is a possible solution to overcome the liability of foreignness for foreign VCs, which is especially important and relevant given the current challenges of global pandemic. It warrants future research to explore how various modern technology, such as video conferencing and global virtual teams (Montoya-Weiss et al., 2001; Shaheer and Li, 2020), can help multinational enterprises to overcome liability of foreignness and achieve success in a world of turmoil.

Second, prior studies have discussed the impact of industry resource complementarity and information flows within the geographic and the industry spaces of VC investments (Sorenson and Stuart, 2001). Our results suggest that accessibility is particularly important for partners with a higher level of resource complementarity because these partners are especially sensitive to geographic distance given the increased difficulties in understanding and leveraging each other's resource repertoire. Our study focuses on the role of HSR in enhancing the benefits of complementary resources for startup–VC partnerships, such as human capital and industry network resources (Davila et al., 2003; Weber et al., 2016). It is worthwhile for future research to explore the impact of resource complementarity on other types of entrepreneurial partnerships.

Although the past decades have witnessed a rising trend of government-backed VC funds to foster entrepreneurial activity in emerging economies, little attention has been paid to the performance implications of government VC investments (Ahlstrom and Bruton, 2006). In emerging economies, government VCs often face higher governance and coordination costs in managing the complex relationships with startups and other VCs (Bruton and Ahlstrom, 2003). Government involvement often has mixed implications for entrepreneurial outcomes (Lerner, 2009; Brander et al., 2015). Our findings suggest that although government VCs have unique advantages in providing financial capital and policy support for startups in emerging economies, their facilitating role is largely geographically bounded unless technology advancement improves the accessibility and governance effectiveness with their partners. Given the massive, growing size of VC investments in emerging economies, the findings call for greater attention to be paid to government VCs and the way their unique governance structures bring value to startups. The findings also add to the ongoing debate on the implications of political ties and government involvement in innovation and entrepreneurial outputs (Zhou, 2013).

We acknowledge several limitations in this study that may provide avenues for future research. First, the HSR introduction could have great impacts on the macroeconomic environment. As the literature shows, transportation improvement can induce the agglomeration of labor, capital, and other resources to big cities (Duranton et al., 2014), which in turn may attract more startups and VCs. We took several steps to improve the research design and better identify the influence of the variables of interest. For example, the sample only consists of startup–VC dyads formed before the construction of HSR lines. In other words, both office locations were selected prior to the introduction of HSR. This approach enables us to eliminate the likely effects of HSR on the initial partnership formation between the startup and its lead VC. Moreover, we included city-dyad fixed effects and time-variant macroeconomic indexes to capture the regional development factors of the startup city and the VC city. In addition, we conducted several interviews to explore the mechanisms of information and resource exchanges between VCs and startups. It warrants future studies to examine the dynamics between entrepreneurial partners using qualitative approaches. Second, while we controlled for startup attributes, such as development stage, we did not capture factors related to the founders and the top management team because of data limitation. It is worth exploring startup heterogeneity and examining how startup respond to and take advantage of improved accessibility to create value.

Despite these limitations, this study takes an important step toward understanding the dynamic effect of geographic distance in the context of startup–VC relationships. Although the role of geographic distance in partnership performance has been recognized in prior research, a dynamic approach that incorporates the effects of changing technology and accessibility remains scarce. We further draw on the relational view to systematically examine how partnership-specific contingencies can shape the influence of improved accessibility triggered by HSR. We hope our conceptualization and findings inspire further research on this emerging phenomenon.

CRediT authorship contribution statement

Jiamin Zhang: Conceptualization, Methodology, Data Curation, Formal analysis, Visualization, Writing - Original draft preparation, Writing - review & editing.

Qian Gu: Conceptualization, Methodology, Formal analysis, Writing- Original draft preparation, Writing - review & editing.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbusvent.2021.106108.

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