Received: 25 November 2021 | Revised: 9 September 2025 | Accepted: 20 September 2025

DOI: 10.1002/smj.70025

RESEARCH ARTICLE

SMS | Strategic Management Journal

WILEY

Concentration in cross-border research collaborations and MNCs' knowledge creation in a host country

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Funding information
Research Grants Council of Hong Kong, Grant/Award Numbers: HKUST#16506622, 16505124; National Natural Science Foundation of China, Grant/Award Numbers: 72374200, 72102221, 72072099

[Correction added on 21 October 2025, after first online publication: The Funding information section has been updated in this version.]

Abstract

Research Summary: This study elucidates the previously underexplored structural heterogeneity inherent in multinational corporations' (MNCs) internal linkages by examining the concentration of cross-border collaborations among inventors within host countries. Building on the boundary spanning literature, we develop a two-stage framework identifying the knowledge distortion mechanism arising from this concentration: information overload in the cross-country knowledge absorption stage and long transmission paths and knowledge hoarding in the within-country diffusion stage. Both hinder local knowledge creation. We further propose that cross-country and within-country network structures serve as contingencies moderating this relationship. The negative effects of collaboration concentration are exacerbated by structural holes in cross-country networks but attenuated by the reach and density of within-country networks. Empirical results based on American pharmaceutical MNCs from 1980 to 2008 support our hypotheses.

Managerial Summary: Effectively structuring internal cross-border R&D collaborations is crucial for MNCs seeking to enhance local innovation outcomes.

All authors contributed equally to this paper.

Although many firms focus on increasing cross-border linkages, this study highlights that overlooking how collaborations are distributed among inventors can obscure key drivers of innovation performance. This research shows that given the number of cross-border linkages, their concentration in the hands of a few inventors within a host country hinders local knowledge creation. The negative effect is amplified when the host country spans many structural holes in the cross-country network. A well-structured within-country network with high reach or high density can help mitigate the effect by facilitating knowledge diffusion. Our findings highlight the importance of considering the structural and geographic configuration of internal MNC networks in global R&D strategy.

KEYWORDS

boundary spanning, co-inventing network, concentration, cross-border collaborations, knowledge creation

1 | INTRODUCTION

Cross-border collaborations are critical to the global innovation strategy of many firms (Asakawa et al., 2018; M. Zhao, 2006). Multinational corporations (MNCs) foster internal cross-border collaborations to globally source diverse knowledge and recombine them to create new knowledge (Alcácer & Zhao, 2012; Belderbos et al., 2021; Fleming, 2001; Kaplan & Vakili, 2015; Xiao et al., 2022). However, strategy scholars merely focused on the intensity of such collaborations and overlooked the importance of their structural distribution (Schotter et al., 2017; J. Zhao & Anand, 2013). For example, in 1994, Johnson & Johnson's R&D staff in Belgium and Germany had equal numbers of cross-border co-inventing collaborations within the firm. However, further analysis shows a relatively even distribution of international collaborations among the Belgian researchers. Despite having a similar number of inventors involved in cross-border co-inventions, the German subsidiary had a single inventor accounting for 60% of the international collaborations. This varied structural distribution of cross-border linkages across different countries of the same MNC is a widespread phenomenon, yet it has received limited scholarly attention.

To fill this research gap, this study asks whether the structure of an MNC's internal cross-border collaborations (concentrated vs. diffused) affects knowledge creation in a host country, and if so, how does such an effect take place? Scholars implicitly viewed inventors' cross-border ties within the MNC as parallel and independent. Such a perspective underestimates their structural configuration (Castellani et al., 2022; Schotter et al., 2017) and does not adequately recognize the fact that these linkages comprise a complex web of relationships with a heterogeneous structure (Cano-Kollmann et al., 2016; Mell et al., 2022). From a structural perspective, this study tests the idea that within an MNC, the concentration of cross-border collaborations distributed among inventors in a country can explain local knowledge creation to an extent.

Inventors involved in boundary-spanning activities engage in two-stage tasks in local knowledge creation, which are crucial for understanding the underlying mechanisms behind the concentration of cross-border collaborations (Mell et al., 2022; Tushman & Scanlan, 1981). The first stage is cross-border knowledge absorption, where inventors gather knowledge from R&D colleagues elsewhere and then filter, synthesize, and translate such knowledge before its diffusion to their domestic R&D colleagues in a way that it can be understood and integrated with domestic knowledge in the second stage (Allen et al., 1979). Drawing on the global knowledge network research and boundary-spanning literature, we argue that the concentrated cross-border collaborations on one or a few inventors in a country may lead to knowledge distortion, thus hindering local knowledge creation.

In the knowledge absorption stage, inventors involved in concentrated cross-border collaborations may become overwhelmed by the presence of varied foreign knowledge, resulting in information overload that hinders the reception and comprehension of critical information (Perry-Smith, 2006; Schilling & Fang, 2014). In the second stage, within-country knowledge diffusion from only a few inventors creates long transmission paths—that is, indirect and delayed knowledge transfers to and among local inventors—thus causing information loss and misunderstandings (Jones et al., 1997; J. Zhao & Anand, 2013). These few inventors may also be tempted to engage in knowledge hoarding or even disseminate information that is incomplete or incorrect for their own interests (Connelly et al., 2012; O'Reilly, 1978). We conducted in-depth interviews with 16 directors, managers, and researchers from pharmaceutical MNCs,[1] and their insights strongly corroborated our theoretical arguments.

To verify the mechanisms that explain the risks of concentration, we take a closer look at the two stages of a boundary-spanning task and distinguish cross-country and within-country collaborations based on whether the co-inventing ties in MNCs connect different countries. In the stage of knowledge absorption, when a host country spans many structural holes in cross-country collaborations, heterogeneous knowledge—arising from structurally disconnected countries—flows through a limited number of channels under conditions of concentration, intensifying the risk of information overload (Edmunds & Morris, 2000). Once knowledge is acquired, its diffusion depends on the structure of within-country networks (Bathelt & Li, 2020; Vestal & Danneels, 2022). According to the network literature (Chang et al., 2023; Watts & Strogatz, 1998), networks with short path lengths (i.e., high reach) are expected to facilitate information diffusion, thus potentially minimizing the challenges associated with long-path knowledge transfers. A dense network suggests that its members are closely interconnected, thus potentially enhancing effective interactions (Phelps, 2010; Yan et al., 2022) and mitigating the risk of knowledge hoarding. Therefore, we propose that the reach and density of within-country networks likely alleviate the negative effects of concentrated cross-border collaborations.

We test our hypotheses by using the data of 97 publicly listed MNCs headquartered in the United States and operating in the pharmaceutical industry during 1980–2008. We used an unbalanced panel of 1954 MNC-country-year observations for our regression analyses. The results show that more concentrated cross-border linkages are associated with less local knowledge creation. Such a negative relationship is weakened when the host country spans fewer

[1]The details of these interviews and representative quotes are provided in Supporting Information Appendix F.

structural holes in cross-country collaboration networks and when within-country collaboration networks have a high reach and/or high density.

Our findings contribute to the scholarly understanding of MNCs' internal cross-border linkages by highlighting the role of distributional heterogeneity. These results support a knowledge distortion mechanism through which concentration in cross-border collaborations may hinder local knowledge creation. Cross-border collaborations are often costly to manage (Alcácer & Zhao, 2012). Some studies provide valuable guidance about whether and where to use cross-border linkages (Belderbos et al., 2021), whereas others examine team composition as a strategy for managing such collaborations (Seo et al., 2020). However, substantial opportunities remain for expanding the scholarly understanding of how cross-border collaborations affect knowledge creation from a structural perspective. Our findings highlight that such linkages based on inventors comprise a broad nexus of relationships with varied distribution structures, thus introducing a promising new line of inquiry with considerable potential in explaining the performance implications of cross-border linkages.

We contribute to the literature on MNC networks by integrating geographic space into the analysis of MNC networks and applying a nuanced perspective that distinguishes between cross-country and within-country inventor networks inside an MNC (Cuypers et al., 2020). Previous research tends to pool cross-border and within-country linkages together to understand the effects of total linkage numbers in the aggregate. This approach can mask the underlying patterns of these linkages, thus failing to address within-country and cross-border heterogeneity simultaneously (Scalera et al., 2018). By responding to the recent scholarly call for a more fine-grained analysis of MNCs' geography of network ties (Beugelsdijk & Mudambi, 2013; Cuypers et al., 2020), we offer new insights into how inventors leverage both types of networks to mitigate the knowledge distortion challenges posed by high concentration in cross-border collaborations. In doing so, we propose novel MNC network-structural contingencies for reducing knowledge distortion risks within MNCs (Hernandez et al., 2015).

2 | THEORY

2.1 | Cross-border linkage strategy for multinational knowledge management

MNCs often seek to establish collaborative linkages among their globally dispersed R&D labs—known as an internal or cross-border linkage strategy—to facilitate cross-border knowledge transfer while minimizing leakage risks (Alcácer & Zhao, 2012; M. Zhao, 2006). Prior research suggests that knowledge inflows within intra-MNC R&D networks are critical enablers of subsidiary-level knowledge creation (Berry, 2018), as they provide the channels and opportunities for subsidiaries to absorb, disseminate, and integrate global knowledge (Gupta & Govindarajan, 2000; Kogut & Zander, 1993). From a recombination perspective (Fleming, 2001), innovation arises through novel combinations of diverse knowledge components. The effective internalization of intra-MNC knowledge enables its recombination with locally embedded knowledge to generate innovation (Tzabbar & Vestal, 2015). Previous research shows that compared with their counterparts, geographically dispersed in-house R&D is associated with more novel innovation (Tzabbar & Vestal, 2015), better productivity (Belderbos et al., 2015), and higher market value (Belderbos et al., 2021).

Despite these benefits, cross-border collaboration has its drawbacks, including communication challenges and coordination costs (Belderbos et al., 2023; Belderbos et al., 2021; Berry, 2014; Liu & Meyer, 2020; Seo et al., 2020; Teece, 2014; M. Zhao, 2006). The benefits of foreign knowledge may not always justify the costs of acquiring it in locations with limited learning opportunities (Alcácer & Zhao, 2012). Therefore, scholars suggested that MNCs should explore alternative and less costly means of acquiring knowledge abroad where possible (Alcácer & Zhao, 2012; M. Zhao, 2006). The justification for building cross-border knowledge linkages depends in part on the external environment. For example, Belderbos et al. (2021) found that the intensive use of cross-border collaboration in countries with strong intellectual property protections is negatively correlated with a firm's market value. Other scholars emphasized the team composition of cross-border collaborations (Boh et al., 2007). For instance, Seo et al. (2020) found that diverse experience and frequent past collaborations among team members may reduce the costs of cross-border collaborations.

However, few studies examine how an MNC can best internally design the structure of its international linkages for efficiency, particularly with regard to the heterogeneity in distribution. MNCs may vary significantly in how they structure their global R&D networks (Gassmann & Von Zedtwitz, 1999; Goerzen & Beamish, 2003; Hitt et al., 1997; Wang et al., 2022; Zaheer & Hernandez, 2011). Configurations that organize inventors in different ways may suit the various opportunities, capabilities, and challenges involved in knowledge creation (Almeida et al., 2002; Reinholt et al., 2011). A structural perspective may thus offer a comprehensive understanding of the function and effectiveness of cross-border linkages. This study highlights that such cross-border linkages account for a broad nexus of relationships with varied distributional structures among inventors in a host country.

2.2 | Boundary spanning in MNCs' internal co-inventing networks

Boundary-spanning activities are often central to generating innovative outcomes (Tippmann et al., 2017). Local researchers with cross-border ties act as boundary spanners that oversee the communication and coordination between local R&D teams and their overseas colleagues (Schotter et al., 2017). Boundary spanning is inherently structural and often relies on organizational mandates and structures to function effectively (Aldrich & Herker, 1977; Schotter et al., 2017). Boundary-spanning inventors link within-country co-inventing networks across internationally dispersed R&D labs to form intricate collaboration networks within MNCs. However, previous research often treats cross-border linkages as parallel and independent rather than as a structured network of relationships (J. Zhao & Anand, 2013).

This perspective also overlooks the real-world possibilities where cross-border linkages have various configurations ranging from those concentrated on a few inventors to those with a diffused distribution of many inventors (Grigoriou & Rothaermel, 2014). Such a variety was confirmed in our interviews. Different firms have various structures in their cross-border collaborations. We specifically focus on the concentration of cross-border linkages in a host country in multinational knowledge management.

A highly concentrated distribution of cross-border collaborations denotes a centralized structure for international knowledge transfer, where a limited number of researchers control the flow of knowledge across borders (Aldrich & Herker, 1977). Actions that span national boundaries can significantly influence innovation outcomes at the MNC-country level (Mell et al., 2022). Despite the prevalent heterogeneity, how concentration affects a firm's knowledge-creation ability has received little research attention (Marrone, 2010; Mell et al., 2022).

Effective boundary spanning for local innovation involves initially absorbing information from overseas R&D colleagues and then decoding, filtering, translating, and transforming such information to suit local needs. The processed knowledge is then disseminated to domestic R&D colleagues and integrated into local knowledge (Allen et al., 1979; Tushman & Scanlan, 1981). Boundary-spanning inventors thus play critical roles in enabling the flow of knowledge (Liu & Meyer, 2020; Schotter et al., 2017), but how they absorb and disseminate overseas knowledge in a firm remains unclear (Meyer et al., 2020). Prior research often treats countries as monolithic and analyzes their knowledge-creation processes on a macro level (Guan et al., 2016). Moreover, these studies focus on knowledge acquisition yet neglect how the knowledge acquired is disseminated and used (Mell et al., 2022). Therefore, the two-stage tasks of boundary-spanning inventors in knowledge acquisition and diffusion warrant further investigation.

On the basis of the boundary-spanning literature and our interviews with practitioners, we expect that concentrated cross-border linkages may introduce knowledge distortions, thus potentially impeding local knowledge creation. Section 2.3 discusses three potential sources of knowledge distortion arising from this concentration, namely, information overload, long transmission paths, and knowledge hoarding.

2.3 | Hindering effects of cross-border collaboration concentration

Information overload occurs at the stage of cross-border knowledge absorption. Concentrated cross-border collaborations impose constraints on the network capacity of the absorption process because information has to be heavily channeled through one or a few inventors (O'Reilly, 1980; Song, 2014). Such information in cross-border communication is often time-consuming and demanding (Moaniba et al., 2020). A high concentration can cause overload, confusion, and forgetfulness, thereby complicating the assessment of the relevance or priority of incoming information (Schick et al., 1990). It introduces bottlenecks in information elaboration, restricting the smooth and effective absorption of knowledge.

Long transmission paths and knowledge hoarding mainly occur at the stage of domestic knowledge diffusion. Cross-border collaboration concentration tends to create long, indirect knowledge transmission paths within a country's innovation network. Domestic inventors, who are often uninvolved in cross-border work, must rely on a few colleagues for foreign knowledge access (J. Zhao & Anand, 2013). These long and indirect contacts can distort knowledge and lead to misunderstandings (Freeman, 1978; Hansen, 2002), time-consuming verification efforts (Kogut & Zander, 1993), and limited recombinant search (Phelps et al., 2012). Concentrated collaboration may also tempt boundary spanners to hoard knowledge. By controlling a large share of the information from cross-border collaborations, boundary spanners can significantly influence whether, how, and to whom information is transmitted, potentially leading to intentional withholding for self-interest (Connelly et al., 2012; Peng, 2013; Schilling & Fang, 2014), promoting distrust, and limiting creativity in the shared network (Černe et al., 2014; Khoreva & Wechtler, 2020). To sum up, concentrated cross-border linkages may distort the absorption and diffusion of MNC knowledge in a host country, restricting its effective recombination with locally embedded knowledge to generate innovation. Based on these insights, we hypothesize the following:

Hypothesis 1 (H1). *Within an MNC, the concentration of cross-border collaboration on inventors in a country tends to be negatively associated with local knowledge creation.*

2.4 | Moderating effect of cross-country network structure

A country that spans structural holes acts as a broker, connecting partner countries that do not directly collaborate (Burt, 1992). These brokerage positions expose the country to a heterogeneous set of information from disconnected foreign partners (Ahuja, 2000). Such information is often highly heterogeneous in content, language, and contextual relevance, making it difficult to absorb simultaneously. As the country bridges more unconnected partners, the risk of information overload from concentrated cross-border collaborations increases because a large amount of heterogeneous knowledge must be absorbed through a limited number of channels. The boundary spanners consequently face difficulties in understanding and absorbing such knowledge (O'Reilly, 1980; Zahra & George, 2002). This challenge heightens the likelihood of information overload and poses a significant barrier to the development of local knowledge. Based on these insights, we hypothesize the following:

Hypothesis 2 (H2). *When a host country spans more structural holes in the cross-country co-inventing network, the negative relationship between cross-border collaboration concentration and local knowledge creation tends to be stronger.*

2.5 | Moderating effects of within-country network structures

Although cross-border knowledge absorption is important for knowledge recombination in a host country, the local diffusion of what has been absorbed is equally critical (Venkataramani & Tang, 2024). A within-country network structure that supports collaboration directly influences the local diffusion of ideas. Networks with great reach and short paths among inventors can facilitate a fast and accurate spread of information (Funk, 2014). Overseas knowledge transferred via cross-border collaborations to a short-path local network tends to be rapidly disseminated among local inventors, reducing knowledge distortion. Inventors in high-reach networks can efficiently establish contact with others, enhancing a within-country network's efficiency in combining or recombining diverse knowledge for innovation (Moreira et al., 2018; Schilling & Green, 2011). Even when only a small number of inventors are involved in cross-border research collaborations, the knowledge they acquire from overseas can be efficiently disseminated in local highly reachable networks, thereby mitigating the knowledge distortion problem resulting from the concentration in cross-border collaborations. Based on these insights, we hypothesize the following:

Hypothesis 3 (H3). *When a country's within-country co-inventing network has a greater reach, the negative relationship between cross-border collaboration concentration and local knowledge creation tends to be weaker.*

A dense network is marked by high levels of cohesiveness among its members. When local inventors are closely linked, the network operates as a relatively closed system that facilitates the circulation of information (Gnyawali & Madhavan, 2001; Lee et al., 2016; Vestal &

TABLE 1 Outline of conceptual framework.

	Knowledge tasks of boundary-spanning inventors for the purpose of local knowledge creation	Knowledge distortion problems caused by cross-border collaboration concentration (H1)	Network structure contingencies (H2–H4)
Stage I	Knowledge absorption from the cross-country network within the MNC	Information overload	Cross-country network structural holes (strengthening)
Stage II	Knowledge diffusion in the within-country network within the MNC	Long transmission paths	Within-country network reach (weakening)
		Knowledge hoarding	Within-country network density (weakening)

Danneels, 2022). In such settings, even if a boundary spanner does not share knowledge directly with every peer, that knowledge can still diffuse through multiple indirect ties (Xia & Li, 2023). Even when knowledge enters through only one or two people, it does not get "stuck"—the dense network helps it spread to others. Furthermore, dense local networks enable effective peer monitoring (Granovetter, 1985; Li & Hambrick, 2005; Tandon et al., 2023). When everyone is connected, quietly keeping information to themselves without being noticed becomes hard. The more interconnected the network, the greater the likelihood that uncooperative behavior—such as withholding valuable knowledge—will be noticed and socially penalized. As a result, dense within-country inventor networks can serve as a structural deterrent to knowledge hoarding and help ensure that knowledge brought in through cross-border collaborations is widely disseminated. Based on these insights, we hypothesize the following:

> **Hypothesis 4 (H4).** *When a country's within-country co-inventing network is denser, the negative relationship between cross-border collaboration concentration and local knowledge creation tends to be weaker.*

Table 1 outlines our conceptual framework.

3 | METHODOLOGY

3.1 | Sample and data collection

We investigated the concentration of cross-border collaborations in MNCs using data on listed pharmaceutical MNCs headquartered in the United States from 1980 to 2008. Knowledge creation is critical to the pharmaceutical industry, with firms extensively patenting new developments wherever possible (Eklund, 2022; Qian, 2007). Around 80% of innovations in this industry are patented, a proportion significantly higher than the 35% average observed in other industries (Arundel & Kabla, 1998). The pharmaceutical industry is recognized as an ideal setting for identifying and evaluating the effect of co-inventing networks within a firm (Moreira et al., 2018; Paruchuri, 2010).

Additionally, the pharmaceutical industry exhibits significant international dispersion of internal R&D activities. Its high degree of globalization provides numerous instances of international co-invention collaborations driving innovation (Seo et al., 2020). We specifically focused on this industry to mitigate the risk of additional confounding factors from other industries.

We only considered MNCs in our analysis. We used the historical segments database of COMPUSTAT to identify pharmaceutical MNCs (SIC codes: 2833, 2834, 2835, and 2836) and classified a firm as an MNC if more than 10% of its total sales occurred in one or more foreign locations (Chakrabarty & Wang, 2012; Gande et al., 2009; Huang, 2018).

We then retrieved the selected firms' patent portfolios from the Duke Innovation and Scientific Enterprise Research Network (DISCERN) database, which aligns US-headquartered firms with US-granted patents (Arora et al., 2021). To analyze MNCs' intra-firm linkages, we excluded patents co-assigned with external firms. The same approach is widely used in co-invention studies[2] (Vestal & Danneels, 2022). We treated each MNC as an integrated strategic agent for patent portfolio identification, given that patent rights might be assigned to either a parent company or its subsidiary for reasons that are not readily apparent (M. Zhao, 2006). DISCERN integrates various sources, including historical Orbis snapshots, SDC Platinum data, CRSP monthly stock data, and the NBER patent database, to dynamically match each patent assignee with its ultimate owner across different periods. This database also accommodates name changes, subsidiary shifts, and ownership transitions because of mergers, acquisitions, or spinoffs. The patent data we retrieved from the Orbis Intellectual Property database included claims, International Patent Classification codes, and application dates.

We identified the inventors of each patent during the final stage of the data collection. We collected unique identifiers and geolocation data from the "Disambiguation and co-authorship networks of the US patent inventor database (1975–2010)" (Li et al., 2014), which employs a Bayesian supervised learning approach for accurate identification.

We collected our institutional distance data from Berry et al. (2010) and supplemented these data with country-level information from World Bank datasets. We retrieved our financial and R&D data on the sampled MNCs from COMPUSTAT. We treated the distribution of cross-border collaborations as our primary variable. We only included host countries to avoid the US home country bias and excluded MNC-country-year observations without cross-border collaborations. We also omitted those observations with fewer than three inventors because of concerns regarding the construct validity of certain moderating variables, such as within-country network density (Vestal & Danneels, 2024). We eventually obtained 97 MNCs involving 60,185 patents, whose overseas research operations are located across 24 host countries, comprising an unbalanced panel of 1954 MNC-country-year observations. Supporting Information Appendix A presents the sample distribution.

3.2 | Variables

3.2.1 | Dependent variable: Local knowledge creation

Consistent with previous research (Wadhwa & Kotha, 2006; Wang & Chen, 2010), we defined our dependent variable *local knowledge creation*$_{i,j,t+1}$ as the number of patents invented by the

[2]Among all patents that involve the sampled MNCs, collaboration patents with external assignees only accounted for 5.82%, which echoes the observations in previous research (Vestal & Danneels, 2022).

inventors of MNC i located in country j during year $t+1$. We assigned a patent to a specific year based on the date when a firm filed its patent application. In the pharmaceutical industry, patent applications often closely follow knowledge creation. We then aggregated these patents by MNC-host country based on the inventors' addresses.

3.2.2 | Independent variable: Cross-border collaboration concentration

The data describing the granted patents allowed us to identify co-inventing collaborations among inventors within the same MNC and then build inventor networks. Given that inventors invest a substantial amount of their time and resources when collaborating on a patent, co-inventing ties are commonly used to indicate collaboration (Alcácer & Zhao, 2012; Belderbos et al., 2021; Vestal & Danneels, 2024). However, collaboration ties do not last indefinitely. In this case, we treated those collaborations older than 3 years as dissolved (Dahlander & McFarland, 2013; Paruchuri, 2010; Paruchuri & Awate, 2017).

Adhering to methodologies in previous research (Karim et al., 2023; Sleptsov et al., 2013), we used a Herfindahl-style measure to compute the degree of concentration in cross-border collaborations with MNC i's inventors in country j in year t.

$$Concentration_{ijt} = \sum_{k=1}^{m} \left(x_k / \sum_{l=1}^{m} x_l \right)^2. \tag{1}$$

Here, x_k is the number of cross-border collaborations involving inventor k, and m denotes the total number of inventors belonging to MNC i and located in country j. The value of this measure ranges from $1/m$ to 1, with higher values indicating cross-border collaborations concentrated around fewer inventors.

3.2.3 | Moderating variables

We measured *cross-country network structural holes* using effective size (Burt, 1992), which captures the extent to which a focal country serves as a broker connecting otherwise unconnected countries in the multinational co-inventor network. The cross-country network is constructed using MNC co-inventor data, where each node represents a country and each tie indicates cross-border co-invention activity between inventors located in different countries. For each host country j in MNC i, we computed the effective size of its ego network as

$$Cross\text{-}country\ network\ structural\ holes_{ijt} = \sum_{k} \left(1 - \sum_{q} p_{jq} m_{kq} \right), \tag{2}$$

where k indexes the countries directly connected to j, q represents third-party countries also connected to j, p_{jq} is the proportion of j's ties invested in alter q, and m_{kq} is the marginal strength of k's connection to q (i.e., the strength of k's tie to q relative to its strongest tie).

We quantified *within-country network reach* using an averaged distance-weighted reach measure (Schilling & Phelps, 2007). This compound measure considers the number of inventors reachable by network path from a given inventor and the path length involved. We calculated this measure as

$$Within\text{-}country\ network\ reach_{ijt} = \left(\sum_{p=1}^{m} \sum_{q=1,\, q \neq p}^{m} 1/d_{pq}\right)/m, \quad (3)$$

where m is the number of MNC i's inventors in the within-country network of country j, and d_{pq} is the minimum (geodesic) distance from a focal inventor p to inventor q ($p \neq q$). This variable ranges from 0 to $m-1$, with higher scores indicating a greater reach.

We quantified *within-country network density*$_{ijt}$ as the ratio of the actual number of local co-inventing ties to the total possible number in the context of country j of MNC i at time t (Ahuja et al., 2012; Moreira et al., 2018; Phelps et al., 2012). We computed this measure as

$$Within\text{-}country\ network\ density_{ijt} = \frac{Actual\ ties_{ijt}}{Possible\ ties_{ijt}}, \quad (4)$$

where $Possible\ ties_{ijt}$ refers to the number of potential ties ($m(m-1)/2$) based on the total number of inventors (m) in country j.

3.2.4 | Control variables

We also included several control variables in our analyses. At the MNC-country level, we included a country's *knowledge stock* in the analyses as a control variable, which we quantified using the count of patents filed by an MNC in a country up to year t to control for the cumulative effects of local knowledge creation (Schilling & Phelps, 2007). We also included the *local inventor pool*, which denotes the total number of unique inventors in the inventor pool up to year t. We treated the number of *inventors per patent* on the patents applied for in year t as another control.

Moreover, we included the average number of *claims* per patent, which represents the number of ways that the patent's knowledge extends existing knowledge (Paruchuri, 2010). We used *total internal cross-border collaborations* to denote the frequency at which local inventors engage in cross-country collaborative activities within an MNC. *Within-country network centralization* represents Freeman's (1978) degree centralization measure; that is, an MNC-country-level measure of the dispersion of local inventors' degree centrality.

To control for the geographic dispersion of inventors in the focal country, we included *within-country geographic distance* (times 10^{-3}), which is the average geographic distance (in kilometers) between the locations of collaborative inventors within the same country based on their latitude and longitude data. We also included the average *local tie strength of boundary spanners*, which measures the average strength of collaborative ties between boundary spanners and other local inventors in the within-country network. Following the patent citation approach suggested by Singh (2007), we included *knowledge inflows*, calculated as the number of times boundary-spanning inventors of MNC i in country j cite patents filed by inventors from other countries within the same MNC in year t.

We quantified *institutional distance* by calculating the average distance of institutional components between the focal country and other countries engaged in co-inventing collaborations in the same MNC in year *t*. To measure this variable, we constructed a composite indicator that encompasses various dimensions of the institutional environment, including economic, financial, political, administrative, cultural, demographic, knowledge, global connectedness, and geographic distance (Berry et al., 2010). Following Wu and Park (2019), we standardized each institutional dimension by subtracting the variable's mean in a given year and dividing the result by the standard deviation (SD). Afterward, we averaged all nine institutional components to obtain our composite indicator.

At the country level, we used *Country IPR* as another control that quantifies the effectiveness of patent protection in an economy based on its Ginarte–Park index (Ginarte & Park, 1997) and its Impartial Courts score from Fraser Institute's Economic Freedom of the World Report. Following Belderbos et al. (2021), we constructed a composite index incorporating statutory information and the actual enforcement of intellectual property rights. We also included *GDP* per capita (times 10^{-4}) and *patent amount* (in thousands) filed by a country's residents as controls.

At the MNC level, we quantified *R&D intensity* as the ratio of R&D spending to total assets (Lin et al., 2006; Testoni, 2022) and used interpolated values for missing data (Hall, 1990; Lenox et al., 2010). *MNC geographic concentration* refers to the concentration of an MNC's patents across countries, which we quantified using a Herfindahl–Hirschman index. *MNC external partners* denotes the number of co-assigned firms with the MNC in its patents.

To address serial correlation concerns, we clustered the standard errors at the MNC-country level (Garg & Zhao, 2018). We included year dummies to account for time and unpredictable shock effects that are not captured by the explanatory variables. To control for the effect of unobserved heterogeneity, we conducted MNC-country fixed effects panel data analyses. Following Belderbos et al. (2023), we included a full set of MNC-country dummies. To address simultaneity concerns, we lagged the independent and control variables by 1 year.

3.3 | Modeling

Given that our dependent variable, local knowledge creation, is a non-negative integer (a count variable), we evaluated Poisson quasi-maximum likelihood (QML) regression models with unconditional MNC-country fixed effects (Allison & Waterman, 2002; Chatterji & Fabrizio, 2014; Jandhyala & Phene, 2015). We selected the unconditional fixed-effects formulation because conditional fixed-effects models identify parameters based solely on within-individual variation and cannot estimate the effects of time-invariant covariates (Belderbos et al., 2023). Moreover, ordinary least squares regression shows inconsistencies, biases, and inefficiencies in modeling count variables (Greene, 2007). The negative binomial formulation is sometimes used. However, this formulation often encounters an incidental parameter problem in panels with limited temporal scope, and this issue is not present in Poisson models (Garg & Zhao, 2018; Greene, 2007). Poisson QML regression with unconditional fixed effects demonstrates its robustness against overdispersion in the data (Jandhyala & Phene, 2015), provides a consistent estimator despite broad assumptions, and generates standard errors that are robust to arbitrary patterns of correlation (Chatterji & Fabrizio, 2014). As such, it facilitates the estimation of a "sandwich" cluster-robust variance–covariance matrix that accounts for intra-cluster correlation (Kumar & Zaheer, 2019).

Our model specification is as follows:

$$E\left(Local\ knowledge\ creation_{ijt+1}\right) = \exp(\beta_0 + \beta_1 \times Cross\text{-}border\ collaboration\ concentration_{ijt}$$
$$+\beta_2 \times Cross\text{-}border\ collaboration\ concentration_{ijt} \times Cross\text{-}country\ network\ structural\ holes_{ijt}$$
$$+\beta_3 \times Cross\text{-}border\ collaboration\ concentration_{ijt} \times Within\text{-}country\ network\ reach_{ijt} \qquad (5)$$
$$+\beta_4 \times Cross\text{-}border\ collaboration\ concentration_{ijt} \times Within\text{-}country\ network\ density_{ijt}$$
$$+\beta \times Controls + \varphi_{ij} + \zeta_t + \varepsilon_{ijt}),$$

where i indexes MNCs, j indexes countries, t represents years, β_0 is a constant, *Controls* is a vector of control variables, φ_{ij} is the MNC-country fixed effect, ζ_t is the year fixed effect, and ε_{ijt} is the error term for country j of MNC i in the current observation. The exponential function ensures the non-negativity of the dependent variable. Supporting Information Appendix D describes the tests of alternative model specifications.

4 | RESULTS

Supporting Information Appendix B presents the descriptive statistics and correlations describing the variables. Table 2 shows the coefficients of the Poisson QML regressions, where the coefficients for testing the hypotheses are highlighted in boldface. The baseline Model 1 incorporates only the control variables. In Model 2, the coefficient of the cross-border collaboration concentration term is negative and significant ($\beta = -0.331$, $p = 0.032$, standard error [SE] = 0.169, 95% confidence interval [CI]: [−0.634, −0.029]). This result indicates that if the concentration in cross-border collaboration increases by 1 SD, then the incidence rate of local knowledge creation is predicted to decrease by a factor of exp. (−0.331 * 0.253) = 0.920, which is equivalent to an 8.03% decrease. Therefore, H1 is supported.

Model 3 further reveals that the interaction of concentration with cross-country network structural holes significantly and negatively predicts local knowledge creation ($\beta = -0.451$, $p = 0.034$, SE = 0.213, 95% CI: [−0.868, −0.035]), thus supporting H2. The extended simple slopes analysis in Table 3 demonstrates how the incidence rate ratios (IRR, exponentiated coefficients), which represent the proportional increase in local knowledge creation because of a unit increase in concentration, vary along with the level of structural holes. As the level of structural holes increases, the IRR decreases, and the negative effect becomes more significant. We also measured the practical effects of these estimates. Focusing on low structural holes (−1 SD), a shift in concentration from 1 SD below the mean to 1 SD above the mean predicts a 14.34% decrease in local knowledge creation. The same shift at high structural holes (+1 SD) results in a 39.41% decrease, lending additional support to H2.

In Model 4, the term representing the interaction between concentration and within-country network reach is positive and significant ($\beta = 0.066$, $p = 0.021$, SE = 0.029, 95% CI: [0.010, 0.122]), suggesting a mitigating effect on the negative impact. Therefore, H3 is supported. Table 3 shows that the IRR of concentration is significantly below 1 for low and moderate levels of within-country network reach, indicating a strong negative effect of concentration on local knowledge creation. However, the IRR exceeds 1 when the reach is large. This result suggests a potential positive effect of concentration on local knowledge creation at very high levels of within-country network reach, hence supporting H3. When holding everything else constant and focusing on low within-country network reach (−1 SD), an increase in concentration from 1 SD below the mean to 1 SD above the mean predicts a 23.91% decrease in

TABLE 2 Regression results predicting local knowledge creation.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Cross-border collaboration concentration		**−0.331 (0.154) [0.032]**	**0.145 (0.252) [0.565]**	**−0.606 (0.199) [0.002]**	**−0.680 (0.245) [0.006]**	**−0.536 (0.352) [0.127]**
Cross-border collaboration concentration × Cross-country network structural holes			**−0.451 (0.213) [0.034]**			**−0.428 (0.209) [0.041]**
Cross-border collaboration concentration × Within-country network reach				**0.066 (0.029) [0.021]**		**0.078 (0.028) [0.006]**
Cross-border collaboration concentration × Within-country network density					**1.058 (0.508) [0.037]**	**1.012 (0.508) [0.046]**
Cross-country network structural holes	0.057 (0.028) [0.045]	0.046 (0.027) [0.083]	0.088 (0.037) [0.017]	0.044 (0.026) [0.086]	0.042 (0.026) [0.107]	0.078 (0.035) [0.023]
Within-country network reach	0.020 (0.007) [0.002]	0.020 (0.007) [0.004]	0.020 (0.007) [0.003]	0.016 (0.007) [0.017]	0.019 (0.007) [0.006]	0.015 (0.007) [0.029]
Within-country network density	−1.267 (0.198) [0.000]	−1.182 (0.198) [0.000]	−1.193 (0.197) [0.000]	−1.152 (0.197) [0.000]	−1.626 (0.303) [0.000]	−1.579 (0.295) [0.000]
Knowledge stock	−0.187 (0.104) [0.072]	−0.197 (0.106) [0.063]	−0.202 (0.105) [0.056]	−0.201 (0.107) [0.060]	−0.206 (0.106) [0.052]	−0.216 (0.107) [0.043]
Local inventor pool	−0.097 (0.141) [0.493]	−0.100 (0.140) [0.475]	−0.114 (0.140) [0.418]	−0.097 (0.140) [0.491]	−0.116 (0.140) [0.406]	−0.124 (0.139) [0.372]
Inventors per patent	−0.037 (0.063) [0.552]	−0.050 (0.062) [0.427]	−0.061 (0.061) [0.318]	−0.062 (0.062) [0.315]	−0.038 (0.062) [0.539]	−0.065 (0.060) [0.284]
Claims	0.002 (0.001) [0.019]	0.002 (0.001) [0.021]	0.002 (0.001) [0.025]	0.002 (0.001) [0.021]	0.002 (0.001) [0.017]	0.002 (0.001) [0.021]
Total internal cross-border collaborations	0.000 (0.001) [0.416]	0.001 (0.001) [0.360]	0.000 (0.001) [0.643]	0.001 (0.001) [0.187]	0.001 (0.001) [0.348]	0.001 (0.001) [0.363]
Within-country network centralization	0.118 (0.198) [0.549]	0.117 (0.189) [0.535]	0.113 (0.184) [0.540]	0.057 (0.188) [0.763]	0.168 (0.189) [0.374]	0.090 (0.183) [0.623]
Within-country geographic distance	0.169 (0.120) [0.161]	0.160 (0.117) [0.171]	0.153 (0.117) [0.190]	0.171 (0.115) [0.137]	0.164 (0.129) [0.205]	0.172 (0.127) [0.175]

TABLE 2 (Continued)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Local tie strength of boundary spanners	0.010 (0.005) [0.029]	0.010 (0.005) [0.067]	0.010 (0.005) [0.054]	0.006 (0.004) [0.154]	0.011 (0.006) [0.060]	0.007 (0.004) [0.112]
Knowledge inflows	0.000 (0.000) [0.132]	0.000 (0.000) [0.132]	0.000 (0.000) [0.263]	0.000 (0.000) [0.068]	0.000 (0.000) [0.189]	0.000 (0.000) [0.182]
Institutional distance	0.121 (0.150) [0.421]	0.086 (0.146) [0.557]	0.080 (0.144) [0.578]	0.058 (0.147) [0.692]	0.074 (0.144) [0.608]	0.038 (0.144) [0.789]
Country IPR	0.214 (0.784) [0.785]	0.003 (0.747) [0.997]	0.069 (0.730) [0.925]	0.023 (0.736) [0.975]	−0.145 (0.756) [0.848]	−0.057 (0.730) [0.938]
Country GDP per capita	−0.056 (0.114) [0.622]	−0.058 (0.111) [0.599]	−0.054 (0.113) [0.634]	−0.055 (0.108) [0.608]	−0.059 (0.107) [0.583]	−0.051 (0.106) [0.630]
Country patent amount	0.001 (0.004) [0.795]	0.002 (0.004) [0.676]	0.002 (0.004) [0.684]	0.002 (0.004) [0.650]	0.002 (0.004) [0.615]	0.002 (0.004) [0.591]
MNC R&D intensity	−0.338 (0.280) [0.227]	−0.343 (0.281) [0.222]	−0.332 (0.278) [0.232]	−0.372 (0.288) [0.196]	−0.316 (0.271) [0.244]	−0.341 (0.277) [0.218]
MNC claims	0.020 (0.012) [0.113]	0.020 (0.012) [0.091]	0.021 (0.012) [0.078]	0.021 (0.011) [0.072]	0.021 (0.011) [0.058]	0.023 (0.011) [0.038]
MNC geographic concentration	−0.361 (0.490) [0.461]	−0.436 (0.477) [0.360]	−0.512 (0.483) [0.290]	−0.496 (0.467) [0.288]	−0.456 (0.472) [0.334]	−0.600 (0.467) [0.199]
MNC external partners	−0.015 (0.011) [0.167]	−0.017 (0.011) [0.139]	−0.017 (0.011) [0.132]	−0.017 (0.011) [0.123]	−0.017 (0.011) [0.138]	−0.018 (0.011) [0.114]
MNC-country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.898 (1.139) [0.430]	−0.539 (1.090) [0.621]	−0.580 (1.090) [0.595]	−0.414 (1.071) [0.699]	−0.219 (1.086) [0.841]	−0.125 (1.073) [0.907]
Pseudo R^2	0.6237	0.6245	0.6252	0.6252	0.6253	0.6267
Log pseudolikelihood	−3614.309	−3606.175	−3599.408	−3599.617	−3598.755	−3585.007
Likelihood ratio test (p-value)		16.268 (0.000)	13.534 (0.000)	13.116 (0.000)	14.840 (0.000)	42.336 (0.000)
Model fit Wald χ^2 (p-value)	205.63 (0.000)	197.26 (0.000)	208.32 (0.000)	249.97 (0.000)	213.90 (0.000)	291.79 (0.000)
Incremental Wald χ^2 (p-value)		4.60 (0.032)	4.51 (0.034)	5.32 (0.021)	4.34 (0.037)	13.33 (0.004)

TABLE 2 (Continued)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Observations	1954	1954	1954	1954	1954	1954
Number of MNC countries	284	284	284	284	284	284

Note: Robust standard errors clustered at the MNC-country level are shown in parentheses, and the *p*-values are presented in brackets. All tests are two-tailed. The likelihood ratio test and incremental Wald tests of improvement of fit compare Model 2 with the base Model 1 and compare Models 3–6 with Model 2. The coefficients of the Poisson QML regressions, where the coefficients for testing the hypotheses are highlighted in boldface.

TABLE 3 Extended simple slopes analysis.

	IRR of cross-border collaboration concentration on local knowledge creation	
Value of moderator variable	**IRR**	***p*-value**
Cross-country network structural holes		
1st percentile	0.7362	0.044
25th percentile	0.7362	0.044
Median	0.7362	0.044
75th percentile	0.5317	0.005
99th percentile	0.0901	0.017
Within-country network reach		
1st percentile	0.5830	0.003
25th percentile	0.6228	0.004
Median	0.6654	0.008
75th percentile	0.7501	0.049
99th percentile	2.3917	0.098
Within-country network density		
1st percentile	0.5270	0.006
25th percentile	0.6245	0.009
Median	0.7735	0.100
75th percentile	1.4596	0.286
99th percentile	1.4596	0.286

Note: Incidence rate ratio (IRR): the exponentiated coefficients.

local knowledge creation. With a large reach (+1 SD), the same shift results in a 2.19% decrease in local knowledge creation, thus supporting H3.

Model 5 demonstrates that the interaction between concentration and within-country network density is a positive and significant predictor of local knowledge creation ($\beta = 1.058$, $p = 0.037$, SE = 0.508, 95% CI: [0.063, 2.054]), indicating that within-country network density weakens the negative effect. Therefore, H4 is supported. Furthermore, the marginal analysis in Table 3 indicates that the effect of concentration is significant and negative at low levels of within-country network density, with IRRs significantly below 1. However, as density increases, the IRR exceeds 1, and the *p*-values become non-significant, suggesting that a higher density may weaken or negate the negative effect of concentration on local knowledge creation. These results again support H4. When the within-country network density is 1 SD below the mean, a shift in concentration from 1 SD below the mean to 1 SD above the mean predicts a 22.96% decrease in local knowledge creation. The same shift with high within-country network density (+1 SD) results in an 11.80% increase, which is consistent with H4.

These findings remain robust in the full Model 6. Figures 1–3 illustrate the relationships between concentration and local knowledge creation with different levels of moderators. These visualizations corroborate the predictions of H2–H4.

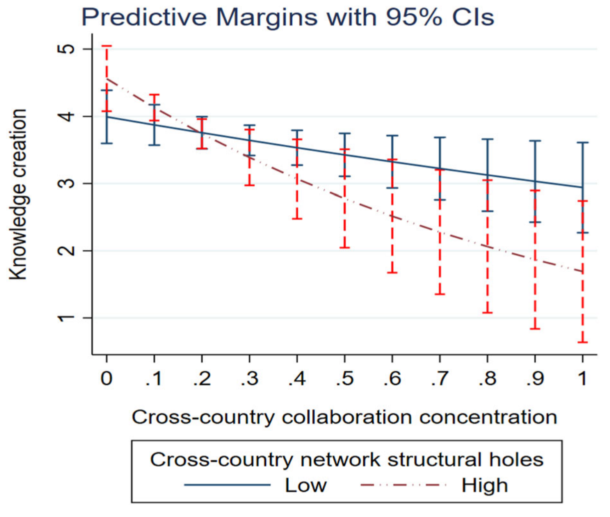

FIGURE 1 Moderating role of cross-country network structural holes.

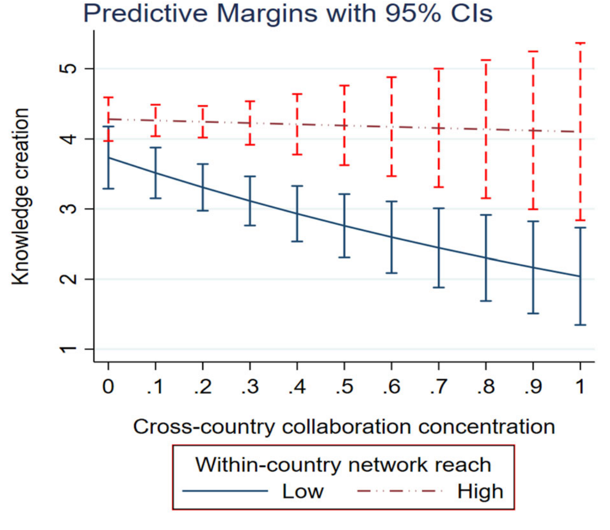

FIGURE 2 Moderating role of within-country network reach.

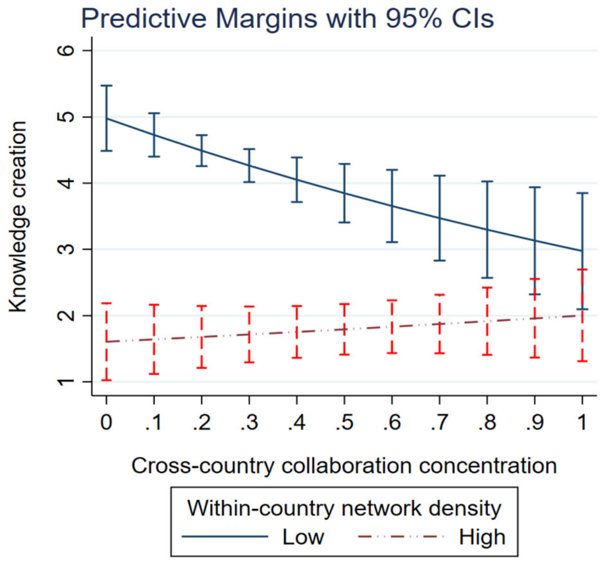

FIGURE 3 Moderating role of within-country network density.

Supporting Information Appendix C presents the measures taken to address potential endogeneity issues in the modeling, including the instrumental variable method and generalized method of moments. Supporting Information Appendix D reports the robustness checks performed, and Supporting Information Appendix E provides additional analyses that evaluate absorption, diffusion, and recombination performance and help rule out alternative explanatory mechanisms.

5 | DISCUSSION AND CONCLUSION

MNCs have increasingly globalized their staff of inventors (Papanastassiou et al., 2020). Nevertheless, recent studies suggest that MNCs often fail to fully exploit the potential of their internal cross-border linkages (Seo et al., 2020). A nuanced exploration of the distribution structure within these linkages may illuminate this issue, but this topic is largely overlooked in the literature. This study advances the current understanding of this topic by integrating insights from the boundary-spanning literature focusing on global R&D and knowledge networks. We develop and empirically test a framework that explains the negative aspects of concentrated cross-border R&D collaboration in MNC host countries.

5.1 | Theoretical implications

Our findings offer several contributions, with the most significant being their emphasis on the critical role of structural configuration in cross-border collaborations within MNCs. Specifically, we introduce the concept of cross-border collaboration concentration to capture their structural heterogeneity, and theorize how varying levels of concentration impose constraints for local knowledge creation. Focusing solely on the quantity of internal cross-border linkages without accounting for their distributional structure may overlook potential differences in the productivity of countries with similar numbers of cross-border collaborations. Our research objective aligns with those of Alcácer and Zhao (2012) and Belderbos et al. (2021), who proposed that not all MNCs can handle internal knowledge linkages cost effectively and that multiple factors must be considered when determining the applicability of developing these knowledge links. The pioneering study by Belderbos et al. (2021) explores the drawbacks of internal linkages in strong intellectual property rights circumstances, whereas our study explores the costs associated with an unequal distribution of internal linkages in the context of local knowledge creation. Our study also addresses a gap highlighted by Seo et al. (2020), who noticed a dearth of research on managing cross-border R&D collaborations for enhancing MNCs' innovation performance.

In addition, we introduce a specific knowledge distortion mechanism and underscore how concentrated cross-border collaborations can impede knowledge creation. Previous studies mostly focus on the knowledge diversity contributions of cross-border collaborations (Kafouros et al., 2022) and implicitly assume that knowledge from different countries is efficiently and accurately transferred, absorbed, and disseminated. However, their analysis ignores the potential for distortion, whether inadvertent or deliberate. We find that this potential distortion is likely to impair knowledge absorption and diffusion (Bathelt & Li, 2020; Bhagat et al., 2002). This finding aligns with the conclusions of recent studies on cross-border research collaborations (Seo et al., 2020; Vestal & Danneels, 2022) and advances them by introducing a specific knowledge distortion mechanism.

Another contribution lies in our formulated contingency framework that explicitly differentiates cross-country and within-country inventor networks within MNCs. We investigated how knowledge flows through cross-country inventor networks into and then gets disseminated in within-country inventor networks within MNCs, and discussed the effectiveness of the two network processes, respectively. Previous research on innovation offers valuable insights into either within-country collaborations or cross-border collaborations independently, but often implicitly assumes that the alternative type of collaboration is done effectively (Scalera et al., 2018). By incorporating geographic space into our analysis, we address the geography of MNC innovation networks highlighted by Cuypers et al. (2020). In line with the recommendation of Beugelsdijk and Mudambi (2013) and Vestal and Danneels (2024) to consider within-country and cross-border variance, our approach offers a more granular network analysis of MNCs' spatial heterogeneity. We further introduce MNC network-structural contingencies, showing that inventors can leverage cross- and within-country networks to mitigate knowledge distortion from concentrated cross-border ties (Hernandez et al., 2015). For cross-country network contingencies, we offer insights into how knowledge heterogeneity—introduced by spanning structural holes in global networks—amplifies the challenges of information overload. For within-country network contingencies, our findings contribute new insights by showing that the effects of international ties are qualified by the receiving local networks (Chung & Jackson, 2013; Grigoriou & Rothaermel, 2017; Kim et al., 2020).

Broadly, we shed light on the antecedents of MNCs' host country performance by integrating boundary-spanning literature into intra-MNC international linkages. In doing so, we extend the analysis of boundary spanners beyond previously well-studied contexts, such as joint ventures (Luo, 2001) and buyer–supplier dyads (Huang et al., 2016), to the context of knowledge workers' internal linkages within the MNC. By doing so, we respond to the calls by previous scholars for a further exploration of boundary-spanning activities in MNCs (Liu et al., 2025).

For example, Schotter et al. (2017, p. 2) called for additional empirical research in this area, noting that previous works on boundary-spanning activities in MNCs are usually conceptual or based on a small number of case studies. To the best of our knowledge, our study is among the first to use large-sample data to link boundary-spanning heterogeneity in global organizations; therefore, drawing attention to the complexity and heterogeneity of their knowledge activities.

5.2 | Managerial implications

Our findings also offer direct managerial implications. For instance, our findings warn managers to pay attention to the effects of their firms' boundary-spanning structures. Some MNCs have established specialized international coordination offices and recruited personnel specifically for cross-border coordination with an aim to reduce coordination costs. However, our findings question the advisability of such a practice at least in R&D divisions because it may be detrimental to local knowledge creation. The primary goal of R&D is not to save costs but to generate knowledge, a sentiment echoed by the interviewees. To achieve knowledge creation, managers can introduce incentives and infrastructure that foster dispersed cross-border collaborations. For example, instead of overly relying on a single researcher for cross-border communication and interaction, managers should provide opportunities for many of their research staff to span country boundaries and participate in cross-border collaborations related to knowledge creation.

In our interviews with practitioners of pharmaceutical MNCs, information overload, long transmission paths, and knowledge hoarding have been raised by interviewees as important knowledge distortion problems in cross-border collaborations within their firms. For instance, a senior manager identified the issue of information overload and remarked: "The main person handling international collaborations often faces challenges due to knowledge overload and conflicts. These challenges arise because every group you're dealing with has their own way of doing things, their own rules. It leads to potentially inconsistent and conflicting thought processes and behaviors." Some managers also noted that when foreign collaborations are disconnected from each other, the workload on local teams intensifies. To address this problem, they recommended fostering direct connections among international partners—through multi-country projects, shared platforms, or structured collaboration loops—to reduce the workload on boundary spanners.

Regarding long transmission paths, a senior researcher remarked: "Relying heavily on certain individuals to disseminate information can make the process lengthy and prone to information decay, and even errors. For pharmaceutical companies, the cost of correcting such errors is very high." Several interviewed managers suggested improving the local network to shorten transmission paths. Recommendations include adopting a matrix structure and leveraging digital platforms—such as collaborative tools or intranets—to improve information accessibility and accelerate diffusion across the domestic network.

When discussing knowledge hoarding, another senior researcher stated: "In the early stages of our company, we relied on a few researchers to collaborate internationally. These researchers, driven by self-interest, may consider themselves very important. They are unwilling to share information, being autocratic." As the interviewees suggested, a dense domestic network is helpful in overcoming this problem. Recommendations for enhancing network density include fostering a culture of collective discussion and collaboration, implementing cross-functional projects to broaden researchers' exposure, and organizing regular workshops or knowledge-sharing sessions to facilitate collaboration and promote mutual understanding.

5.3 | Limitations and future work

This study has several limitations, the first of which concerns the generalizability of its findings. Although the mechanisms we discussed are based on pharmaceutical firms, the need to structure cross-country collaborations is relevant to any organization where innovation intensity and cross-country collaborations are prevalent. In this case, our theoretical framework may be applicable to firms across a wide range of industries. We encourage future research to leverage these sources for cross-industry comparisons, which will help uncover whether similar patterns exist beyond the pharmaceutical industry and broaden the understanding of these metrics' generalizability. We also conducted an empirical study using publicly available databases, but this study has a limited observation window. Future research should explore this issue using a broader dataset.

Second, while our theory posits that concentrated cross-border linkages impede local innovation by distorting knowledge absorption and diffusion and, in turn, constraining recombination for local innovation, our main tests focus on knowledge creation as the ultimate outcome. To probe the underlying mechanisms, we conducted two supplementary analyses. The first analysis incorporated citation-based measures of absorption and diffusion and found that higher concentration is empirically associated with lower levels of both processes (see Supporting Information Appendix E). The second analysis examined recombination by identifying combinations of IPC classes used by local and foreign inventors, and again found a negative relationship between concentration and recombination (see Supporting Information Appendix E). These conservative measures provide preliminary evidence that concentration influences the processes of knowledge absorption, diffusion, and recombination. Given that our measures are conservative, the significant effects we observe are best understood as lower-bound estimates. We therefore expect that future research employing richer operationalizations and process-tracing designs to model absorption, diffusion, and recombination as distinct stages will yield sharper evidence on the processes of knowledge creation.

The third limitation lies in our focus on the local innovation output of host countries, which is a local-level phenomenon and does not aim to capture the full breadth of an MNC's corporate-level strategy or competitive advantage. The latter encompasses a broader set of considerations, including the unique local capabilities, the strategic roles assigned to specific subsidiaries, and the MNC's ability to appropriate value from innovation globally. A lower local patent output in a subsidiary may represent organizational costs that MNCs are willing to incur to achieve a sustainable competitive advantage. Although we identify the potential costs inherent in concentrated cross-country linkages, we do not imply that such concentration is suboptimal for an MNC, given that maximizing local knowledge creation may be one of its goals and not its only goal. Future work should investigate how the strategic goals of MNCs influence the design and outcomes of their global R&D networks, particularly the tradeoffs between local knowledge creation and broader firm-level objectives.

The fourth limitation concerns the potential tradeoff in concentrated cross-border collaborations, which involves balancing the costs associated with local knowledge creation against potential knowledge protection benefits. The structure of R&D networks may, in some cases, function as part of a broader knowledge appropriation strategy (Yan et al., 2022). Boundary spanners may play a controlling role to restrict local inventors' access to only a subset of the knowledge generated at the R&D units located elsewhere (Belderbos et al., 2024). This tradeoff likely varies across host countries, the experience of boundary spanners, and the nature of knowledge involved. Given the complexity of our theoretical model, although concentrated cross-border linkages may reflect this tradeoff, we did not aim to precisely map out the intricate interplay. Future research should explore the optimal structure of knowledge linkages to balance knowledge creation and appropriation.

Our measurement of network reach is also subject to limitations. As articulated by Chang et al. (2023, p. 2957), the assumption of full connectedness, which is commonly adopted in the literature, overlooks the presence of isolated subgroups that are prevalent in many real-world networks. Our use of the averaged distance-weighted reach measure (Schilling & Phelps, 2007) allows for infinite path length in co-inventing networks, yet we acknowledge that this approach may not fully address the issue of disconnected parts within typical social networks. Chang et al. (2023) proposed relaxing the connectedness assumption and using alternative modeling approaches, such as percolation theory, to study the formation of giant clusters that integrate fragmented subgroups. Following this insight, future research should utilize more sophisticated methods to account for disconnected components and further examine the application of these approaches.

Subsidiaries are not only recipients of global knowledge but also important channels of outflows back to the MNC network, reflecting the bidirectional nature of flows noted by Singh (2007). Their roles—home-base exploiting or home-base augmenting (Belderbos et al., 2015; Gassmann & Von Zedtwitz, 1999; Kuemmerle, 1997)—shape how they engage with such flows. These flows are influenced by various factors, including home- and host-country characteristics, the specific attributes of subsidiaries, and their interactions with headquarters (Asakawa et al., 2018; Frost, 2001). Extending these insights, we emphasize subsidiary-level network structures and propose a two-stage knowledge creation process that explains how foreign subsidiaries absorb and diffuse global knowledge. Differences between home-base exploiting and augmenting subsidiaries, especially regarding the effects of cross-border collaboration concentration, offer a promising direction for future research.

Finally, our study adopts a structural perspective, focusing on network-level conditions that constrain knowledge creation. Mell et al. (2022) classified prior studies on boundary spanning and intergroup knowledge sharing research into structural and agentic perspectives. Future research can complement this view by adopting an agentic lens to examine how individual-level heterogeneity—such as differences in capacity, motivation, or prior experience—shapes the effectiveness and outcomes of boundary-spanning roles within MNC networks.

5.4 | Conclusion

Our findings show that a high concentration of cross-border collaborations is associated with reduced local knowledge creation. This effect is moderated by the structural holes of cross-country networks within the MNC and by the reach and density of within-country networks. Our findings underscore that it is not only the volume of cross-border linkages that matters, but also their structural distribution across inventors and the configuration of local networks. Our study advances understanding at the interface of MNC internal linkages, network theory, and innovation, and opens promising avenues for future research.

ACKNOWLEDGMENTS

We thank the action editor, Prof. Minyuan Zhao and two anonymous reviewers for their insightful comments, which were instrumental in developing the paper. The paper has benefited from comments at seminars at Central University of Finance and Economics, Dalian

University of Technology, Huazhong University of Science and Technology, Nottingham University China, and Zhejiang University. We thank James (Jianguo) Li, Xu Huang, Yanxin Liu, Hao Wang, and Yi Chen for their valuable discussions that contributed to the development of this paper. Jiatao Li is grateful for the financial support from the Research Grants Council of Hong Kong (HKUST# 16506622 and 16505124). This research was supported by the National Natural Science Foundation of China (Nos. 72374200, 72102221, and 72072099).

DATA AVAILABILITY STATEMENT

This study's dataset combines open-source and proprietary data. The patent and company data are available from the authors upon request and with permission from Orbis Intellectual Property and Compustat.

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SUPPORTING INFORMATION

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How to cite this article: Zhang, J., Li, J., Yan, Y., & Xie, Z. (2025). Concentration in cross-border research collaborations and MNCs' knowledge creation in a host country. *Strategic Management Journal*, 1–28. https://doi.org/10.1002/smj.70025