



Knowledge capital and innovation management: Impact of transboundary investment and assimilative capacity

**Authors:**

Suleman Bawa¹ 
Xie Yongping¹ 

Affiliations:

¹Department of Economics and Management, Faculty of Management Science and Engineering, Xidian University, Xi'an, China

Corresponding author:

Suleman Bawa,
sulemanbawa@ymail.com

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Background: In today's volatile and highly competitive business environment, the importance of knowledge capital and innovation management for multinational manufacturing firms has been widely recognised by both academia and industry.

Aim: This article aims to explore the impact of transboundary investment and assimilative capacity on the association between knowledge capital and innovation management in this specific context.

Setting: A total of 217 managers and employees were selected from 19 multinational manufacturing firms listed on the Ghana stock exchange to participate in the survey.

Method: Using a theoretical-based association existing research model, data were collected through an online electronic questionnaire survey. The collected data were then analysed using path analysis, utilising SPSS 22.0 and AMOS 24.0 software to test the formulated hypotheses.

Results: The study found that an organisation-wide unified system, technological, organisational resource and knowledge capital-enabling structures strongly influence multinational manufacturing firms. Besides, knowledge capital and innovation management have a positive mediating role and a significant impact on multinational manufacturing firms. However, there was no significant impact between knowledge of empirical capital and innovation management.

Conclusion: The findings of this study highlight the importance of knowledge capital in enhancing innovation management and emphasise the role of transboundary investment and assimilative capacity in mediating this relationship.

Contribution: This research contributes to the theoretical understanding of how knowledge capital and innovation management are interconnected, as well as the relationship between transboundary investment and assimilative capacity, and their respective roles in mediating this relationship.

Keywords: knowledge capital; transboundary investment; innovation management; multinational firms; assimilative capacity.

Introduction

In the current fast-paced and highly competitive corporate environment, academia and industry widely acknowledge the significance of knowledge capital and innovation management for multinational manufacturing firms (Chin, Zhang & Jawahar 2023; Obeidat et al. 2017). With the emergence of a knowledge-based economy, the importance of knowledge capital and firms' innovation management has surged, attracting foreign direct investment (FDI) (An et al. 2022; Singh et al. 2023). Transboundary investments and their assimilative capacity have encouraged FDI to engage with firms possessing physical knowledge capital and innovative management practices (Liu 2023; Lyu et al. 2022). These alliances in innovation networks facilitate learning, provide a platform for the exchange of ideas and foster knowledge sharing among firms. The increase in transboundary investments and assimilative capacity has made advancing knowledge capital and firms' innovation management a shared concern for researchers and FDI (Duan et al. 2021).

This article will focus on knowledge capital and firms' innovation management as the starting point to investigate the impact of transboundary investment and assimilative capacity on them.

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This is because multinational corporations are striving to confront various challenges, such as limited resources, capital (both knowledge and financial), and inadequate innovation management and assimilative capacity (Gulema & Roba 2021; Pereira et al. 2023). Multinational FDIs provide a prolonged time horizon and significant investment, benefiting not only local firms but also multinational firms, which would otherwise face considerable strain on their corporate resources (Duan et al. 2021; Fuchs 2023). Given these challenges, internal corporate resources often fall short of meeting the demands for business innovation (Gulema & Roba 2021). As a result, many multinational companies are consolidating their knowledge capital to gain access to additional capital. Business knowledge capital is commonly perceived as a firm's value because it serves as an operational asset to acquire knowledge, drive innovation processes, enhance interactions and improve learning mechanisms (Ortiz, Donate & Guadamillas 2018; Sheng & Hartmann 2019; Zhang et al. 2020).

Companies with significant knowledge capital can acquire diverse knowledge by establishing constrained relationships or reaching compromises with accommodating matters (Tsai & Hsu 2019). Ultimately, diverse knowledge acquisition not only drives firms to innovate but also enhances their corporate innovation management practices. However, the imperative for firms to globalise, coupled with economies seeking investment from foreign partners and scarce resources for investment, has intensified the level of transformation in business settings (Anand et al. 2021). Consequently, firms seek transformation by internationalising to leverage their mobile capital.

Knowledge capital has faced setbacks because of a lack of resources and therefore needs to undergo multinational transformation (Duan et al. 2021). Specifically, it is crucial for multinational firms to continuously transform and expand their operations, seeking revenue investment streams while managing their innovation. Meanwhile, building knowledge capital also requires investment in business resources. Thus, whether multinational corporations can advance innovation management by structuring their knowledge capital remains uncertain.

Consequently, scholarly works on multinational corporations primarily emphasise knowledge capital, particularly innovative exchanges between parent companies and affiliates (Jiménez-Jiménez, Martínez-Costa & Sanz-Valle 2014; Papanastassiou, Pearce & Zanfei 2020). This focus extends beyond companies operating in the same sector to include those in comparable legal or regulatory environments and with similar objectives (Duan et al. 2021; Lyu et al. 2022). For such corporate firms, and the scholarly works on them, transboundary investment, knowledge capital management and execution of corporate innovative works have become burning issues to achieve their transnational transformational agenda (Nikolay & Andrey 2021).

In their 1987 study, Fennell and Alexander examined how organisational boundaries impact operations within stable environments. However, these stability-focussed strategies are becoming less suitable in today's dynamic multinational business environment. Contextually, transboundary investment, implicit knowledge distribution and knowledge capital can significantly impact the development of various multinational corporate firms' divergent innovation capabilities (Sheng & Hartmann 2019). This can lead to an enhancement in the quality of ambidextrous innovation management within multinational firms, in which social detachment acts as a regulating role in this process (Duan et al. 2021). Hence, there is a close connection between transboundary investment and corporate innovation management (Nikolay & Andrey 2021). Knowledge across firm borders is conducive to the generation of knowledge capital and resource generation, bringing heterogeneous knowledge to firms (An et al. 2022). Firms interact with each other as nodes of collective interest with intricate interdependent networks (Bawa et al. 2023). Knowledge capital involves a collaborative discussion action where participants constructively argue and exchange ideas and values. This fosters close dealings possibly among transboundary knowledge investment and innovative business management.

To enhance innovation, the assimilative capacity to absorb can optimise inter-firm collaboration (Wu & Chiu 2018). Having diverse knowledge alone is insufficient for corporate innovation; firms must also possess the ability to effectively utilise heterogeneous knowledge (Moeen & Agarwal 2017; Santoro et al. 2020). Given the contemporary state of resource constraints faced by many firms, it is unclear whether assimilative capacity can mediate the relationship between knowledge capital and corporate innovation management. Specifically, firms can effectively obtain heterogeneous knowledge through transboundary investment as this inspires knowledge conception within firms, inspiring innovative thinking and improving their capacity to absorb and share knowledge (Moeen & Agarwal 2017; Lyu et al. 2022). Thus, the transitional restraint between transboundary investment and assimilative capacity hypothetically acts as pivotal in mediating the link between knowledge capital and innovation management within corporations. For many multinational firms, managing knowledge capital is essential for their self-reformation, networks and growth (Bawa et al. 2023). Knowledge capital management is a spherical process; multinational firms gather information from various sources and network with corporate allies (Gulema & Roba 2021; Tarasenko 2023). In this way, successful knowledge capital and innovation management implementation are crucial for innovation and growth, without which, firms may struggle to progress or survive in foreign markets (Anand et al. 2021; Marti & Do Rosário Cabrita 2012). Therefore, multinational firms should focus on effectively applying their knowledge capital and managing innovation.

In the current global business environment, firms are expanding rapidly into new territories, facing challenges such as cultural differences, political environments, emerging

management innovative skills and e-technologies in their globalisation (Bawa et al. 2023). These facets also epitomise hindrances for overseas multinational firms that are trying to do business with local firms. Relatively, knowledge capital and corporate innovation management are key strategies for firms in this changing landscape. Intense competition, changing customer preferences and new market opportunities are driving the need for firm innovation (Huang 2023). To succeed internationally, firms must understand and respect the diverse beliefs and standards of the host country and local firms.

While previous studies have partially explored aspects of knowledge capital and innovation management, study gaps persist in prevailing research, and hence need to be addressed. Secondly, studies have contended that knowledge capital empowers corporate firms to build physical systems, build up inter-firm relations and eventually advance innovation management (Akintimehin et al. 2019; Pieroni, Lattanzi & Riccaboni 2023). While FDI has deepened resource pressure, the transformation of multinational corporations is crucial for innovation management. However, it is unclear whether multinational corporations can improve their innovation management through knowledge capital initiatives under the constraints of resource scarcity and multinational transformations (Petricevic & Teece 2019; Schaltegger, Loorbach & Hörisch 2023). Additionally, business relations centred on knowledge capital facilitate investment flow between firms and promote transboundary investment, which can enhance innovation management. Transboundary investment brings heterogeneous investment to firms to increase innovation management. Nonetheless, in effect, there is a lack of clarity in existing studies regarding the relationship between knowledge capital, transboundary investment and assimilative capacity (Akintimehin et al. 2019; Lyu et al. 2022). Lastly, the processes of investment and assimilation are inseparably knotted. Knowledge capital provides avenues for firms to pursue diverse transboundary value, and the value gained from transboundary investment can enhance firms' assimilative capacity, ultimately improving their innovation management (Bawa et al. 2023; Lyu et al. 2022). Regrettably, there is a lack of scholarly work exploring the impact of transboundary investment and assimilative capacity on the relationship between knowledge capital and corporate innovation management.

Indeed, in the context of the multinational revolution, multinational firms' knowledge capital remains crucial for accessing peripheral information (Zhang et al. 2020). This is because knowledge capital sets the basis for transboundary investment (Maximov, Scheglova & Surtaeva 2023), enabling firms to navigate through different corporate environments and gain external diverse value through knowledge capital systems (Dudin et al. 2013; Hafner, Diepold & Fottner 2021). Additionally, acquiring diverse knowledge enhances multinational firms' assimilative capacity, enabling them to convert acquired knowledge into innovative products and thus enhancing corporate innovation management. We address three study questions based on our hypothetical analysis and empirical investigations:

Research question 1: Does the knowledge capital of multinational firms still improve corporate innovation management under the collective pressures of resource restraints and multinational transformation?

Research question 2: Does transboundary investment intermediate the relationship between knowledge capital and corporate innovation management in multinational firms?

Research question 3: Does assimilative capacity have an impact on knowledge capital and innovation management in multinational firms?

Based on the prevailing study results, this article analyses the knowledge capital and innovation management of multinational firms through empirical analysis, further examining the impact of transboundary investment and assimilative capacity on multinational firms. The Ghanaian background helps authenticate strategies developed and implemented in an example of a developing economy and latecomer evolution, influencing the knowledge capital and corporate innovation management of multinational firms. The study's remaining sections detail how these factors address the research questions.

Literature analysis and study hypotheses

Knowledge capital and corporate innovation management

Knowledge capital represents the value a firm derives from its workforce in terms of its capabilities, knowledge and learning within the organisation (Allameh et al. 2017; Al-Husban et al. 2023). It encompasses the relationships, practices, techniques and innovations that constitute invaluable assets for a firm (Dino 2015). By enhancing and maintaining the value of these assets, knowledge capital gives multinational firms an economic advantage over their competitors (Farooq & Ahmad 2023). Generally, knowledge capital is viewed through three dimensions: knowledge human empirical capital, knowledge interactive capital and knowledge physical capital (Inkinen et al. 2017; Lyu et al. 2022; Vătămănescu et al. 2023).

Knowledge human empirical capital refers to the contributions made by employees to a firm through their capabilities, knowledge and expertise (Al-Husban et al. 2023; Wang et al. 2023). Leading firms prioritise attracting innovative and creative personnel (Balle et al. 2020; Lyu et al. 2022). Agreements result from the assimilation of differences among partners (Pieroni et al. 2023). This process alters the firm's prevailing perception and expands its intellectual capacity (Peng 2013). Firms with innovative intellectual models can derive diverse values from collaboration, becoming hubs for corporate innovation management (Wu & Chiu 2018; Yong & Yang 2014). Additionally, a firm's knowledge of human empirical capital is shaped by enduring

mutual declarations, objectives and ethics (Mea & Sims 2019; Yoshida, Gordon & James 2021). Therefore, knowledge of human empirical capital is crucial for mitigating conflicts and obstacles between firms, enabling the exchange and integration of assets and knowledge, and creating an environment conducive to firm innovation (Ali et al. 2023; Konno & Schillaci 2021).

Knowledge interactive capital refers to interactions between personnel and stakeholders such as providers, businesses, partners and agents (Abualoush, Bataineh & Alrowwad 2018). These interactions derive value from the relationships they form. Deep interactions are based on trust, respect and shared values (Lyu et al. 2022). A corporation with good knowledge of interactive capital is perceived as trustworthy, authentic and reliable by its partners (eds. Leenders & Gabbay 2013; Wang et al. 2023). Reliance-based relationships between businesses are even and cost-effective (Ali et al. 2023), enabling the institutionalisation of enduring interactions. Robust knowledge interactive capital ensures equal value and productivity in information exchange, supporting firms in managing innovation without being hindered by temporary technical changes (Bradley et al. 2012). Moreover, reliance-based collaborations are flexible and unrestricted, crucial for transmitting and displaying implicit knowledge (Ganguly, Talukdar & Chatterjee 2019).

Knowledge physical capital comprises the practices, approaches and methods that enable a firm to function and exploit its competencies (Wang et al. 2023). It includes the participants associated with a firm and reflects the magnitude of these relationships. These relationships serve as vital conduits for acquiring diverse knowledge (Tsai & Hsu 2019), which is considered fundamental for business innovation management (Morabito 2014). Resilient relationships allow multinational firms to gain valuable knowledge with innovative value (Hennart 2012; Fuchs 2023). Various means, such as establishing partnerships and adopting collaboration agreements, facilitate these relationships, reducing information irregularity to facilitate corporations in enhancing their corporate innovation management (Dhir et al. 2023; Riley, Michael & Mahoney 2017; Saxena et al. 2017).

Admittedly, knowledge capital is crucial as it reduces the need for a firm to start from scratch when implementing specific practices, especially when employees have access to documents outlining the required activities (Kianto, Sáenz & Aramburu 2017; Ovsienko 2023). It requires significant investment, drives success and provides insights crucial for a firm's continued survival (Chellaraj & Mattoo 2015). Diverse knowledge acquisition can effectively inspire firm innovation management, thereby improving overall innovation (Ali et al. 2023). Based on this analysis, we propose the following hypothesis:

H1: Knowledge capital significantly contributes to corporate innovation management.

The intermediating role of transboundary investment between knowledge capital and corporate innovation management

Transboundary investment refers to the actions taken by investors to acquire a significant ownership stake in a company located in another country (Volz et al. 2021). This occurs when a company requires external funding to sustain its operations, prompting external investors to purchase a permanent management interest by acquiring shares, forming alliances through mergers and acquisitions, or taking over an existing company. Emerging market firms are aware of their operational limitations, which guide their participation in the knowledge economy and influence their investment strategies based on internal value capacity (Wang et al. 2023). Establishing physical limits on investments is aimed at effectively managing operational funds to achieve managerial objectives (Tripathi et al. 2021). Businesses need to continually adjust their limits according to their capabilities or human empirical structures as part of their investment practices. However, these limits can hinder knowledge acquisition, making it difficult for firms to gain diverse knowledge (Leonardi 2015). Transboundary investment can exceed the limits of multinational firms and introduce innovative perspectives and concepts that go beyond their current investment portfolio. Zhou and Wu (2018) emphasise the importance of taking an inclusive approach to this expansion. Transboundary investments are commonly categorised into two main types: transboundary inward investment and transboundary outward investment (Lyu et al. 2022; Milani 2021). Transboundary inward investment occurs when a foreign entity invests in or acquires assets in a domestic economy, while transboundary outward investment happens when a domestic firm expands its operations to a foreign economy through mergers and acquisitions or by developing an existing foreign capability (Milani 2021).

Transboundary investment serves as a proactive strategy for multinational firms to contrivance knowledge management, enabling access to valuable insights and resources from the knowledge systems of the regions where these corporations operate (Kano, Tsang & Yeung 2020). Additionally, through transboundary investment, multinational firms can leverage innovative investment strategies to enhance their existing investment to create and expand upon new merchandise with increased investment credibility and appropriateness (Motohashi 2015). Consequently, based on these findings, we put forward the following hypothesis:

H2: Transboundary investment mediates the association between knowledge capital and corporate innovation management.

The intermediating role of assimilative capacity between knowledge capital and innovation management

In the primary stage of a multinational company's transboundary system, the focus is on searching for

investment prospects (Wallace 2021). Additionally, multinational firms need to improve their ability to absorb, process and share knowledge. Assimilative capacity, as defined by Chichkanov (2021), refers to a firm's capacity to recognise, evaluate, integrate and apply novel external knowledge. Zahra and George (2002) further categorise assimilative capacity into potential and actual assimilative capacity. Potential assimilative capacity is the firm's ability to assess and integrate external knowledge (Algarni et al. 2023; Camisón & Forés 2010), while actual assimilative capacity is its ability to modify and utilise integrated knowledge (Singh et al. 2023).

Companies that possess a deep understanding of their physical capital are frequently acknowledged and recognised by a range of stakeholders (Ciambotti et al. 2023). This recognition often leads to these firms acquiring extra resources and discovering new opportunities for collaboration (Porter & Kramer 2018; Ritala et al. 2013). In business, having a solid understanding of physical capital can help create both formal and informal networks between companies. These networks allow resources and information to flow freely, making it easier to identify and acquire knowledge (Jinghua & Jisheng 2017). This is because when businesses share information willingly, it is generally seen as safe, simple and effective (Peng 2013).

Effective assimilative capacity reduces the costs associated with acquiring, transforming and utilising knowledge. This efficiency leads to the enhancement of a firm's knowledge base (Lyn et al. 2022:4). Knowledge assimilation enables multinationals to generate innovative ideas for improving current procedures, such as product strategy, manufacturing and marketing (Mea & Sims 2019; Maximov et al. 2023). Additionally, multinationals can strategise and develop entirely new products based on newly absorbed knowledge (Konno & Schillaci 2021). Hence, improving and utilising current procedures and creating novel products are key aspects of business innovation management (see Figure 1). Based on this analysis, the following hypothesis is proposed:

H3: Assimilative capacity acts as a mediator between knowledge capital and the management of corporate innovation.

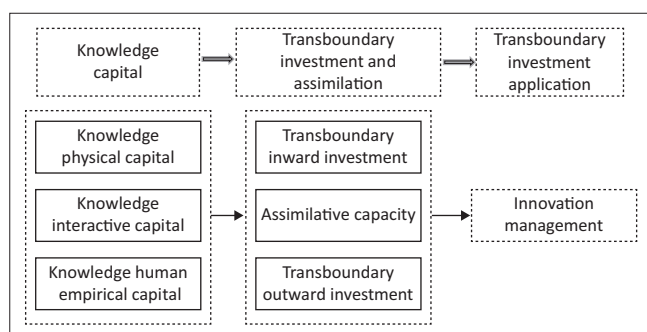


FIGURE 1: Theoretical background framework.

Methodology

Data collection

The study gathered data from 19 multinational manufacturing firms in Ghana using an online electronic questionnaire survey over 7 months from February to August 2023. This method was chosen for its effectiveness in reaching a widely distributed population, which is common in fast-moving environments like this (Jafari & Ramalingam 2014). Electronic surveys are widely used and greatly facilitate comprehensive research (Bawa et al. 2023). The firms we targeted were spread across different regions of Ghana, making a web-based survey the perfect tool for reaching them (Jafari & Ramalingam 2014:87). All questionnaire surveys conducted were usable and used for data analysis.

Multinational firms, defined as firms with operations in countries other than their local country, were selected based on their positive economic impact on the countries where they operate. The top 19 multinational firms in Ghana were selected for the study because of their strong investment bases and accumulations, which are indicative of their expertise in investment knowledge and transformation (see www.asetena.com and www.Kompass.com for the database description).

To ensure data quality, we identified the most senior person in the highest managerial position within each department, with many years of experience (Bawa et al. 2023; Fisher, Lauria & Chengalur-Smith 2012). These senior managers were entrusted with distributing the survey to other employees in their department, assuming they had the knowledge and authority to do so.

Letters were sent to Managing Directors (MDs) to inform all departmental senior managers about the survey beforehand (see e.g. Bawa et al. 2023). These letters explained the research purpose and requested senior managers' contact information. Senior managers were then instructed to share the survey with as many relevant employees as possible. Respondents and their firms were promised a report card of their firm profile and future research opportunities at a moderate fee as an incentive (Bawa et al. 2023).

After receiving responses from MDs, the questionnaire was distributed to potential respondents using official email, WhatsApp or WeChat. The usable sample size was 217, with all 19 firms responding, representing a 100% response rate after follow-ups. To check for non-response bias, a random sample of three firms completed a brief phone interview, and the AMOS 24.0 test showed no significant difference in responses.

The questionnaire was pre-tested by specialists in questionnaire design (Bawa et al. 2023), innovation management and knowledge capital. After improving the questionnaire based on their suggestions and feedback, a reliability test was performed using sample respondents

from a pilot study, resulting in insignificant changes to the questionnaire.

Research design and method

The study used both quantitative and qualitative methods to collect and analyse data, aiming to provide a thorough understanding of the research subject. Quantitatively, a survey was conducted among multinational manufacturing firms to collect data on their transboundary investments, assimilative capacity and innovation management practices. This survey used structured questionnaires designed to gather quantitative data on these variables. Qualitatively, in-depth interviews were conducted with key informants within these firms to explore how transboundary investment and assimilative capacity affect innovation management. These interviews offered valuable insights into the specific strategies and processes employed by these firms in managing innovation within the context of transboundary investment.

Sampling method and selection technique

For sampling, purposive sampling was employed to select multinational manufacturing firms that have engaged in transboundary investment and have varying levels of assimilative capacity. This method allowed the researchers to select participants who could provide relevant and insightful information. Selection criteria included the size of the firm, the extent of transboundary investment and the level of assimilative capacity. This ensured diversity in the sample and captured a wide range of experiences and perspectives.

Descriptive statistics

The respondent demographics are as follows: (1) 75% are male and 25% are female. (2) The highest frequency of respondents falls within the 31–40 age group, representing more than 45% of all respondents. The combined total of respondents in the 21–30 and above 41 age groups, along with the 31–40 age group, accounts for 100% of all respondents. (3) Approximately 74% of respondents hold a bachelor's degree or higher, while the remaining respondents hold a diploma. (4) A total of 40% of respondents are in executive or management-level positions, while the rest are in other roles. It is important to note the significance of executives' and managers' perspectives, as they often contribute fresh ideas for innovation by challenging existing working procedures, which can lead to business growth (Bawa et al. 2023). (5) Over 65% of survey participants had been with their respective companies for more than 7 years, because of their prolonged work experience, which adds reliability to their responses. The results for the control variables are presented in Table 1.

Measurement of variables

The study focusses on examining how the relationships between multinational firms, as identified through their knowledge capital, influence innovation management.

Following the approach of Lyu et al. (2022), we measure knowledge capital using three dimensions: physical capital, interactive capital and human empirical capital. This measurement approach is supported by scholars such as Wu and Chiu (2018) and Jeong, Ha and Lee (2021).

For physical capital, we adopt the scale used by Kim and Shim (2018), which assesses physical capital using three components. Similarly, for interactive capital, we rely on Jeong et al.'s (2021) recommendation, using three components to measure it. The assessment of human empirical capital considers mutual dialect, mutual descriptions, and mutual ideas and directions, drawing on the work of Nahapiet and Ghoshal (1998), Jeong et al. (2021) and Lyu et al. (2022).

Transboundary investment is measured in terms of inward and outward investment, with 12 items drawn from Sidhu, Commandeur and Volberda (2007) and Zhang et al. (2020). Innovation management is assessed based on scales from Hagedoorn and Cloudt (2003) and Alpan et al. (2010), using five items. Assimilative capacity is measured using scales from Zahra and George (2002) and Lau and Lo (2015).

TABLE 1: Demographics of correspondents ($N = 217$).

Details	Frequency	%
Gender of respondents		
Male	162	75
Female	54	25
Age groupings of respondents (years)		
21–30	62	28
31–40	98	45
41 >	57	27
Qualifications		
Diploma	55	26
Bachelors and above	162	74
Positions		
Executive and management level	86	40
Other employees	131	60
Years of employment		
> 6	76	35
7 >	141	65
Firm type		
Collectivistic	70	32
Personal	68	31
WFOE	55	25
Equity joint ventures	17	9
Others	7	3
Firm size (staff)		
< 30	20	9
30–60	55	25
60–90	87	40
90–120	36	17
> 120	19	9
Firm age (years)		
< 6	8	4
6–10	42	19
10–14	78	36
14–20	52	24
20–24	37	17

WFOE, wholly foreign-owned enterprise.

To account for potential influences on innovation management and transboundary investment, we include firm type, firm size and firm age as control variables. Innovation management and transboundary investment may also impact these variables, as suggested by Bawa et al. (2023). The study uses a five-point Likert scale to measure agreement with statements, ranging from 'strongly disagree' to 'strongly agree'.

Ethical considerations

Ethical approval to conduct the study was obtained by the School of Economics and Management from the Xidian University of Research Ethics Committee (reference no.: Ref#2023/XDU/SEM/001).

Empirical analysis and results

Reliability and validity tests

We used SPSS 22.0 to evaluate the reliability and validity of our scales (see Lyu et al. 2022), as described in Table 2. Our reliability test yielded a significantly positive score, surpassing the 0.7 threshold for each measurement scale, indicating strong reliability. Consequently, we utilised Cronbach's alpha scores for our construct variables (see Hayes & Coutts 2020).

Results of the correlation analysis of variables

A correlation analysis was performed using SPSS 22.0 to explore the relationship between the variables (see Lyu et al. 2022), and the findings are outlined in Table 3. The main variables of the study show significant correlations, providing

TABLE 2: Reliability and validity test statistics results.

Variable	Cronbach's alpha (α)	CR	AVE
Knowledge physical capital (KPC)	0.723	0.835	0.629
Knowledge interactive capital (KIC)	0.709	0.822	0.606
Knowledge human empirical capital (KHEC)	0.749	0.860	0.672
Transboundary inward investment (TII)	0.789	0.900	0.599
Transboundary outward investment (TOI)	0.789	0.899	0.598
Assimilative capacity (AC)	0.788	0.899	0.597
Innovation management (IM)	0.812	0.924	0.706

CR, composite reliability; AVE, average variance extracted.

TABLE 3: The mean, standard deviation and correlation analysis results.

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Type	2.045	0.782	-	-	-	-	-	-	-	-	-	-
2. Size	3.071	1.926	0.122	-	-	-	-	-	-	-	-	-
3. Age	3.212	1.934	0.115	0.197	-	-	-	-	-	-	-	-
4. KPC	3.131	1.289	0.022	0.058	0.029	0.692	-	-	-	-	-	-
5. KRC	3.553	0.712	0.055	0.026	0.147	0.304**	0.768	-	-	-	-	-
6. KHEC	3.534	0.731	0.048	0.011	0.003	0.410**	0.447**	0.818	-	-	-	-
7. TII	3.305	0.662	0.013	0.123	0.121	0.193**	0.384**	0.286**	0.773	-	-	-
8. TOI	3.426	0.631	0.057	0.044	0.026	0.228**	0.330**	0.272*	0.205**	0.772	-	-
9. AC	3.526	0.621	0.102	0.107	0.036	0.250**	0.401**	0.317**	0.331**	0.306**	0.672	-
10. IM	3.466	0.752	0.011	0.033	0.065	0.448**	0.553**	0.537**	0.497**	0.516**	0.465**	0.841

Notes: Two-tailed test: the digits on the transverse are average variance extracted square roots.

KPC, knowledge physical capital; KIC, knowledge interactive capital; KHEC, knowledge human empirical capital; TII, transboundary inward investment; TOI, transboundary outward investment; AC, assimilative capacity; IM, innovation management; SD, standard deviation.

*, $p < 0.05$, **, $p < 0.01$.

initial support for the proposed hypotheses. Therefore, further hypothesis testing can be carried out.

Table 4 shows that 'Group A' has the highest average value for innovation management, suggesting that knowledge capital negatively affects innovation management in multinational firms ($I > III > II > V > IV > VI$). When multinational firms have significant knowledge capital, the absence of FDI affects their innovation management differently, as indicated by the sequence $I > II > V$, in comparison to firms with lower knowledge capital, represented by the sequence $B > D > F$. Therefore, H1 is confirmed. Similarly, when multinational firms face the same level of FDI deprivation, those with high knowledge capital exhibit greater innovation management than those with low knowledge capital ($I > II$; $III > IV$; $V > VI$). Moreover, we noted a compelling pattern indicating that multinational corporations possessing substantial knowledge capital are more likely to achieve advanced levels of innovation management, even in the absence of FDI ($III > II$; $V > IV$).

Direct influence analysis

The study employed path analysis for its efficiency in modifying the model and testing hypotheses, allowing for a clear visual presentation of path coefficients (Bawa et al. 2023). To analyse the direct influence between variables, we used AMOS 24.0, given the complexity of associations and the large number of hypotheses. Initially, we conducted a path analysis based on a hypothetical model to establish the path's significance. Subsequently, we adjusted the model based on the constructed composite reliability (CR) value paths, resulting in a modified path analysis (see Figure 2).

TABLE 4: Outcomes of least significant difference variance study between sets ($N = 217$).

Dependent variable	Group A	Group B	Mean-variance (A-B)	Results
Innovation management	I	II	0.257*	A > B
		III	0.171*	A > C
		IV	0.468*	A > D
		V	0.403*	A > E
		VI	0.510*	A > F

Notes: Levene value = 0.730 ($p = 0.457 > 0.05$), identical variances hypothesis is sustained, hence supported; mean variances among all sets are not completely presented in this table because of space restrictions; the total mean association of innovation management is $I > III > II > V > IV > VI$.

*, $p < 0.05$.

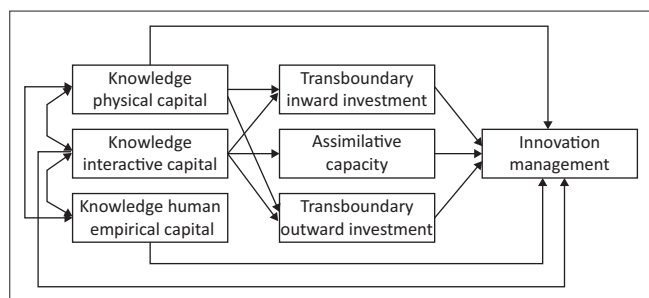


FIGURE 2: Path analysis.

Analysis of the impact of transboundary investment

Regarding transboundary inward investment, our findings (Figure 2) indicate a positive and substantial association with both knowledge physical capital and knowledge interactive capital ($\beta = 0.251, p < 0.05$; $\beta = 0.238, p < 0.001$). Additionally, transboundary inward investment significantly and positively influences innovation management ($\beta = 0.304, p < 0.001$). However, the link from knowledge of human empirical capital to transboundary inward investment lacks significance. To further test the impact of transboundary inward investment, we employed the 'bootstrap method', setting knowledge of physical capital as the independent variable, transboundary inward investment as the mediating variable and innovation management as the dependent variable. Using the 'PROCESS' package in SPSS 22.0, a bootstrap test with 5000 samples (Hayes 2018; Lyu et al. 2022) was conducted. The results suggest that when companies invest across borders, this helps to strengthen the connection between their knowledge and physical capital, leading to better management of corporate innovation. This finding supports hypothesis H2.

For transboundary outward investment (refer to Figure 2), both knowledge physical capital and knowledge interactive capital are significantly and positively associated with transboundary outward investment ($\beta = 0.237, p < 0.001$; $\beta = 0.258, p < 0.001$). Similarly, transboundary outward investment is positively significant and related to innovation management ($\beta = 0.245, p < 0.001$). Therefore, transboundary outward investment mediates the relationship between knowledge physical capital and corporate innovation management. This implies that cross-border investments can act as a mediator between interactive knowledge capital and the management of corporate innovation. Conversely, the relationship between knowledge human empirical capital to transboundary outward investment is insignificant.

Analysis of the impact of assimilative capacity

Both physical and interactive knowledge capital significantly and positively impact assimilative capacity ($\beta = 0.163, p < 0.01$). Assimilative capacity positively affects innovation management ($\beta = 0.244, p < 0.001$). Nevertheless, the link between human empirical knowledge capital and assimilative capacity is insignificant. Notably, assimilative capacity acts

as a mediator between physical knowledge capital, interactive knowledge capital and innovation management. Therefore, hypothesis H3 remains undecided.

Conclusion

Research conclusions

We investigated how knowledge capital influences innovation management in multinational firms, focussing on the impact of transboundary investment and assimilative capacity. Guided by three key study questions and informed by our theoretical review and empirical tests, we made several findings.

Firstly, we found that knowledge capital significantly and positively affects innovation management in multinational firms. Specifically, the knowledge capital within firms can facilitate the transfer of knowledge, thereby enhancing innovation management (Maurer, Bartsch & Ebers 2011). This reaffirms the connection between corporate knowledge capital and innovation management, especially considering the challenges posed by resource limitations and the transformation of multinational firms. Our results suggest that knowledge capital plays a crucial role in enhancing the innovation management of multinational firms, even though it requires substantial resources. The interactions facilitated by knowledge capital ensure the smooth flow of knowledge and information, contributing to the growth of multinational expertise (Forman & Van Zeebroeck 2019; Horng & Wu 2020). We also observed that multinational firms with higher knowledge capital are more effective in developing innovation management compared to those with lower knowledge capital, even if the former may face challenges such as limited interest in FDI. Despite these challenges, building knowledge capital is essential for multinational firms to add value. Our findings support the view that multinational firms should proactively develop their knowledge capital. This can lead to improved innovation management by enabling the exchange and dissemination of knowledge resources, thereby enhancing the value derived from limited resources (Maurer et al. 2011). Therefore, fostering knowledge capital is crucial for multinational firms to enhance their innovation management capabilities.

Secondly, transboundary investments mediate the relationship between physical and interactive knowledge capital and innovation management. The role of transboundary investment in linking knowledge human empirical capital and innovation management appears to be insignificant for multinational firms. According to Sheng and Hartmann (2019), a key challenge in transboundary investment is establishing investment pathways between new companies and investors. Fortunately, companies with strong knowledge capital can effectively address this challenge by establishing agreements and partnerships with investors. Additionally, the diverse knowledge gained through transboundary investment (Duan et al. 2021) revitalises multinational innovation and

enhances the uniqueness of companies' knowledge base. This is crucial for enhancing the innovation management practices of multinational firms.

Finally, the impact of transboundary investment and assimilative capacity on knowledge capital and innovation management is notable. Utilising insights from knowledge creation theory, and integrating a variety of knowledge sources can drive innovation within a company, broadening its knowledge foundation (Fabiano, Marcellusi & Favato 2021). This broadened knowledge base empowers firms to identify, adjust and disseminate additional knowledge, thus nurturing innovation management (Bawa et al. 2023) and ultimately enhancing the firm's knowledge capital value. Thus, transboundary investment, which enables access to diverse investment flows and enhances firm value, can influence knowledge capital and innovation management, alongside the firm's assimilative capacity.

However, concerning human empirical capital (a facet of knowledge capital), the impact is minimal. While this result may be unexpected, it aligns with a comprehensive analysis. Regarding the relationship between human empirical capital and innovation management, inter-firm relations formed through shared principles or consensus (Zhang et al. 2020) can enhance innovation management. Conversely, disruptions to these relations (e.g. because of a lack of FDI) can lead to a negative impact on firm value, despite the diverse investment inflows from transboundary investment. This indicates that the varied investments from transboundary investments might not be enough to notably improve the ability to adapt and manage innovation in multinational companies. Given this, we find the limited effect of transboundary investment and adaptability on the link between human empirical capital and innovation management to be reasonable.

Theoretical contributions

We conducted theoretical analysis and empirical tests to address our research questions and contribute to the prevailing literature on innovation management in multinational firms. Firstly, we investigated the relationship between knowledge capital and innovation management in multinational firms, considering the context of FDI. While past studies have focussed on social capital as a driver of firm innovation in stable environments (Pucci et al. 2020; Singh et al. 2023), our study diverges by emphasising the role of knowledge capital. We contend that knowledge capital not only drives innovation within firms but also enhances their ability to manage innovation in competitive, emerging economies with substantial transboundary investments.

Our findings suggest that multinational firms with abundant knowledge capital are better equipped to manage innovation during challenging times compared to those with limited knowledge capital. This aligns with existing literature (Lyu et al. 2022; Maurer et al. 2011) on the association between knowledge capital and innovation management. Additionally,

our research reveals that multinational firms with substantial knowledge capital can excel in innovation management, even when faced with challenges such as a lack of investment interest from FDIs. This deepens our understanding of how the innovation management of multinational firms varies during periods of limited FDIs, based on their levels of knowledge capital.

Secondly, building on the second study inquiry, we investigate the mediating role of transboundary investment in the relationship between knowledge capital and multinational firms' innovation management, both theoretically and empirically. While prior research has recognised the importance of business innovation (Hasan et al. 2020) and joint knowledge creation (Al-Omouh, Simon-Moya & Sendra-García 2020), few studies have specifically examined how knowledge capital influences innovation management through the lens of transboundary investment. To address this gap, we explore how transboundary investment acts as a mediator between knowledge capital and innovation management in multinational firms. Our theoretical analysis and empirical tests reveal that transboundary investment, including both inward and outward investment, can mediate the association between knowledge capital and innovation management in multinational firms. This implies that having a strong base of knowledge allows companies to create transboundary investment pathways, which helps investment move more easily between different economic regions. Consequently, diversified investments acquired through transboundary investment can enhance multinational firms' innovation management. In conclusion, our research contributes to the advancement of scholarly understanding regarding the mechanisms by which multinational firms' knowledge capital enhances innovation management through transboundary investment.

In line with our third research question, we investigated the combined effects of transboundary investment and assimilative capacity on the association between knowledge capital and innovation management in multinational firms. Our findings reveal that transboundary investment and assimilative capacity act as serial mediators between knowledge capital and innovation management. This discovery points towards a promising avenue for future research.

Prior scholars have highlighted the significance of knowledge acquisition and assimilation concerning knowledge capital and innovation management (Bawa et al. 2023; Lyu et al. 2022). However, these studies have often treated these practices as separate entities. For example, while some argue that knowledge capital drives service innovation through peripheral knowledge acquisition (Huang & Liu 2019), others suggest that knowledge capital can negatively affect a firm's assimilative capacity (Golgeci & Kuivalainen 2020), yet a firm's assimilative capacity can enhance innovation. Despite this recognition, there has been limited research linking investment and knowledge assimilation to understand their

roles in the association between knowledge capital and innovation management in multinational corporations. Our study fills this gap by investigating the impact of transboundary investment and assimilative capacity on the relationship between knowledge capital and innovation management in multinational corporations. Overall, our research adds to the current literature, connects with related fields and provides a new angle for future research.

Managerial implications

Our research has revealed insights into how transboundary investment and assimilative capacity influence the relationship between knowledge capital and innovation management. We aim to outline the managerial implications of these findings.

Multinational firms, especially those expanding into emerging markets or undergoing transformation because of multinational investments, should focus on the role of knowledge capital in innovation management. Our study validates that multinational firms benefit from all three forms of knowledge capital, which significantly contribute to innovation management. However, in situations of limited investment, enhancing knowledge capital can be particularly challenging for multinational firms.

To enhance a multinational firm's physical knowledge capital, it is essential to engage in collaborations across firms. This means that fostering supportive partnerships is crucial. Hafner et al. (2021) suggest that multinational corporations should establish open business-to-business (B2B) virtual advertising platforms to collaboratively share information on investment partnerships. Unlike generic virtual B2B collaboration platforms (Yi Liu et al. 2020), these platforms should prioritise the transparency of investment information. This means that multinational corporations seeking partnerships can post their partnership information requests on these platforms, enabling the formation of collaborative partnerships to enhance knowledge and physical capital. These new partnerships can bring diverse investment opportunities to multinational corporations, thereby boosting their innovation management.

Regarding interactive knowledge capital, trust plays a vital role in building knowledge capital between firms (Li, Zhao & Wu 2017). Business-to-business virtual forums can help multinational corporations quickly understand the operations of potential partners, enabling them to assess if the partnership aligns with their investment criteria and if trust can be established (which is crucial for building interactive knowledge capital). This can lead to improved innovation management.

For human empirical knowledge capital, multinational corporations need to effectively communicate their values, standards and objectives to their partners (Ghinoi, Steiner & Makkonen 2021). Therefore, we suggest that multinational corporations create virtual B2B platforms to share investment

opportunities and foster collaboration. These platforms can help multinational corporations share investment prospects, expand their investment base and establish similar investment credentials (Jeong et al. 2017), thus fostering corporate innovation management.

Transboundary investment serves as a vital link between knowledge capital and innovation management for multinational corporate firms. Companies with robust knowledge capital benefit greatly from establishing strong partnerships and alliances, which in turn facilitate transboundary investment. This type of investment allows these firms to invest in various markets with ease, thereby acquiring diverse value streams that can boost capital creation and enhance innovation management.

Moreover, the mediating role of the mediation restraint, which includes transboundary investment and assimilative capacity, further emphasises the importance for multinational corporate firms to focus on both diverse investment and assimilative capacity processes. Simply aiming to improve innovation management through knowledge capital without considering these processes is insufficient. Instead, companies should actively engage in transboundary investment while simultaneously enhancing their assimilative capacity. This dual focus on diverse investment and assimilative capacity processes is essential for multinational corporate firms looking to improve their innovation management effectively.

Limitations and future research

While our study aims to make theoretical contributions and offer management implications, several questions remain for future research. Given the prevalent trend of multinational expansion among corporate firms (Teece & Linden 2017), we chose multinational corporate firms as our study sample to investigate associated concerns. However, the challenges of multinational expansion vary across industries. For example, industries with a strong industrial base may face fewer obstacles compared to outdated industries.

For future studies, it may be beneficial to analyse the sample based on different industries for more specific recommendations. We believe that for multinational corporations to improve their innovation management with knowledge capital, both investment and assimilative capacity are essential. Therefore, our study investigates the effects of cross-border investment and assimilative capacity. Nevertheless, the influence of a corporation's other competencies on investment processes and value assimilation should not be underestimated. Subsequent studies could explore the role of these competencies in the aforementioned processes.

Our research is primarily intended to examine the association between knowledge capital and the innovation management of multinational firms during times of investment constraints, such as limited FDI availability or willingness. To investigate our study hypotheses, we used cross-sectional data. However, considering the potential consequences of persistent FDI

constraints, leading to multinational companies folding up and new ones retracting their investment intentions, the insights provided by cross-sectional data may be limited. Therefore, we recommend that future researchers utilise other methods, such as case studies, to examine the changes in innovation management among multinational corporate firms.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

S.B. was responsible for the conceptualising and writing of the article and X.Y. acted as supervisor.

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Data availability

The data that support the findings of this study are available on request from the corresponding author, S.B.

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