

How can digitalisation help emerging marketing multinational companies improve innovation performance through international ambidexterity? Analysis of China's healthcare industry

Improving
China's
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industry

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Abstract

Purpose – This study aims to explore the role of international ambidexterity (IA) in improving the innovation capability of emerging market multinationals. In particular, the main purpose of this research is to study the relationship amongst digitalisation, IA and innovation performance (IP) amongst multinational enterprises in China's healthcare industry.

Design/methodology/approach – The data for this investigation were collected from 134 listed companies in China's healthcare industry during the study period. This study tested the hypotheses by constructing a two-way fixed-effects model.

Findings – The results show that both the balance dimension and the combined dimension of IA have significant positive effects on IP. Digitalisation not only has a direct positive effect on IP but also positively moderates the positive correlation between IA and IP.

Originality/value – Previous studies have not captured the relationship between ambidexterity, digitalisation and IP, and this study helps to fill in the gap and examine these associations in China's healthcare industry. The results of this study provide valuable insights for healthcare industry managers to understand the role of ambidexterity and digitalisation in innovation in the context of internationalisation.

Keywords International ambidexterity, Innovation, Digitalisation, Exploration, Exploitation

Paper type Research paper

1. Introduction

The rapid rise of emerging market multinational enterprises (EM MNEs) and their aggressive internationalisation tendency has attracted wide attention from the academic circle (Ozkan *et al.*, 2022). Many researchers in international business believe that EM MNEs are different from multinationals in traditional developed countries (Ramamurti, 2012). Researchers have shown great interest in and conducted a lot of studies on the motivations, different entry modes and location choices of EM MNEs (Piperopoulos *et al.*, 2018; Thakur-Wernz and Samant, 2019). There is a general consensus that EM MNEs tend to view international

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operations as an important springboard to expand their knowledge base and enhance their global competitiveness (Luo and Tung, 2018; Ozkan *et al.*, 2022), and their goal of internationalisation is to become more innovative. EM MNEs may face a number of obstacles in their home countries, such as weak institutional environments and underdeveloped capital markets (Cuervo-Cazurra, 2012; Lamin and Ramos, 2016; Shirodkar and Shete, 2021; Witt and Lewin, 2007). Therefore, internationalisation seems to have become a requirement for competitive success rather than an option (Oliva *et al.*, 2022). However, internationalisation does not always have a positive impact on a company's innovation performance (IP) (Bahl *et al.*, 2020). Therefore, an important question is which EM MNEs have successfully reaped the benefits of internationalisation and further improved their IP?

Existing theoretical perspectives on the international operations of emerging market multinationals have undergone a shift from exploration and exploitation to ambidexterity (Wu and Chen, 2020). The concept of "ambidexterity" which refers to the dynamic capability to engage in both exploratory and exploitative activities (Chebbi *et al.*, 2015; Christofi *et al.*, 2021; Dezi *et al.*, 2019) has become a critical perspective of discussing the internationalisation of EM MNEs since Prange and Verdier (2011) first introduced the concept of "international ambidexterity" (IA) (Choi *et al.*, 2019). Earlier research by Luo and Rui (2009) establishes the link between IA and emerging economies and points out that EM MNEs need to build ambidexterity in the internationalisation process to overcome their latecomer disadvantages. Literature emphasises that today's multinationals face an unprecedentedly complex competitive environment, which requires "ambidexterity" in strategic decisions and activities (Hsu *et al.*, 2013). Some researchers believed that emerging market multinationals should become ambidextrous and engage in both exploratory and exploitative activities in international markets to ensure short-term survival and long-term growth (Prange and Verdier, 2011; Bandeira-de-Mello *et al.*, 2016). Ambidexterity seems to offer some ideas to explain the different IP of internationalisation of EM MNEs, yet there is still little research on the performance of IA in innovation and its contextual conditions.

Besides internationalisation, digitalisation is also a growing phenomenon that broadly affects business strategies and structures and there are potential benefits of company performance (Truant *et al.*, 2021; Wu *et al.*, 2019). In the era of Industry 4.0, digital transformation and innovation are both very important for enterprises (Tajudeen *et al.*, 2022). The contemporary economy emphasises the relevance of digital transformation as a core driver of innovation and corporate renewal and digitalisation has become a hot topic in business and research (Denicolai *et al.*, 2021). In this study, digitalisation refers to the use of digital technologies to integrate people, processes, products and services and business models (Yu *et al.*, 2023). For example, companies partially or wholly transform elements of corporate value chain activities and business models linked to digital platforms through emergent digital technologies such as mobile and visual connectivity, cloud computing, robotics, smartphones, artificial intelligence, block chain, additive manufacturing, 3D printing and the Internet of Things. Digitalisation has been integrated into products and services and has had a broad impact on enterprise business processes (Truant *et al.*, 2021). Although many studies have identified new digital technologies, such as big data analytics, as key to gaining competitive advantage and thus achieving high business performance (Asad *et al.*, 2021, 2022), research on the internationalisation process of digitally transformed multinationals and their performance is still underdeveloped (Truant *et al.*, 2021), and very few studies have discussed the interplay between digitisation and internationalisation strategies.

Healthcare, which refers to all services provided by medical professionals to protect people's physical and mental health, has been one of the major industries where digital transformation is taking place (Kraus *et al.*, 2021). Especially in the context of the widespread economic changes and social transformations already caused by the current product and service innovations driven by digital transformation and the application of emerging digital technologies (Berger *et al.*, 2019), improving the IP of healthcare multinationals will bring positive benefits in many areas such as

economic development, job creation and human well-being. The ageing population and the global pandemic of COVID-19 have led to a variety of health problems, and the increase in the number of patients has made healthcare systems in almost all countries face serious challenges, whilst increasing the physical burden on patients and the financial burden on their families (Wen *et al.*, 2022a, b). COVID-19 pandemic has also led to difficulties in business development and national economic development (e.g. declining household income, corporate layoffs, falling gross domestic product (GDP), etc.), resulting in a global economic downturn (Asad and Kashif, 2021). Healthcare innovation, including medical technology innovations, healthcare service innovations and healthcare system innovations, will hold the promise of reducing the burden of disease on patients and the society. For example, new drugs and advanced medical devices can facilitate patient improvement whilst alleviating the national burden of disease due to increased social welfare and human capital (Wen *et al.*, 2022a, b). In addition, health innovations have a significant impact on disease prevention. For example, innovative vaccines can prevent mass infections of diseases, thereby reducing the cost of healthcare for patients and the negative economic and social impact of diseases on the country. Some studies also argue that digital transformation can help companies overcome innovation dilemmas (Zhuo and Chen, 2023) and can help them achieve high-quality growth (Wu *et al.*, 2023).

Based on this background, the purpose of this paper is to examine how IA affects the IP of EM MNEs and the moderating effect of digitalisation on this relationship. We believe that this paper is instructive in both theoretical and practical aspects. First, we shift the focus of digitalisation research from manufacturing to healthcare industry and verify the positive effects of IA and digitalisation on innovation of EM MNEs. In addition, by dividing patents into three different categories, we further discuss the relationship between IA and innovation quality based on the existing research, improving the previous study which only considered the quantity of innovation. Finally, we introduce digitalisation as a moderating variable to further supplement the boundary condition related to IA affecting innovation. In addition, this paper explores digital strategies and key digital technologies that facilitate multinationals in the healthcare industry to improve their IP and provides some practical suggestions.

2. Theoretical basis and hypothesis

2.1 Internationalisation of EM MNEs and ambidexterity perspective

EM MNEs are international firms that initially originate in emerging economy markets and engage in outward foreign direct investment, exercise effective control and engage in value-added activities in one or more foreign countries (Luo and Tung, 2007). The internationalisation of EM MNEs is interesting and ambidexterity is becoming a valuable perspective to explain the international path taken by these companies (Hsu *et al.*, 2013). International business scholars insist that transnational corporations can not only exploit their existing overseas advantages to promote short-term survival, but also explore and acquire resources in overseas markets to make up for their competitive disadvantages in long-term growth (Makino *et al.*, 2002). This is a significant departure from the traditional theory of international business based on multinational corporations from developed countries. The traditional theory of international business assumes that the purpose of internationalisation of multinational companies is to exploit existing ownership advantages in foreign markets in order to reap rewards (Campbell-Hunt, 2004). In this context, Luo and Rui (2009) first introduced the idea of ambidexterity into the international expansion of EM MNEs, emphasising the need for EM MNEs to establish and utilise ambidexterity to offset late-comer disadvantages. IA requires viewing exploitation and exploration as different but complementary options for shaping, harnessing and building capacity for competitive advantage (Gupta *et al.*, 2006; He and Wong, 2004). By integrating and balancing exploitation and exploration, ambidexterity becomes a comprehensive dynamic capability that enables

multinationals to play competitive catch-up over the long term without sacrificing short-term profitability (Ciasullo *et al.*, 2020). Empirical studies show that ambidexterity significantly promotes enterprises' overseas market expansion (Zhou *et al.*, 2019). EM MNEs have recognised the importance of innovation for individuals, organisations and societies to thrive in a global world of volatility, uncertainty, complexity and ambiguity (Liu *et al.*, 2022; Wang *et al.*, 2022) and are increasingly focussing on enhancing their innovation capabilities through internationalisation (Wang and Tao, 2019). However, little attention has been paid to how emerging market multinationals balance exploitation and exploration to achieve ambidexterity; we do not know exactly how ambidexterity affects innovation in EM MNEs (Bandeira-de-Mello *et al.*, 2016; Choi *et al.*, 2019).

2.2 Digital transformation and innovation of multinational enterprises

Information communication technology and digital technologies have a fundamental impact on the overall efficiency of economic activities and residents' well-being by improving the efficiency of production, circulation, distribution and consumption (Gregory *et al.*, 2021; Li *et al.*, 2020; Tajudeen *et al.*, 2022). Since Nobel laureate Solow proposed the IT productivity paradox in 1987, a large number of studies have discussed the impact of information and communication technology (ICT) investment on corporate productivity and economic performance (Wen *et al.*, 2022a, b). Most studies support the view that digital transformation brings economic benefits and social dividends (DeStefano *et al.*, 2018; Wang *et al.*, 2021). Research on international business has always emphasised the impact of information technology on the process of internationalisation, such as the reduction of transaction costs, user network economy, (Banalieva and Dhanaraj, 2019; Brouthers *et al.*, 2016) etc. Some studies believe that digital transformation improves enterprises' internationalisation degree (Adomako *et al.*, 2021) and export tendency (Elia *et al.*, 2021; Pergelova *et al.*, 2019). However, there are also concerns about digital transformation. For example, digitalisation has the potential to foster corruption in countries as a perverse form of innovation (Malik and Froese, 2022). At the same time, the vulnerability of multinationals is likely to increase. New technologies may expose firms to security breaches, fraud, service disruptions and threats of failure to meet service levels (Luo, 2022). Obviously, there is still a debate about whether to invest in digital transformation, and this is the first research opportunity we have identified. Furthermore, we find that although the literature has studied the impact of digital transformation on firm innovation (Ferreira *et al.*, 2019; Gaglio *et al.*, 2022; Tajudeen *et al.*, 2022; Wen *et al.*, 2022a, b; Wu *et al.*, 2022a, b), but few studies consider the relationship between digital transformation and innovation in the context of multinationals. Previous studies have discussed numerous factors that drive innovation in multinationals, such as R&D internationalisation (Vrontis and Christofi, 2021; Sommer and Bhandari, 2022), entrepreneurial orientation (Majali *et al.*, 2022), etc., but have neglected the impact of the digital transformation on the emergence of EM MNEs and their innovation impact. Finally, current researches on digital transformation most take manufacturing enterprises as research objects (Gaglio *et al.*, 2022; Wen *et al.*, 2022a, b; Wu *et al.*, 2022a, b). As an important part of the digital economy, the digital health industry is rarely mentioned. The COVID-19 pandemic has deeply impacted and challenged the global medical and health system and promoted the wider application and profound impact of digital technologies such as artificial intelligence, intelligent wearable devices and brain-computer interface in the medical and health field (Amankwah-Amoah *et al.*, 2021; Bamel *et al.*, 2022). Therefore, digitalisation research based on healthcare industry is of great significance.

2.3 The effect of the balance dimension of international ambidexterity on innovation performance

The success of multinationals in global markets depends not only on the existing portfolio of capabilities and resources but also on its ability to continuously reconfigure and adapt them

to international emergencies (Kogut and Singh, 1988). The balance dimension of IA explains this principle well. Balance dimension of IA maintains a close relative balance between exploratory and exploitative activities, implying that multinationals will allocate resources between exploratory and exploitative internationalisation without preference (Wu *et al.*, 2019). From a positive perspective, exploration and exploitation play different advantages in the international expansion of firms. Exploitation improves firm performance by refining and reducing differences and further penetrating the firm's existing markets. Exploration improves business performance by creating new opportunities and enabling companies to target new markets (He and Wong, 2004; Mueller *et al.*, 2013). On the negative side, failure to achieve a close balance between exploration and exploitation may expose firms to the risk of becoming obsolete or unable to adapt (Cao *et al.*, 2009). Although concentrating on exploiting existing capabilities and strengths helps firms achieve short-term success from existing products and markets, such short-lived success is challenging to sustain in the face of a rapidly changing international competitive environment and rapid technological change (Tushman and Anderson, 1986). It may lead to solid path dependence and core rigidity (Leonard-Barton, 1992). Conversely, when firms focus too much on exploratory activities to exclude exploitative activities, they must risk not reaping the rewards of costly experimentation (Cao *et al.*, 2009).

Therefore, it is necessary for managers to make a trade-off between exploration and exploitation (He and Wong, 2004). Multinationals can benefit from the efficient allocation of resources (Cao *et al.*, 2009; O'Reilly and Tushman, 2013). Thus, we proposed the hypothesis:

H1. The balance dimension of IA positively affects the IP of EM MNEs.

Patents have been widely used as a proxy variable for firm performance in past studies. However, it needs to be particularly emphasised that existing studies tend to examine IP in terms of total patents generally, taking the patents obtained by firms as a whole. This may suffer from a number of errors. First, different patent types do not have the same impact on firm performance. High-value new inventions may bring about disruptive technological changes, and their benefits to firms and society are unmatched by simple technological improvements. Second, the difficulty of realisation varies widely across patents, implying variability in how and at what cost firms invest in the resulting innovations. Therefore, this study argues that we must clarify precisely the quality of innovation that IA helps companies achieve. It is reasonable and feasible to examine IP from the perspective of patent quantity, but it is also necessary to further examine IP from the perspective of patent quality. This study divides the total number of patents into three subcomponents, measured separately. Specifically, it includes the number of invention patents granted, the number of utility model patents granted and the number of design patents granted. This classification method division standard is consistent with the *Patent Law of the People's Republic of China* (amended in 2020) [1] for types of patents. Therefore, we further propose the following hypothesis:

H1a. The effective balance of exploration and exploitation leads to more invention patents.

H1b. The effective balance of exploration and exploitation leads to more utility model patents.

H1c. The effective balance of exploration and exploitation leads to more design patents.

2.4 The effect of the combined dimension of international ambidexterity on innovation performance

The core idea of the combined dimension of IA is that exploratory and exploitative activities are not necessarily in absolute competition and opposition (Cao *et al.*, 2009). We argue that

exploratory and exploitative internationalisation are not mutually exclusive but interdependent over time and as functions shift (Johnson *et al.*, 2022). As Gupta *et al.* (2006) point out, exploration and exploitation do not necessarily compete for resources because they may occur in complementary areas (such as technology and markets). Specifically, exploitation is related to a company's strategic ability to manage existing resources and add value to them. Exploration includes not only a firm's ability to seek and acquire new resources, but also its ability to combine these resources to foster strategic assets related to long-term capacity building (Brown and Eisenhardt, 1997; Ciasullo *et al.*, 2020; Levinthal and March, 1993). Thus, the combined dimension of IA emphasises the different but complementary roles that exploitation and exploration play in shaping, harnessing and building capacity and competitive advantage (Gupta *et al.*, 2006; He and Wong, 2004).

Exploitation and exploration processes can be mutually reinforcing and supportive and positively interact (Cao *et al.*, 2009). On the one hand, high-quality exploitation can effectively help companies understand the capabilities of the organisation and be fully familiar with the organisational processes, which can enhance enterprises' ability to identify and absorb external knowledge and resources closely related to the renewal of organisational and the successful development of new products or technologies (Zahra and George, 2002). On the other hand, as firms internalise more external knowledge and resources through exploration, exploitation by firms will help them apply effective routines and processes on a larger scale (Cao *et al.*, 2009). Therefore, we assume that:

H2. The combined dimension of IA positively affects the IP of EM MNEs.

The irrationality of examining patents as a whole has been elaborated when discussing the theoretical assumptions of the equilibrium dimension of IA and firm IP. Therefore, we further assume that:

H2a. The union of exploitation and exploration leads to more invention patents.

H2b. The union of exploitation and exploration leads to more utility design patents.

H2c. The union of exploitation and exploration leads to more design patents.

2.5 The moderating role of enterprise digitalisation

Digitalisation has shaped the company's innovation advantage in the process of internationalisation in many ways (Cenamor *et al.*, 2017). First, digital transformation improves the dynamic capability of enterprises in the process of internationalisation, so that enterprises can gain more innovation benefits from the IA. Dynamic capability theory (Teece *et al.*, 1997; Teece, 2018) explains this. On the one hand, digital transformation can improve enterprises' ability to perceive opportunities in the dynamic and complex international market, whilst reducing the search cost of identifying innovative opportunities and unique resources (Huang *et al.*, 2017). This alleviates the productivity dilemma of multinationals to some extent (Utterback and Abernathy, 1975) and facilitates the internal coordination of exploratory and exploitative internationalisation. For instance, Apps in smart devices and cross-border e-commerce platforms can help enterprises timely track and analyse consumer behaviour and preferences and accumulate experience and knowledge related to the international market (Pergelova *et al.*, 2019). Digital technologies also enable enterprises to communicate effectively with a more diverse set of participants and enable a wider range of information search at lower cost (Ives *et al.*, 2016), which facilitates rapid identification and access to innovation-related resources (Wu *et al.*, 2022a, b). On the other hand, digital transformation can reduce the barriers for multinationals to enter overseas markets. Blockchain, the Internet of Things and crowd-sourcing in digital infrastructure allow companies to easily connect with potential customers, suppliers, investors, etc., on a global

scale and facilitate effective coordination of value chains to access various resources (Adomako *et al.*, 2021). In addition, digital technology capability enhances organisational agility and efficiency of resource integration (Troise *et al.*, 2022), thus enhancing innovation capability (Wen *et al.*, 2022a, b). The application of digital technologies can not only improve communication, distribution and customer relationships in enterprises (Truant *et al.*, 2021), but also enhance user experience and optimise process coordination (Verhoef *et al.*, 2021). At the same time, digital technology is forcing companies and people to constantly develop skills to better adapt to volatile environments (Sousa and Rocha, 2019), and the modular nature of digital technology allows components to be dismantled and reassembled in entirely new environments (Johnson *et al.*, 2022).

Secondly, the innovation ecosystem theory (Gomes *et al.*, 2018) explains the advantages of digital transformation companies in terms of innovation resources and innovation efficiency. Big data, Internet of Things, artificial intelligence and other digital technologies are constantly integrated into the production and operation of enterprises and thus generate a large number of data elements (De Vass *et al.*, 2018), providing a strong digital resource base for enterprise innovation (Ives *et al.*, 2016). Digital transformation also realises information sharing amongst members of the innovation ecosystem. Multi-agent collaboration and information circulation can improve innovation efficiency and encourage enterprises to increase innovation input (Wen *et al.*, 2022a, b). In addition, digital capabilities can guide enterprises to co-innovate with consumers in the opportunity utilisation process, improve enterprise product matching with market demand (Kitchens *et al.*, 2018). Based on the above analysis, we proposed the hypothesis:

- H3. Digitalisation positively moderates the relationship between the balance dimension of IA and the IP.
- H4. Digitalisation positively moderates the relationship between the combined dimension of IA and the IP.

Analogous to the previous section, in order to gain a clearer understanding of the qualitative level at which international duality affects IP, we divide IP into three dimensions and refine the above assumptions:

- H3a. Digitalisation positively moderates the relationship between the balance dimension of IA and the number of invention patents.
- H3b. Digitalisation positively moderates the relationship between the balance dimension of IA and the number of utility model patents.
- H3c. Digitalisation positively moderates the relationship between the balance dimension of IA and the number of design patents.
- H4a. Digitalisation positively moderates the relationship between the combined dimension of IA and the number of invention patents.
- H4b. Digitalisation positively moderates the relationship between the combined dimension of IA and the number of utility model patents.
- H4c. Digitalisation positively moderates the relationship between the combined dimension of IA and the number of design patents.

3. Methodology

3.1 Variables

Independent variable: *IA*. We measured IA separately from the balance and the combined dimensions. Measures proposed by past studies on organisational ambidexterity inform this

study (Barkema and Drogendijk, 2007; Cao *et al.*, 2009; He and Wong, 2004; Hsu *et al.*, 2013; Katila and Ahuja, 2002). This study adopts the most common approach, referring to He and Wong (2004) and Cao *et al.* (2009), using the number of exploratory subsidiaries to denote exploration and the number of exploitative subsidiaries to denote exploitation. Existing studies consider the strategic exploration/exploitation orientation of foreign affiliates to be dependent on their current competitive position and their activities related to their core competencies (Hsu *et al.*, 2013). We agree with this view and use a similar approach to classify subsidiaries of multinational groups. Exploratory subsidiaries specialise in R&D and marketing, whilst non-exploratory subsidiaries are referred to as exploitative subsidiaries. In addition, we followed Wu *et al.* (2019) to measure the balance dimension of IA using 5 minus the absolute deviation between exploration and exploitation and the combined dimension of IA using the product of exploitation and exploration. The larger the absolute deviation between exploration and exploitation, the more unbalanced the two are, the larger the product of exploration and exploitation, the more pronounced the synergistic effect of the two.

Dependent variable: *IP*. Patents are the most directly measurable innovation indicator (Ding *et al.*, 2021; Leung and Sharma, 2021). Considering that the disclosure of financial and other data of listed companies is based on consolidated statements and that this study focusses on the substantive innovation of companies, we finally use the total number of patents granted by listed companies themselves, their subsidiaries, joint ventures and associates as a proxy variable for corporate IP. More specifically, considering the industry characteristics of our research sample, listed companies in the healthcare industry (the time to obtain a patent grant for an invention in this industry is usually three years), we use the total number of patents granted with a three-year lag as a measure of IP. The total number of patents here refers to the total number of invention patents, utility model patents and exterior design patents. Then, when examining the relationship between IA and innovation of different quality, we conduct regression analysis using invention patents, utility model patents and design patents as dependent variables respectively. Considering that obtaining invention patents also has a time lag effect, we use the number of invention patents granted with a lag of three years as the value of the variable “*Invention*” (according to the State Intellectual Property Office, the examination cycle of invention patents in China is 18.5 months by the end of 2021 [2], meaning that there is a lag effect between innovation performance and patent grant). Simultaneously, since the acquisition and examination of utility model patents and exterior design patents are relatively easy, we use the number of utility model patents granted in the current period as the value of the variable “*Utility*” and the number of design patents granted in the current period as the value of the variable “*Design*”.

Moderating variable: *Digitalisation*. At present, the measurement of digitalisation in academic research is immature, and many mainstream studies use methods such as natural language processing or the frequency-inverse document frequency (TF-IDF) method (Wan *et al.*, 2022). Using these methods for reference (Wu *et al.*, 2023), this paper extracts digitalisation-related keywords from enterprise annual reports through natural language processing and makes logarithmic measurements to measure the scores of enterprises’ digitalisation. First, we downloaded a total of 1,337 annual reports of 134 companies in the healthcare industry from 2010–2021 from Juchao.com (there should be 1,608 annual reports if we count 134 companies over 12 years, but since not every company was listed in 2010 or before, some companies did not have 12 annual reports). Next, we performed the text mining work. In the first step, 50 companies with more successful digital transformation each year are selected, and a total of 798 samples are finally obtained. The judgement criteria are whether the enterprises adopt new digital technologies, implement Internet business models, realise smart manufacturing and build modern information systems in their production and operation. The second step, using Python’s Chinese-word splitting function to split the selected samples. The high-frequency words related to digitalisation development were

screened from four aspects: digital technology application, Internet business model, intellectualisation and modern information system. It can be found that words such as big data, digitalisation, artificial intelligence, informatisation, information technology, e-commerce and the Internet appear more frequently. Third, filter more specific keywords. Based on the words filtered in the second step, the text before and after the keywords are extracted from the total sample, and the combinations of words with a high frequency of occurrence are searched for. In the fourth step, references are added to the keywords in order to form the final keyword lexicon. The keyword lexicon is shown in Table 1. In the fifth step, based on the self-built keyword lexicon, each sample file was word-sorted using Python, and the frequency of each keyword was counted. On this basis, since the value of this index has typical “right bias” characteristics, the sum of the frequencies of all keywords is added by 1, and the natural logarithm is taken to obtain the value of the variable *Digitalisation* to reflect the level of digitalisation of listed enterprises in the healthcare industry.

Control variables. The first variable we control for is the intensity of R&D investment. Many studies demonstrate from different theoretical and empirical perspectives that R&D is a necessary condition for firm innovation (e. g. Shefer and Frenkel, 2005). Referring to Piga and Atzeni (2007), this study uses the ratio of a firm’s R&D investment in the current year to its total assets in that year to measure *R&D investment intensity*. In addition to *R&D investment intensity*, some studies have shown that *Enterprise size* is another firm-level variable that can have an impact on a firm’s IP (Cohen and Klepper, 1992; Gomes and Ramaswamy, 1999). At the firm level, a third control variable common in the innovation literature is *Nature of business ownership* (Cuervo-Cazurra, 2012; Wu et al., 2022a, b). We set the nature of firm ownership as a dummy variable, with state-owned firms taking a value of 1 and other firms taking a value of 0. Finally, we control for the possible impact of *Last year’s sales revenue* of the enterprise.

Based on the above theoretical assumptions and variable measurement method, a conceptual framework diagram was constructed in this study (Figure 1).

3.2 Model construction

As this study used panel data, a Hausman test was conducted before constructing the regression model. The results indicate that this study prefers to construct a fixed-effect model to test the relationship between the variables.

3.2.1 Direct effect. First, to test the effect of *IA* on *IP*, the following two-way fixed-effect model was used to examine the direct effects:

$$IP_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + Firm_i + Year_t + \varepsilon_{it} \quad (1)$$

Second, in order to examine the impact of *IA* on *IP* from the perspective of innovation quality, this paper classifies patents into three categories of invention patents, utility model patents and design patents according to the *Patent Law of the People’s Republic of China* and includes them as dependent variables in the regression equation respectively:

$$Invention_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + Firm_i + Year_t + \varepsilon_{it} \quad (2)$$

$$Utility_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + Firm_i + Year_t + \varepsilon_{it} \quad (3)$$

$$Design_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + Firm_i + Year_t + \varepsilon_{it} \quad (4)$$

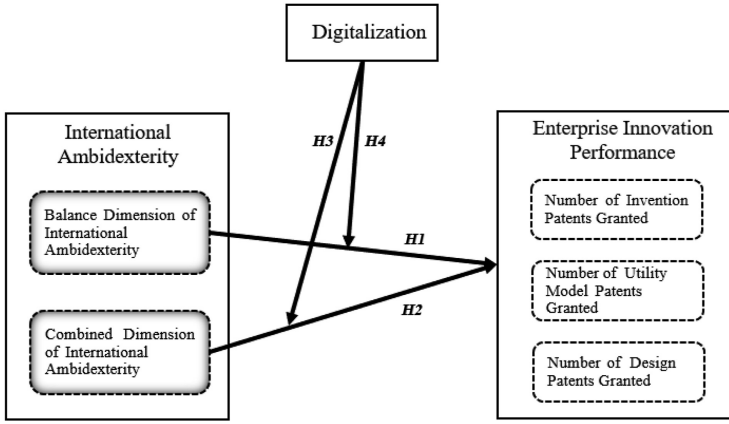
The dependent variable *IP* in model (1) denotes the IP of firm *i* in period *t*, expressed as the sum of the number of invention patents, utility model patents and design patents of firm *i* in period *t*+3. The dependent variable *Invent* in model (2) indicates the high-quality innovation

	(1) Keyword category	(2) High-frequency keywords extracted from annual reports of 50 manually selected enterprises with more successful digital transformation	(3) Keywords extracted from all samples that contain adjacent phrases of keywords in (2)	(4) Complete keyword database supplemented according to existing research
Construction process of the keyword database	Internet business model	Data, digital, digitalisation	Big Data, digitalisation, data mining, data centre, data analysis, database, data management, digital technology, cloud computing, third-party payment	Big Data, digitalisation, data mining, data centre, data analysis, database, data management, digital technology, cloud computing, third-party payment
	Digital technology application	E-commerce, online trade, B2C, Internet, B2B	Internet, mobile Internet, Internet healthcare, Internet finance, Internet platform, Internet services, Internet marketing, Internet technology, E-commerce, online trade, Internet of Things, B2B, B2C	Internet, mobile Internet, Internet healthcare, Internet finance, Internet platform, Internet services, Internet thinking, Internet technology, Internet of things, Internet model, Internet strategy, Internet marketing E-commerce, B2B, online trade, B2C
	Intellectualisation	Integration, systems intelligence, computers, intellectualisation, automation	Intelligence, intellectualisation, artificial intelligence, intelligent algorithm, automation, system automatic control, fully automatic, semi-automatic, automatic production, office automation, computer, integration, computer technology, management system	Intelligence, intellectualisation, artificial intelligence, intelligent algorithm, automation, computer, automatic control, fully automatic, semi-automatic, automatic production, office automation, computer technology, system software, software system, management system, intelligent robot, computer management
	Modern information system	Information system, information, informatisation	Information, informatisation, information technology, information system, information network, information management system, information centre	Information, informatisation, information technology, information system, information network, information management system, information centre, information terminal

Table 1.
Construction process of the keyword database

Source(s): Authors' own creation

of firm i in period t , measured by the number of invention patents of firm i in period $t+3$. The dependent variable *Utility* in model (3) indicates the low-quality innovation of firm i in period t , measured by the number of utility model patents of firm i in period t . The dependent variable *Design* in model (4) represents low-quality innovation of firm i in period t , measured by the number of design patents for firm i in period t .



Source(s): Authors own creation

Figure 1.
Conceptual framework

The core independent variable in all four models above is *IA*, which represents the value of *IA* for firm *i* in period *t*. It consists of two different dimensions: *IA_Balance* and *IA_Combined*. *i* denotes firm, *t* denotes year and α , β and γ are constant terms. *Firm_i* and *Year_t* denote individual and time fixed effect, respectively. ϵ is a random perturbation term. *Control* represents the control variables, which includes *R&D Investment Intensity*, *Enterprise Size*, *Nature of Business Ownership* and *Last Year's Sales Revenue*.

3.2.2 *Moderating effects*. Firstly, to test the moderating effect of digitalisation on the relationship between *IA* and *IP*, the following model is constructed:

$$IP_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + \eta Digitalisation_{it} + \theta Digitalisation * IA + Firm_i + Year_t + \epsilon_{it} \quad (5)$$

Secondly, to test in turn the moderating effect of digitalisation on the relationship between *IA* and different patents, we constructed the following models:

$$Invention_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + \eta Digitalisation_{it} + \theta Digitalisation * IA + Firm_i + Year_t + \epsilon_{it} \quad (6)$$

$$Utility_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + \eta Digitalisation_{it} + \theta Digitalisation * IA + Firm_i + Year_t + \epsilon_{it} \quad (7)$$

$$Design_{it} = \alpha + \beta IA_{it} + \sum \gamma_k Control_{it} + \eta Digitalisation_{it} + \theta Digitalisation * IA + Firm_i + Year_t + \epsilon_{it} \quad (8)$$

Digitalisation is the moderating variable, indicating the digitalisation score of the firm *i* in period *t*. *Digitalisation*IA* is the interaction term, consisting of two dimensions: *Digitalisation*IA_Balance* and *Digitalisation*IA_Combined*.

3.3 Data collection and sample analysis

Chinese multinationals are chosen for this study because China is a typical emerging market where many multinationals are gathered. China is one of the highest R&D investments country in the world (equivalent to \$163 billion), has the world's leading intellectual property output.

In this study, the stock codes of 513 listed corporations in China's healthcare industry and the basic information of the companies were collected using the Origin Parameters-Global Economic (Financial) Database. First of all, 14 companies marked with ST or *ST were excluded from the sample of this study, as they had incurred losses and even risked delisting, which might cause bias in the research results. At the same time, we removed 25 companies whose primary business does not belong to the category of healthcare industry, and thus, we obtained a list of 474 companies to be further screened. Then, to clarify how many of these 474 firms had international operations, the researchers searched through the China Stock Market and Accounting Research (CSMAR) database and ended up with a list of 167 firms with overseas subsidiaries. Next, we collected patent grants from 2010 to 2021 for 167 companies with overseas subsidiaries. The search results showed that only 137 companies were granted patents with overseas subsidiaries. Finally, the researchers removed the samples with incomplete data on overseas subsidiaries or patent grants and obtained 798 samples from 134 companies for data analysis. (The reason for the missing data is, on the one hand, that many multinational enterprises were not involved in overseas operations in earlier years. On the other hand, that even if the companies had internationalisation or R&D activities, the researchers could not obtain them from the database or elsewhere).

4. Results

4.1 Main findings

Descriptive statistics and correlation analyses were performed using SPSS26 and the results are reported in Table 2. It can be determined *IA_Balance* ($r = 0.740, p < 0.001$) and *IA_Combined* ($r = 0.498, p < 0.001$) have a significant positive relationship with *IP*. There is also a correlation between digitalisation and *IP* ($r = 0.286, p < 0.001$).

We implemented the regression analysis using Stata 17, and Table 3 reports the results of the regression analysis with *IP* as the dependent variable when controlling for individual fixed effects and time fixed effects.

Columns (1) and (3) show that the regression coefficients for *IA_Balance* before and after the addition of the control variables are $r = 20.5324$ and $r = 20.5079$, respectively. Columns (2) and (4) show that the regression coefficients for *IA_Combined* before and after the addition of the control variables are $r = 5.6536$ and $r = 5.6803$, respectively. All regression coefficients passed the 1% statistical significance test, which indicates that both *IA_Balance* and *IA_Combined* have a significant positive effect on *IP* and hypothesis H1 and H2 was tested. The interaction terms *Digitalisation * IA_Balance* ($r = 11.7173, p < 0.001$) and *Digitalisation * IA_Combined* ($r = 2.7883, p < 0.001$) have statistically significant regression coefficients as shown in columns (5) and (6). Therefore, hypotheses H3 and H4 are confirmed.

Second, to further test whether *IA* helps firms achieve high-quality innovation (in China, it is incrementally more difficult to obtain design patents, utility model patents and invention patents), we conducted three additional independent regression analyses with *Invention*, *Utility* and *Design* as dependent variables, controlling for individual fixed effects and time fixed effects, respectively. The regression results are presented in Tables 4–6.

Columns (1–4) in Table 4 report the results of the tests of hypotheses H1a and H2a. The regression coefficients for both *IA_Balance* ($r = 4.2676, p < 0.001$) and *IA_Combined* ($r = 1.3499, p < 0.05$) are significantly positive, which indicates that *IA* increases the rate of invention patent acquisition in comprehensive health firms. Columns (5) and (6) are used to

Table 2.
Descriptive statistics
and correlation

Variables	1	2	3	4	5	6	7
1 Innovation performance (<i>IP</i>)	1						
2 Invention patents (<i>Invention</i>)	0.781***	1					
3 Utility model patents (<i>Utility</i>)	0.661***	0.440***	1				
4 Design patents (<i>Design</i>)	0.496***	0.387***	0.391***	1			
5 Balance Dimension of International ambidexterity (<i>IA_Balance</i>)	0.661***	0.575**	0.393***	0.443***	1		
6 Combined Dimension of International ambidexterity (<i>IA_Combined</i>)	0.650***	0.553**	0.413***	0.421***	0.608***	1	
7 <i>Digitalisation</i>	0.351***	0.205***	0.309***	0.314**	0.285***	0.323***	1
11 Observations	798	798	798	798	798	798	798
12 Std. Dev	31.17	13.54	12.78	8.03	0.68	2.45	0.76
13 Mean	25.24	11.05	5.82	3.89	3.33	1.14	2.63
14 Max	295.00	110.00	221.00	73.00	5.00	20.00	4.49
15 Min	0.00	0.00	0.00	0.00	1.00	0.00	0.00
16 Data sources			CNRDS		Calculated from CMARS data		Corporate annual report

Note(s): Indicates significance at the $p \leq 0.10$ (*** $p \leq 0.001$ ** $p \leq 0.01$, * $p \leq 0.05$)
Source(s): Authors' own creation

Table 3.
Results of regression
analysis 1

Variables	(1)	(2)	(3)	(4)	(5)	(6)
<i>IA_Balance</i>	20.5324*** (1.9118)		20.5079*** (1.9151)		15.6832*** (2.1095)	3.8517*** (0.8809)
<i>IA_Combined</i>		5.6536*** (0.7694)		5.6803*** (0.7788)		−0.3117 (0.2168)
<i>R&D Investment Intensity</i>			−0.0965 (0.2454)	−0.2079 (0.2279)	−1.1782 (0.2193)	1.0174 (1.2466)
<i>Enterprise Size</i>			0.2399 (1.0911)	1.1782 (1.2751)	0.1884 (1.0416)	0.4363 (1.7990)
<i>Nature of Business Ownership</i>			−0.8889 (1.4957)	0.2620 (1.8312)	−0.5843 (1.4443)	−1.2000 (0.1.2817)
<i>Last Year's Sales Revenue</i>			0.4950 (1.1688)	−1.0446 (1.3118)	0.0278 (1.1499)	4.2643*** (1.4332)
<i>Digitalisation</i>					3.4605** (1.1922)	
<i>Digitalisation * IA_Balance</i>					11.7173*** (3.1331)	
<i>Digitalisation * IA_Combined</i>						2.7883* (1.0034)
<i>Firm</i>	No	No	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
F	16.67***	11.76***	17.09***	12.21***	16.66***	20.53***
<i>R</i> ² (adj)	0.7211	0.7141	0.7199	0.7130	0.7398	0.7293

Note(s): Indicates significance at the $p \leq 0.10$ (*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$); heteroskedasticity robust standard errors in parentheses

Source(s): Authors' own creation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
<i>IA_Balance</i>	7.5946*** (1.0382)		7.5490*** (1.0297)	2.1981*** (0.3737)	5.8167*** (1.0817)	1.3474*** (0.3208)
<i>IA_Combined</i>		2.2032** (0.3743)				1.5452* (0.6625)
<i>Digitalisation * IA_Balance</i>					1.1578 (0.7259)	
<i>Digitalisation * IA_Combined</i>					4.2676* (1.8462)	
<i>Control</i>	No	No	Yes	Yes	Yes	Yes
<i>Firm</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>F</i>	14.99***	16.71***	16.82***	16.56***	19.95***	23.33***
<i>R² (adj)</i>	0.6094	0.6124	0.6080	0.6107	0.6211	0.6288
Note(s): Indicates significance at the $p \leq 0.10$ (*** $p \leq 0.001$ ** $p \leq 0.01$, * $p \leq 0.05$); heteroskedasticity robust standard errors in parentheses						
Source(s): Authors' own creation						

Table 4.
Results of regression
analysis 2

[illegible]

Variables	(1)	(2)	(3)	(4)	(5)	(6)
<i>IA_Balance</i>	2.6801*** (0.4772)		2.6663*** (0.4791)	0.6133*** (0.1225)	2.2579*** (0.5171)	0.5455** (0.1654)
<i>IA_Combined</i>		0.6297*** (0.1173)				0.5865 (0.3619)
<i>Digitalisation</i>					0.5027 (0.3112)	
<i>Digitalisation * IA_Balance</i>					0.8418 (0.8769)	
<i>Digitalisation * IA_Combined</i>						0.0519 (0.1664)
<i>Control</i>	No	No	Yes	Yes	Yes	Yes
<i>Firm</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
F	11.69***	9.59***	39.32***	13.62***	239.66***	22.76***
R ² (adj)	0.5108	0.5018	0.5106	0.5008	0.5115	0.5008
Note(s): Indicates significance at the $p \leq 0.10$ (*** $p \leq 0.001$ ** $p \leq 0.01$, * $p \leq 0.05$); heteroskedasticity robust standard errors in parentheses						
Source(s): Authors' own creation						

Table 6.
Results of regression
analysis 4

test hypotheses H3a and H4a respectively. The results indicate that *Digitalisation* positively moderates the positive causality between *IA_Balance* and *Invention*, and *IA_Combined* and *Invention* and the hypothesis holds.

The test results for hypotheses H1b and H2b are reported in columns (1–4) of Table 5. The hypotheses are tested as the regression coefficients for both *IA_Balance* and *IA_Combined* are significantly positive. In addition, since the coefficients of the interaction terms in columns (5) is statistically significant, hypotheses H3b is empirically supported. However, hypothesis H4b cannot be accepted because the coefficient of the interaction term in column (6) is not statistically significant.

According to columns (1–4) in Table 6, both *IA_Balance* and *IA_Combined* have a positive effect on *Design* and hypotheses H1c and H2c are acceptable. However, none of the coefficients of the interaction terms in columns (5–6) are statistically significant and therefore hypotheses H3c and H4c are rejected. This suggests that the positive impact of *IA_Balance* and *IA_Combined* on *Design* hardly changes with the level of digitisation.

4.2 Robustness testing

Selecting subsamples. To test the robustness of the results, we conducted some additional analyses. First, referring to the common practice of existing studies, we randomly selected 500 samples from all samples for robustness testing, and the results are shown in Table 7.

Shortening the observation period. We shortened the observation period for the second robustness check because the business environment in 2010 may be different from today, and the digital transformation of enterprises has emerged in recent years. The regression results are shown in Table 8.

As can be seen from Tables 7 and 8, the robustness test results remain consistent with the baseline regression results.

4.3 Endogeneity discussion

Although endogeneity due to unobservable factors is mitigated by introducing fixed effects in the construction of regression equations, and robustness tests have been conducted using different methods, this still leaves endogeneity concerns. For example, there may be potential reverse causality. Superior IP may be the driving force behind the development of duality capabilities in the internationalisation process of EM MNEs. Therefore, we employ instrumental variable (IV) approach to further test the impact of endogeneity. According to standard conventions, a valid IV should be correlated with the endogenous variable whilst being orthogonal to the error term (Piperopoulos *et al.*, 2018). We refer to the usual idea of looking for IVs in panel data studies by using the independent variable lagged by one period as an IV (Aitken and Harrison, 1999) and use two-stage least squares to test the robustness of the regression structure. Before regression we first perform a first-stage *F*-test to test the validity of the IV. The test shows that when *IA_Balance*_{*t*-1} is used as an IV to discuss the endogeneity of the regression model for the balance dimension of IA, the IV (*IA_Balance*_{*t*-1}) has a strong correlation with the endogenous independent variable (*IA_Balance*_{*t*}) ($\beta = 0.7338$, $t = 24.76$, $p < 0.001$) and $F = 124.22$ (>10). When *IA_Combined*_{*t*-1} was used as an IV to test the endogeneity of the regression model for the combined dimension of IA, the IV (*IA_Combined*_{*t*-1}) was also strongly correlated with the endogenous independent variable (*IA_Combined*_{*t*}) ($\beta = 0.9320$, $t = 46.84$, $p < 0.001$) and $F = 446.17$ (>10). Therefore, as IVs, *IA_Balance*_{*t*-1} and *IA_Combined*_{*t*-1} are pertinent and trustworthy. Stata regression results are shown in Table 9. Table 9 shows that controlling for potential endogeneity, the positive effects of *IA_Balance* and *IA_Combined* on IP remain significant.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
<i>IA_Balance</i>	19.1958*** (2.3534)		19.1836*** (1.8727)		15.7805*** (1.9322)	3.4096** (1.0721)
<i>IA_Combined</i>		4.9525*** (0.9493)		4.9777*** (0.5280)		7.8302*** (2.7143)
<i>Digitalisation * IA_Balance</i>					6.4521 ** (2.0248)	
<i>Digitalisation * IA_Combined</i>					11.8310*** (2.7024)	
<i>Control</i>	No	No	Yes	Yes	Yes	2.9671 * (1.3989)
<i>Firm</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
F	10.04***	9.61 ***	9.67***	9.25***	10.36***	9.87***
R ² (adj)	0.7157	0.7057	0.7130	0.7026	0.7311	0.7204
Note(s): Indicates significance at the $p \leq 0.10$ (*** $p \leq 0.001$ ** $p \leq 0.01$, * $p \leq 0.05$); heteroskedasticity robust standard errors in parentheses						
Source(s): Authors' own creation						

Table 7.
Robustness test
results (1)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
<i>IA_Balance</i>	20.2130*** (1.9972)		20.2192*** (1.8727)		15.6579*** (2.1306)	3.8952*** (0.4857)
<i>IA_Combined</i>		5.6199*** (0.7938)		5.6674*** (0.3965)	3.9350** (1.3433)	4.5490*** (1.2674)
<i>Digitalisation</i>					12.0692*** (3.1352)	
<i>Digitalisation * IA_Balance</i>						
<i>Digitalisation * IA_Combined</i>						
Control	No	No	Yes	Yes	Yes	2.7611*** (0.4977)
<i>Firm</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes	Yes
F	14.66***	14.32***	14.21***	13.90***	15.53***	14.77***
R^2 (adj)	0.7239	0.7188	0.7227	0.7179	0.7440	0.7336

Notes(s): Indicates significance at the $p \leq 0.10$ (***) $p \leq 0.01$, * $p \leq 0.05$; heteroskedasticity robust standard errors in parentheses

Source(s): Authors' own creation

Variables	First stage <i>IA_Balance_t</i>	<i>Innovation_t</i>	Second stage <i>Invention_t</i>	<i>Utility_t</i>	<i>Design_t</i>
<i>IA_Balance_t</i>		35.2599*** (3.0778)	13.8062*** (1.2662)	10.1247*** (1.9734)	7.4956*** (0.7780)
<i>IA_Balance_{t-1}</i>	0.7338*** (0.0391)				
<i>Control</i>	Yes	Yes	Yes	Yes	Yes
<i>Firm</i>	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes
F	69.17***	—	—	—	—
R ²	0.4398	0.4282	0.3199	0.1363	0.1621

Variables	First stage <i>IA_Combined_t</i>	<i>Innovation_t</i>	Second stage <i>Invention_t</i>	<i>Utility_t</i>	<i>Design_t</i>
<i>IA_Combined_t</i>		8.3047*** (0.9747)	3.1764*** (0.3738)	2.1916*** (0.3394)	1.6230*** (0.1608)
<i>IA_Combined_{t-1}</i>	0.9320*** (0.0574)				
<i>Control</i>	Yes	Yes	Yes	Yes	Yes
<i>Firm</i>	Yes	Yes	Yes	Yes	Yes
<i>Year</i>	Yes	Yes	Yes	Yes	Yes
F	247.53***	—	—	—	—
R ²	0.7382	0.4252	0.3053	0.1730	0.1759

Note(s): Indicates significance at the $p \leq 0.10$ (***) $p \leq 0.001$ (**) $p \leq 0.01$, * $p \leq 0.05$); heteroskedasticity robust standard errors in parentheses
Source(s): Authors' own creation

Table 9.
Instrumental variable
regression

5. Discussion and conclusion

5.1 Theoretical contributions

First, in the context of China's healthcare industry, this study confirms the positive role of IA in improving IP and provides strong empirical evidence for the positive causal relationship between IA and IP, thus enriching the literature on ambidexterity and innovation. The theoretical meaning of the term "ambidexterity" has developed many branches with different focusses (Roth and Corsi, 2023). These focus ranges from culture to international expansion and foreign subsidiaries (e.g. Bruyaka and Prange, 2020; Hsu *et al.*, 2013). The theoretical concept is rapidly expanding from the basic concept of ambidexterity. This paper joins the theoretical dialogue between internationalisation and innovation and will help to promote the further conceptualisation of "international ambidexterity". We believe that IA is a unique opportunity to explain the differences in the IP of EM MNEs in healthcare industry (Khan *et al.*, 2020). Previous research has shown that ambidextrous strategies help firms ensure short-term viability through exploitation whilst maintaining future competitive viability through exploration (Ancona *et al.*, 2001; Floyd and Lane, 2000; Levinthal and March, 1993; March, 1991). Our findings confirm the views of previous researchers on ambidextrous strategies. The balance and combined between exploration and exploitation increases the ambidexterity of healthcare multinationals, both in time and geography (Roth and Corsi, 2023) and thus facilitates innovation.

Second, by introducing digitalisation as a moderating variable, this study identifies a boundary condition for the impact of IA on IP and expands the theoretical research framework for the impact of IA on IP. Previous studies have examined the moderating effects of factors such as organisational learning (Hsu and Pereira, 2008), governance structure and

degree of centralised control (Xiao *et al.*, 2013), experience in foreign expansion (Hsu *et al.*, 2015), interpersonal and organisational social networks (Do *et al.*, 2023) on the relationship between internationalisation and IP. However, few studies have examined the moderating effect of enterprise digitalisation. This study explores the moderating effect of digitalisation on the relationship between IA and IP base on ambidexterity theory and digitalisation theory. We find that (1) digitalisation mainly moderates the effect of the balance dimension of IA on IP, with a relatively weak moderating effect on the joint size of the two, digitalisation may facilitate the balance between exploration and exploitation; (2) digitalisation affects IP mainly by moderating the positive correlation between IA and invention patents, and the effect of IA on utility model and design patents does not change significantly depending on the level of digitalisation.

Third, by examining digitalisation and innovation in Chinese healthcare multinationals, this paper responds to the current call for digitalisation in the literature relevant to the healthcare industry (Beaulieu and Bentahar, 2021). The empirical results show that the moderating effect of digitalisation on IA and low-quality innovation is not significant. Therefore, for Chinese healthcare multinationals, investing in digitalisation in simple innovation projects is not necessarily going to pay off. This finding adds to the literature on strategic choices between internationalisation and digitalisation (Bhandari *et al.*, 2023).

Fourth, this paper introduces the perspective of innovation quality to remedy the deficiency that previous studies on the relationship between IA and IP only consider the quantity of innovation but not the quality of innovation, thus failing to objectively evaluate the IP of firms. This paper classifies patents into invention patents, utility model patents and design patents to indicate different levels of innovation quality. Thus, this paper compensates for the neglect of innovation quality in the existing innovation literature by analysing the heterogeneous effects of IA and digitalisation on the acquisition of different quality of innovation. The *Patent Law of the People's Republic of China* classifies patents into three types, including invention patents, utility model patents and design patents. Since the difficulty of obtaining these three types of patents is not the same, they reflect different quality of innovation. The empirical analysis shows significant differences in the effects of IA on the three types of patents. First, achieving a balance between exploration and exploitation or pursuing the joint scale of the two will increase high-quality invention. Second, the positive impact of IA on high-quality innovation is more significant than that of low-quality innovation, suggesting that IA not only promotes IP in general but also this ambidexterity may be an effective way for EM MNEs to solve R&D challenges and achieve high-quality innovation. Moreover, the balance of exploration and exploitation always plays a more significant role than combining the two for both high-quality and low-quality innovations. This empirical finding is highly consistent with Cao *et al.* (2009), who argue that achieving a balance between exploration and exploitation is a more promising strategy for EM MNEs with limited resources.

5.2 Policy and managerial implications

First, we suggest that healthcare multinationals in China and similar emerging markets need to fully consider institutional barriers to healthcare innovation and the impact of such corporate innovation on a wide range of stakeholders when developing and implementing digital transformation strategies. On the one hand, despite the benefits that digital technologies can bring to healthcare innovation, such a highly regulated industry often relies on proven and established technologies and organisational processes that may be at odds with the new logic of digital innovation (Satwekar *et al.*, 2023). Existing research suggests citing that digital innovation may be hindered by obstacles from established systems (Scott, 2014), including established regulations, industry norms, ways of working, or inherent

mindsets. Understanding these institutional barriers and their premises in advance is crucial for the successful implementation of innovative digital technology solutions (Kulkov *et al.*, 2023). In addition, accurate positioning and extensive collaboration are important for the new technology entry process in the healthcare industry. Depending on the domain and novelty of the technologies and solutions, firms need to collaborate with different industry players to overcome institutional barriers. For example, companies facing barriers in the regulatory institution will need to work with hospitals, doctors and patients, whilst companies will be forced to work with policymakers and insurers if they are providing solutions in new areas. For policymakers, the potential conflict between healthcare innovations and the established system means that there is a need to flexibly adapt legislation to the most promising and beneficial innovations. On the other hand, as an industry that enables human well-being, the digitalisation of the healthcare sector may change the way value is created for multiple stakeholders, including patients, hospitals, regulators, biopharmaceutical companies, social welfare organisations and insurance companies, amongst others (Satwekar *et al.*, 2023). Therefore, any operation in the healthcare industry must be accountable, coherent and collaborative (Iyanna *et al.*, 2022). A multi-stakeholder perspective is essential to properly understand how the various players in the healthcare ecosystem are utilising digital technologies and techniques in practice to achieve quality of care, value creation and more management issues (Kraus *et al.*, 2021).

In addition, business managers should know what dynamic capabilities their organisations should develop to embrace digitalisation (Capurro *et al.*, 2021). Although multiple digital technologies play an important role in all aspects of innovation management, the role of big data technologies in innovation in the healthcare industry deserves further exploration. We find that big data analytics are the most mentioned digital technologies in the annual reports of our sample of multinationals and existing research confirms the important role of big data technologies in driving clinical decision-making and innovation (Basile *et al.*, 2022). Big data analytics are important because they enhance a company's ability to connect technology and customers (Dobusch and Kapeller, 2018), enabling the aggregation of large amounts of data on technology development (Papadopoulos *et al.*, 2017), insights into consumer and user behaviour (Van Rijmenam *et al.*, 2018; Lu and Weng, 2018) and predicted customer needs (Bresciani *et al.*, 2018). Investing in big data analytics can support the innovation process and provide new sources of innovation (Chen *et al.*, 2012). Big data-based innovation processes differ significantly from traditional innovation paths, with big data technologies acting as a bridge between the 'technology-driven' and 'demand-driven' views of innovation sources (Capurro *et al.*, 2021). Some scholars have argued that the key success factors in the use of big data for product innovation are related to the acceleration of the innovation process, customer connections and the development of an innovation ecosystem (Agostini *et al.*, 2019). Whether from a 'technology-driven' or 'demand-driven' viewpoint, the ability of managers to strategically master the innovation process and expand market demand whilst strengthening the company's technological base is of paramount importance (Capurro *et al.*, 2021).

Secondly, multinationals in healthcare industry operating in China and similar emerging markets are encouraged to be able to consciously develop an IA and to see achieving a relative balance between exploration and exploitation as a primary objective in the context of limited resources. Continued expansion of either exploration or exploitation in an unbalanced state leads to a growing gap between the two and is not conducive to improved IP. Emerging market managers must be clear that, as latecomers to a globally competitive market, EM MNEs do not have a resource advantage, or even the knowledge associated with transnational management and innovation. Innovative companies with limited resources often need to decide whether they should focus on exploration or exploitation, or adopt an ambidextrous strategy (pursue both) (Mavroudi *et al.*, 2023). We believe that a balanced

allocation of resources for exploration and exploitation in the context of limited resources is more effective than increasing resources to achieve greater integrated scale. In studies where the IA was initially divided into the balance dimension and combined dimension, [Cao et al. \(2009\)](#) showed that the balance dimension of the IA was more favourable to resource-constrained firms. Our findings confirm this view. Moreover, based on past experience, we believe that EM MNEs can reduce resource competition tensions in exploitation and exploration by combining different entry modes and isolated organisational structures ([Bandeira-de-Mello et al., 2016](#)). The findings also suggest that the moderating role of digitalisation is mainly in the balance between exploration and exploitation and that the current trend of digital transformation provides technical support to find the right balance between the two.

Thirdly, we believe that digitalisation strategies should be developed and implemented in the context of the corporate innovation needs and resource base, as different dimensions of IA and digitalisation have different effects on different qualities of innovation. Advancing the digital transformation of a company is an effective strategy for multinationals that expect to seek high-quality innovation through IA (as the positive effect of IA on high-quality innovation is greater when the level of digitalisation is higher). Besides, the empirical results show that the positive impact of whether or not to digitalisation on improving IP is mainly related to the balance of exploitation and exploration. Therefore, managers of EM MNEs should focus on applying digital technologies in activities and processes to achieve a balanced allocation of resources and monitor resource utilisation. In fact, many researchers have focussed on the significant benefits of digital technologies in achieving a balanced allocation of resources and optimising resource utilisation ([Saarikko et al., 2020](#)). For example, [Xiao et al. \(2013\)](#) state that Cloud Computing allows business users to increase or decrease the use of their resources as needed. The Industrial Internet of Things provides a new way to optimise the management and dynamic scheduling of a wide range of manufacturing resources by integrating key technologies such as industrial communication, computing and control ([Wan et al., 2018](#)). Visionary managers should be keen to observe the positive role of digital technology applications or digital transformation in leveraging international duality to improve the IP of their firms. In this regard, we believe that Big Data Technologies, E-commerce, Information Systems, Internet Business Models and Artificial Intelligence should be brought to managers' attention, as they are the most frequently occurring digital items statistically identified by researchers working on text mining. These technologies have been rapidly developed and provide new solutions for multinational companies.

Finally, in order to maximise improvements in IP, managers of healthcare multinationals in China and similar emerging economies need to focus not only on overall changes in IP when expanding internationally, but also deploy their resources appropriately in light of the different impacts of the relative scale between exploration and exploitation on different qualities of innovation. This study introduces a quality of innovation perspective, innovatively considering the IP in terms of both the quantity and quality of patents. We remind managers of EM MNEs of healthcare industry that when expanding internationally, they should not only focus on overall changes in IP, but also examine what quality of innovation the firm wants to achieve in order to develop sound digitalisation and internationalisation strategies. EM MNEs facing technological difficulties should focus on finding and acquiring knowledge and resources relevant to solving various technological problems and finding new technological routes and technological change solutions through internationalisation. Conversely, for healthcare multinationals that urgently need to achieve low-quality innovation, indiscriminate access to any resources and information may lead to information overload and wasted resources. Furthermore, our observation that whether or not firms adopt digital transformation measures directly affects the achievement of low-

quality innovation for EM MNEs (an effect that is even greater than that of IA) suggests that for healthcare industry multinationals from emerging economies such as China, digitalisation is more conducive to less complex R&D tasks than internationalisation and that too much internationalisation is not economical.

5.3 Limitations and future research

First, the study sample includes only Chinese multinationals, even though we consider China to be one of the representatives of emerging economies. Therefore, the application of conclusions may differ for other emerging economies due to differences in economic development, geographical location and other idiosyncrasies. Second, in order to get a more focussed understanding of the digital development and current status of internationalisation of multinational companies in the healthcare industry, our study sample only includes listed companies in the Healthcare industry, which limits the applicability of the findings to other areas. Future studies can consider comparative studies across industries with larger samples to enhance the generalisability of the findings.

Notes

1. www.wl.gov.cn/art/2020/12/23/art_1402229_58946899.html
2. https://www.cnipa.gov.cn/art/2021/6/11/art_53_159941.html

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