Drivers of R&D greenfield investment projects in the communications, software and IT service industries in developing countries*

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Abstract

Globalization has led to the decentralization of research and development (R&D) activities by multinational enterprises (MNEs). Investment in these activities is affected by both the host-country environment and the investment strategies of the entrant MNEs. Using data on greenfield R&D investment projects for a sample of digital MNEs in the communications, software and IT service industries during the period 2003–2019, we investigate the importance of host-country characteristics on MNEs' R&D investment and examine the moderating role of the host country's innovation capabilities as well as two strategies – exploitation versus exploration – on the part of MNEs. We find that the size of investment projects is larger in developing countries than in developed ones, especially when host countries have stronger innovation capabilities and when MNEs pursue strategies of exploitation rather than exploration. Our findings contribute to the extant research in this area and furnish related policy implications for developing countries.

Keywords: developing countries, global innovation index, host country innovation capabilities, R&D greenfield investment project, R&D investment strategies

JEL classification codes: F21, F23, F68, L21, L86

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1. Introduction

International business research has paid close attention to foreign direct investment (FDI) in research and development (R&D) (Choquette et al., 2021; Dachs and Zahradnik, 2022) and has shown that multinational enterprises (MNEs) play an important role in generating foreign R&D activities in both developing and developed countries. The last decades have seen a shift in the international R&D investment of MNEs from developed economies to emerging and developing ones (UNCTAD, 2005a; von Zedtwitz, 2004). The rise of emerging and developing economies in MNEs' location choice for foreign R&D challenged the traditional approach to overseas R&D, by focusing solely on the technological and knowledge capacity of host countries as key determinants of R&D internationalization. This calls for a better understanding of the importance of location characteristics among investment characteristics for MNEs' international R&D investment.

The importance of the digital industries as a destination for R&D investment has been increasing over time. A survey of the top 2,000 companies that invested the most in R&D in 2014 found that 21 per cent of their subsidiaries were in the information and communication technology (ICT) industry, and that the share of subsidiaries going to developing countries such as China, India and Malaysia was larger than the share going to the United States or Northern Europe (Daiko et al., 2017). Within the ICT industry, the largest share of active subsidiary companies was in IT services, telecommunication, computers and electronics and publishing and broadcasting. The number of FDI projects in these industries rose from 2,232 in 2020 to 2,886 in 2021, and most of them were greenfield investment – 1,778 in 2020 and 2,206 in 2021.[1] Geographically, while almost all regions experienced increases in the number of projects attracted, four – Western Asia and Northern Africa, and Central America and the Caribbean – experienced the highest growth rates.[2] In addition, research shows that low-cost developing countries are hubs for the non-core R&D activities of many MNEs (Awate et al., 2015; Reddy, 2000) and that digitalization, development of new technologies and advancements in ICT have created immense opportunities for developing countries (UNCTAD, 2017). These trends underscore the growing importance of developing countries as destinations for R&D investment and necessitate a closer look at factors that drive this phenomenon.

Although there is extensive research on MNEs' use of exploitation and exploration strategies (e.g. Choquette et al., 2021; Frost et al., 2002), little attention has been paid to the interdependence between the host-country context, firms' investment

[1] Lara Williams, "FDI in software and IT services in 2021: The state of play", Investment Monitor, 8 September 2022.
[2] Ibid.

strategies and the size of R&D investment of digital MNEs in developing and developed countries. Accordingly, this paper explores the role of location and investment project characteristics in determining the size of MNEs' greenfield R&D investment in communication, software and IT service industries (used interchangeably with "digital industries" in the rest of the paper)[3] across the globe over the period 2003–2019.

The ability of developing countries to attract R&D investment depends, among other things, on the host country's characteristics, such as innovation capabilities (Choquette et al., 2021). The globalization of R&D has led to higher technological intensity in MNEs' products, strengthening their competitive advantage through improved innovation capabilities in international operations (von Zedtwitz and Gassmann, 2002). By targeting developing countries for establishing subsidiaries that focus on R&D activities, MNEs are expected to gain access to national innovation systems (Patel and Vega, 1999), facilitating successful adaptations (Dunning, 1988). Hence, we focus on developing-country factors – and especially their national innovation systems – in attracting greenfield R&D investment.

Furthermore, the patterns of globalization of R&D activities depend on MNEs' market expansion strategies. To ensure both short-term success and long-term survival, MNEs may choose between exploiting existing knowledge or exploring new knowledge. Exploitation refers to market expansion strategies in which MNEs adapt their technological assets in response to new demand conditions (Kuemmerle, 1997; Patel and Vega, 1999), and exploration refers to new market entry strategies in order to access and absorb specific local knowledge (Kuemmerle, 1997). Over the last decades, many MNEs have shifted from exploitation strategies to exploration ones in their international R&D activities (Awate et al., 2015). The optimal balance between the two strategies depends not only on firm-specific factors, but also on technological dynamism and market competitiveness. Developing countries are characterized by environmental uncertainties driven by political, economic and institutional changes. Such uncertainties demand that firms not only reconfigure existing resources and competencies to survive in the short term but also create new products and processes to compete in the long term.

The objective of this research is to understand (i) whether developing or developed countries attract higher investment in greenfield projects in the communication, software and IT service industries, (ii) the role of a country's innovation capabilities in determining the size of R&D greenfield investment and (iii) whether the size of greenfield investment projects is affected by the project's investment strategy.

[3] Although "digital industries" is broader than the industries we focus on, the communication, software and IT service industries constitute a large part of them.

The analysis is based on comprehensive and authoritative data on greenfield R&D investments compiled by fDi Markets, and our conclusions do not generalize beyond this context. Our findings provide important contributions to the literature on R&D internationalization and have several policy implications.

2. Literature review and research questions

2.1 Digital MNEs' greenfield R&D investment projects in developing and developed countries

Research on international business argues that developed countries have traditionally attracted R&D FDI (Haakonsson and Ujjual, 2015; Lemi, 2010). Indeed, in line with the theory of technological competence, MNEs have chosen to invest in developed countries because of their more advanced technologies (Le Bas and Sierra, 2002). Developed countries have also offered comparable advanced technological infrastructure for developed-country multinationals, allowing them to combine home- and host-country R&D activities (Chung and Yeaple, 2008). For example, communication technology companies such as Ericson, Motorola and Qualcomm preferred to apply R&D investment and conduct the majority of their R&D activities in developed countries that have strong enforcement of intellectual property rights, which serves as a safety net for their investments (Di Minin and Bianchi, 2011). By comparison, developing countries have traditionally not been desirable locations for international R&D (UNCTAD, 2005b).

Yet, this pattern has been changing. Digital MNEs in particular have recently started to carry out investment related to ICT infrastructure. For instance, Alphabet has made telecommunication investments and Amazon has started a number of renewable energy projects in Africa (UNCTAD, 2022). Furthermore, most developing countries have embraced digitalization to improve business transparency, revolutionize the banking system and increase revenue mobilization (Ayakwah et al., 2021; Senyo and Osabutey, 2020). This has led to growing demand for digital technologies, driving international R&D investment by digital MNEs in developing countries (Thursby and Thursby, 2006).

Research shows that a variety of factors influence R&D FDI in developing countries. Availability of internet infrastructure can help attract digital MNEs to build regional cooperation with local governments to invest in infrastructure and subsequent R&D investment projects (UNCTAD, 2017). The strength of intellectual property rights protection and government support through fiscal policies can further attract larger R&D FDI (Nielsen et al., 2017; UNCTAD, 2005a). Yet, market size and income-level growth are the two main drivers of such investment (Dunning, 1981; Grosse, 2019; Grubert and Mutti, 1991; Lim, 1983; Schneider and Frey, 1985).

A sizeable and growing market offers better prospects for return on investment to digital MNEs by lowering R&D costs per unit of sales, and creating opportunities to recoup R&D investment quickly (Cohen and Klepper, 1996; Hitt et al., 1997). For instance, Ghana represents a large market prospect for mobile and telecommunication companies, given the increased importance of the banking industry's mobile money accounts (Senyo and Osabutey, 2020). Furthermore, the growth in local demand from a rising affluent middle class with augmented purchasing power has led MNEs to adopt market development or market penetration strategies in many developing countries (Ansoff, 1957).

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In addition to market size and income-level growth, the need to attract more FDI and to amplify the benefits from foreign to local firms (Meyer and Sinani, 2009) has spurred developing countries to invest in building their human capital and innovation potential. A well-educated and comparatively cheap labour force represents an innovation recruitment pool for R&D projects, whether in strategies of exploitation or exploration (Gassmann and Han, 2004). Investment-friendly fiscal policies and government investment in R&D infrastructure, e.g. science parks and incubators, have further driven MNE R&D investment expansion in developing countries (Chen, 2008; Haour and Jolly, 2014; UNCTAD, 2005a). Utilizing these advantages, many jobs in digital industries have been outsourced to developing countries, such as to China, India, Mexico and Viet Nam (Sethi et al., 2021; UNCTAD 2005a). For example, Accenture and IBM are among digital companies outsourcing their R&D to India (Hira, 2020). Over time, growing market-driven pressure for customized solutions has led leading digital MNEs such as Adobe Systems in India (Asakawa and Som, 2008), Google (Komoda et al., 2021) and Motorola (Qi et al., 2014) expand their R&D-related investment projects in developing countries towards more knowledge-seeking activities to meet local demand (UNCTAD, 2005a; Zhao et al., 2021).

In comparison with developing countries, the majority of digital industry R&D investment projects in developed countries has occurred through mergers and acquisitions (M&As) rather than greenfield investment (UNCTAD, 2017 and 2022). Among developing countries, greenfield R&D projects have primarily been located

in upper-middle-income countries such as Brazil, Mexico and South Africa. Digital MNEs have a high FDI lightness index, defined as the share of foreign sales to foreign assets, which determines their business models (UNCTAD, 2022). For instance, digital platforms and solutions do not require large physical capital investments, whereas e-commerce and digital content MNEs more often do. FDI research on developing countries shows that they attract more greenfield investment as such investment contributes more to economic growth (Wang and Wong, 2009). In this regard, market size and growth in income level are expected to play important roles also in attracting greenfield R&D investment (Athukorala and Kohpaiboon, 2010; Wang and Wong, 2009). This seems to be corroborated from our data showing that upper-middle-income countries, such as Brazil, Mexico and South Africa, do attract larger R&D projects (table 2). Although the overall tendency of global R&D investment in digital industries might lean towards M&As as the preferred entry mode, when one focuses on greenfield transactions it may be that developing countries might attract larger-sized projects. Therefore, we ask the following research question:

RQ1: Do developing countries attract higher investment in greenfield R&D projects in the communications, software and IT services industries compared with developed countries?

2.2 Host-country innovation capabilities and greenfield R&D investment projects

MNEs' investment in R&D improves their ability to acquire, absorb and utilize new technologies through FDI (Birkinshaw and Hood, 1998; Kogut and Zander, 1993; Wei and Nguyen, 2020). Thus, it is important to understand the nature of factors specific to a host country that "have an influence in creating national technological advantage, including the competitive climate, the financial system and education, training and basic research institutions" (Patel, 1995, p. 152).

Many developing countries seek to attract R&D investment to encourage technology transfer, knowledge stock and human capital formation, international trade integration and a competitive environment, as well as local enterprise development (Buckley et al., 2007; Liu et al., 2000; Meyer and Sinani, 2009). R&D investment is also expected to increase the developing country's absorptive capacity and strengthen the country's technological capabilities, thus ultimately improving its innovation capabilities (Buckley et al., 2007; Meyer and Sinani, 2009). Attracting R&D investment is also expected to improve any weaknesses in a host country's national innovation system, for example by fostering science–industry links and creating a critical mass of innovation capabilities (Bell and Pavitt, 1995; Lall, 1992). Hence, developing countries with established and improved innovation capabilities are expected to attract more R&D investment (Guimón et al., 2018).

Indeed, evidence shows that Chile's Government has promoted R&D FDI with policies that aim to improve the country's technological and innovative capabilities and target knowledge-based industries (Guimón et al., 2018).

The growing importance of developing countries as destinations for R&D-related FDI indicates the combined effect of economic development, technological progress and improved business environments. Many developing countries have made significant progress on a set of factors necessary to attract R&D investment, particularly in the digital industries, such as investing in skill and capacity development; improving research infrastructure, education and innovative capability; and increasing their own R&D investment as a proportion of GDP (World Bank, 2018; UNCTAD, 2017). These factors serve as proxies for the concept of absorptive capacity (Lane et al., 2006), which is the cornerstone of a country's ability to attract R&D-related investment. Continued improvements in developing countries' innovative capabilities, coupled with the global digitalization drive, are expected to increase the attractiveness of developing countries as destinations for R&D-related FDI.

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In research question RQ1 we asked whether developing countries attract higher investment in greenfield R&D projects in the digital industries than developed countries considering their large market size and growth potential. We extend this research question and ask whether digital MNEs with R&D investment projects will prioritize investments in developing countries with stronger innovation capabilities:

RQ2: Is the size of R&D greenfield investment projects in the communications, software and IT service industries in developing versus developed countries affected by the host country's innovation capabilities?

2.3 MNE investment strategy and greenfield R&D investment projects

Decentralization of knowledge-sourcing activities through R&D-related FDI has been a prerequisite for fuelling and sustaining MNEs' unique competitive advantages in any industry (Ambos, 2005; Grosse, 2019; Zhao et al., 2021). MNEs invest in a range of R&D and other knowledge-based activities in host countries to expand their global innovation networks and access market and technological opportunities (Haakonsson and Ujjual, 2015). The literature on R&D internationalization has identified home-based augmenting (exploration) and home-based exploitation (Kuemmerle 1997) as important knowledge-sourcing investment strategies. Both strategies take place across heterogenous locations that make use of both location- and firm-specific advantages (Cano-Kollmann et al., 2016; Narula and Santangelo, 2012).

Considering the complexity of globalization and FDI, MNEs may use a distinct, single strategy or a combination of the two strategies in their foreign subsidiaries (Haakonsson and Ujjual, 2015). MNE investment in accordance with exploitation strategies seeks to expand the current knowledge base and leverage already acquired skills and capabilities to utilize technologies (Choquette et al., 2021; Lavie et al., 2010). Hence, exploitation strategies tend to exploit existing competitive advantages (Kang et al. 2021; Makino et al., 2002). Exploitation activities are supported by intra-MNE knowledge transfer with the aim of recombining knowledge within the host market (Awate et al., 2015). They have been common to improve the ability to serve local market needs, reduce import tariffs (i.e. tariff-jumping) (Kojima, 1978) and to lower production costs in the host country (Pearce, 2012).

Exploration strategies are those through which MNEs develop new technical skills and capabilities (Lavie et al., 2010). MNEs that follow exploration strategies gain advantage by creating new products, often using novel technology (Kang et al., 2021). MNEs choose to focus on exploration strategies in developed countries, considering their advanced technological capabilities (Song et al., 2011). In some cases, however, MNEs use exploration strategies with the intent to invest in new, more creative R&D projects in developing countries in order to access specific tacit and locally bound knowledge that is unavailable in their home market (Choquette et al., 2021; Papanastassiou et al., 2020). Exploration strategies may thus generate additional innovation and facilitate the establishment of centres of excellence that become global leaders within the MNE in specific areas (Frost et al., 2002).

Previous research has argued that new larger R&D investments under exploration strategies tend to be located mainly in developed countries, owing to their higher innovation levels and stronger innovation capabilities (Choquette et al., 2021), whereas developing countries are the stage for exploitation investment in R&D owing to their lower R&D costs and capabilities (Demirbag and Glaister, 2010). However, as argued earlier, market and institutional developments have made

developing countries more attractive destinations for R&D investment projects, including as locations for both exploiting and exploring knowledge (Andersson et al., 2016). While there seems to be agreement on this development, there are opposing views on whether exploitation and exploration take the form of an either-or type of activity or can be combined at different levels, leading to different forms of ambidexterity (Dodourova et al., 2023). Taking a microfoundational perspective, Dodurova et al. (2023) find support for MNEs' combined use of both strategies, albeit in different combinations leading to different types of ambidexterity.

It is important to note that the distinction between exploration and exploitation is often a matter of degree and should therefore be viewed as a continuum, with both activities being essential for firms. Yet, building on past research one could expect developed countries to attract relatively more R&D investment for exploration purposes than developing countries (Demirbag and Glaister, 2010; Gereffi et al., 2005). Therefore, we ask the following research question:

RQ3: Is the size of greenfield R&D investment projects in communications, software and IT industries in developing versus developed countries affected by the MNE's investment strategy?

3. Data, variables and methodology

Our data consists of greenfield R&D investment projects made by digital MNEs, in the communications and software and IT service industries, (i.e., digital industries) during the period 2003–2019. The source of the data is fDi Markets data by fDi Intelligence, a division of the Financial Times, which is widely used in previous research (Albino-Pimentel et al., 2022; Castellani et al., 2013; Castellani and Lavoratori, 2020; Choquette et al., 2021). This data provides information on the size of investment projects and the revenue generated for each R&D investment project, as well as whether the project is new or an expansion project, and whether the R&D investment is made in design, development and testing; ICT and internet infrastructure; research and development; or technical support. Moreover, it provides information on the home and host countries as well as the industry of each greenfield R&D investment.

The dependent variable is *investment size*, which is measured as the logarithm of the investment project size. The independent variables used to explore the three research questions are *host-country type*, *investment strategy* and *innovation capability*.

Host-country type equals one if a host country is a developing country and zero otherwise. We delineate developing countries on the basis of the OECD's Development Assistance Committee list of ODA recipients on which the OECD

database "Statistics on resource flows to developing countries" is based.[4] On that basis we create the dummy variable, dividing host countries between developing and developed countries.[5]

Investment strategy captures the nature of the MNE R&D investment strategy (i.e. exploiting versus exploring). It equals one if the project in the fDi Markets data is an expansion project, and zero if it is a new project. In line with existing research, we argue that expansion projects exploit current firm knowledge and *existing* competitive advantages, and thus reflect exploiting strategies, whereas new projects (or new products) allow firms to explore new competitive advantages and reflect exploration strategies (Kang et al., 2021; Makino et al., 2002).

Innovation capability is measured with the Global Innovation Index (GII), which is an indicator of the host country's ability to innovate and support innovative activities and is based on the premise that innovation is a driver of a host country's economic growth and prosperity (Dutta et al., 2020). The larger the index, the more innovative and supporting of innovative activities the economy is.

In the analysis we also control for home- and host-country characteristics, as well as investment project characteristics that have previously been associated with MNE investment decisions in foreign markets. For instance, the extant research has shown that firm decisions depend on location-specific characteristics such as market size, market growth, labour costs, human capital and knowledge stock needed in R&D production (Alcácer and Chung, 2007; Castellani et al., 2013; Nachum et al., 2008). Thus, we control for home- and host-country characteristics that capture economic and institutional differences at the country level and the dyad level.

At the country level, we control for home- and host-country *Investment incentives* and *R&D expenditure per capita*. Research has shown that a country's investment policy and stock of knowledge are important factors in attracting FDI (Borensztein et al., 1998; Grosse, 2019). For instance, a country's investment policy may encourage both outward as well as inward FDI (Meyer and Sinani, 2009). *Investment incentives* is an index that rates countries in terms of how attractive the investment climate is for foreign investment. The higher the index, the more attractive the investment incentives. Furthermore, countries that invest in R&D improve their absorptive capacities and are expected to attract more FDI (Guimón

[4] See www.oecd.org/dac/financing-sustainable-development/development-finance-data/statisticson resourceflowstodevelopingcountries.htm. The list of ODA recipients we used is for aid reported in 2022–2023 (www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC-List-of-ODA-Recipients-for-reporting-2022-23-flows.pdf).

[5] The grouped countries are not identical to developing and developed economies under the United Nations classification.

et al., 2018; Krammer, 2010). *R&D expenditure per capita* is the ratio of total R&D expenditure (in dollars) to a country's population. Furthermore, in line with previous research (Albino-Pimentel et al., 2022; Castellani and Lavoratori, 2020), we account for host-country location-specific characteristics that increase the likelihood of MNE investment such as market size, which is measured with the logarithm of host-country population, and growth in income levels, which is measured with the growth of host-country GDP per capita.

Research also suggests that a firm's investment decisions in a given location depend on the country's political risk and that all things equal, political risk deters firms' new entry and new investment (Delios and Henisz, 2003; Oetzel and Oh, 2014). Therefore, we control for home- and host-country political risk. A country's *political risk* score varies from the least risky (0) to the riskiest (100) in terms of unfavourable political environment for international business.

At the dyad level we control for whether home and host countries share a *common border*, have had *colonial ties* or have a *common primary language*. Research by Castellani et al. (2013) and Witte et al. (2020) shows that these variables increase the probability of MNEs' engaging in FDI in a specific host country, given that they reflect institutional similarities and a firm's ability to engage in more FDI investment. *Colonial ties* is a dummy that takes the value of 1 if the home and host countries had colonial ties and 0 otherwise; *common language* is a dummy that equals 1 if the home and host countries share a common primary language and 0 otherwise; and *contiguous* is a dummy that equals 1 if the home and host countries share a common border.

Finally, in line with prior research that controls for firm characteristics that affect investment decisions (Albino-Pimentel et al., 2022; Castellani et al., 2013; Choquette et al., 2021; Oetzel and Oh, 2014), we control for investment project characteristics. For instance, we control for project *performance* with the logarithm of the revenues it generated, and for the *R&D project designation* with a dummy for whether investments are made in business activities such as design, development and testing; ICT and internet infrastructure; R&D; or technical support. Table 1 provides a summary of the variables definitions, measurements, data sources and the level in the analysis.

Table 1. Variables, definitions and sources

Variable	Measurement	Source
Investment size	The logarithm of the size of each investment project.	fDi Intelligence, fDi Markets project database, 2003–2019.
Host-country type	1 = if a country is subject to the OECD's official development assistance (ODA) (i.e. considered a "developing country"), 0 = otherwise.	OECD, "Statistics on resource flows to developing countries", updated 22 December 2022; "DAC list of ODA recipients: Effective for reporting on 2022 and 2023 flows", www.oecd.org.
Innovation capability	The GII, ranging from 0 to 100 (highest innovation performance), indicates the host country's ability to innovate and support innovative activities as a driver of economic growth and prosperity. The overall GII is constructed as the average of the innovation input and innovation output sub-indexes.	Cornell University, INSEAD and the World Property Organization, "Global Innovation Index 2022", www.globalinnovationindex.org.
Investment strategy	1 = if the investment is an expansion project, 0 = if it is a new project.	fDi Intelligence, fDi Markets project database, 2003–2019.
Project designation – ICT and infrastructure	1 = if the investment is made in ICT infrastructure, 0 = otherwise.	fDi Intelligence, fDi Markets project database, 2003–2019.
Project designation – R&D	1 = if the investment is made in R&D, 0 = otherwise.	fDi Intelligence, fDi Markets project database, 2003–2019.
Project designation – Technical support	1 = if the investment is made in technical support, 0 = otherwise.	fDi Intelligence, fDi Markets project database, 2003–2019.
Project performance	The logarithm of revenue of each investment project.	fDi Intelligence, fDi Markets project database, 2003–2019.
Investment incentives	An index from 0 to 10 that rates countries in terms of how attractive their investment incentives are to foreign investors.	IMD, "World competitiveness 2022 ranking", World Competitiveness Online, www.imd.org.
R&D expenditure per capita	The ratio of total R&D expenditure to a country's population (in $ per capita).	IMD, "World competitiveness 2022 ranking", World Competitiveness Online, www.imd.org.
Political risk	Scores countries from least risky (0) to riskiest (100) in terms of political changes that are unfavourable for international business.	PRS Group, "International Country Risk Guide (ICRG)", November 2020, www.prsgroup.com.

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Table 1. Variables, definitions and sources (Concluded)

Variable	Measurement	Source
Colonial ties	1= if a colony–colonizer relationship existed between the home and host country, 0 = otherwise.	CEPII, Gravity database, November 2022 (202211) version, www.cepii.fr.
Common language	1 = if the home and host country share a common primary language, 0 = otherwise.	CEPII, Gravity database, November 2022 (202211) version, www.cepii.fr.
Common border	1 = if the home and host country share a common border, 0 = otherwise.	CEPII, Gravity database, November 2022 (202211) version, www.cepii.fr.
Market size	The logarithm of the host country's population.	World Bank, "World Development Indicators" (accessed on 25 January 2023).
Market growth	The growth of the host country's GDP per capita (as a percentage).	World Bank, "World Development Indicators" (accessed on 25 January 2023).
Patent applications per capita	Measured as the number of applications filed by the applicant's country of origin, per 100,000 inhabitants.	IMD, "World competitiveness 2022 ranking", World Competitiveness Online, www.imd.org.
Patents granted	Measured as the number of patents granted by the applicant's country of origin (average 2016–2018).	IMD, "World competitiveness 2022 ranking", World Competitiveness Online, www.imd.org.

Source: Authors' compilation.

Note: CEPII = Centre d'Études Prospectives et d'Informations Internationales, DAC = Development Assistance Committee, GDP = gross domestic product, GII = Global Innovation Index, IMD = International Institute for Management Development, INSEAD = Institut Européen d'Administration des Affaires, OECD = Organisation for Economic Co-operation and Development, R&D = research and development.

4. Results and discussion

The distribution of the host countries and the respective (average) size of investment (table 2), shows that while the number of investment projects is higher mostly in developed countries, such as Australia, Canada, France, Germany, the United Kingdom and the United States, the size of investment is larger in the upper-middle-income ones, such as Argentina, Brazil, Mexico and Peru. This is important information; it shows that the size of R&D investment during the period 2003–2019 has, on average, been larger in developing countries. Therefore, identifying the factors that explain this pattern is an important contribution to the extant literature on MNE's internationalization of R&D.

Table 2. Distribution of the mean size of investments and number of investments, by host economy, 2003–2019

Destination economy	Mean investment ($ millions)	Number of investments	Destination economy	Mean investment ($ millions)	Number of investments
Argentina	249.99	44	Latvia	37.38	7
Australia	57.24	92	Lithuania	17.79	44
Austria	47.09	27	Luxembourg	288.08	5
Belgium	83.65	37	Malaysia	48.99	51
Brazil	169.34	177	Mexico	231.93	74
Bulgaria	14.13	43	Mongolia	91.00	1
Canada	124.42	251	Netherlands	231.01	97
Chile	236.90	38	New Zealand	41.74	16
China	48.17	224	Norway	79.92	12
Colombia	89.80	63	Peru	128.39	16
Croatia	30.04	13	Philippines	34.92	13
Czechia	27.34	41	Poland	21.48	123
Denmark	129.36	29	Portugal	35.15	39
Estonia	32.14	24	Qatar	15.30	1
Finland	70.00	51	Romania	18.27	137
France	35.72	170	Russian Federation	25.94	76
Germany	25.98	250	Singapore	71.13	203
Greece	60.19	11	Slovakia	43.14	22
Hong Kong, China	113.23	79	Slovenia	38.96	5
Hungary	24.37	52	South Africa	84.97	50
Iceland	107.00	4	Spain	31.04	211
India	36.49	459	Sweden	50.20	51
Indonesia	42.02	17	Switzerland	36.51	8
Ireland	49.06	223	Thailand	63.96	19
Israel	25.04	72	Türkiye	58.72	21
Italy	119.85	40	United Arab Emirates	60.56	31
Japan	36.85	92	Ukraine	28.54	19
Jordan	32.50	5	United Kingdom	46.04	423
Kazakhstan	64.16	10	United States	62.38	318
Korea, Republic of	66.56	38	Venezuela, Bolivarian Republic of	99.97	19
			Total	**65.85**	**4 788**

Source: Authors' calcluations, based on fDi Markets project database.

Table 3. Distribution of the number of investments from communications and software and IT services across business activities, 2003–2019

Business activity	Communications	Software and IT services	Total
Design, development and testing	547	2 027	2 574
ICT and internet infrastructure	1 325	384	1 709
Research and development	51	100	151
Technical support	86	268	354
Total	**2 009**	**2 779**	**4 788**

Source: Authors' calculations, based on fDi Markets project database.
Note: ICT = information and communication technology, IT = information technology.

Furthermore, a distribution by business activities (table 3) shows that most of the investments in the digital industries are in design, development and testing and in ICT and internet infrastructure. This pattern is in line with the *World Development Investment Report 2022* (UNCTAD, 2022), which points out that the need (which prevailed during the pandemic) to adopt new digital solutions has led to new entrants in digital MNEs' market, mainly in digital platforms and e-commerce. Furthermore, although international investment in ICT infrastructure has increased, only the top digital MNEs pursue such investment abroad (UNCTAD, 2022).

Table 4 shows the summary statistics and the correlation matrix of our main variables. The results show that correlations are low, suggesting there are no multicollinearity issues.

Our data consists of 4,788 R&D investment projects, made by parent firms across multiple host countries, over the period 2003–2019. Since the project data represent different R&D investments made by parent firms over time, the database represents a cross-section of R&D investment. However, given that a parent firm may have made several R&D investments over the period 2003–2019, we are able to cluster the errors at the firm level and estimate ordinary linear regressions with heteroscedastic and autocorrelation-consistent standard errors, also including year, digital industries and region fixed effects.

The regression results are reported in table 5, models 1–3. Model 1 tests for research question RQ1, and models 2 and 3 test for the proposed moderators. RQ1 inquires whether developing countries attract higher R&D investment than developed countries. Our results show that the coefficient for the *host-country type* is positive and significant at the 1 per cent significance level (model 1: b1 = 0.184, p = 0.002). The coefficient of the *host-country type* implies that, on average, R&D investment in developing countries is larger than investment in developed countries

Table 4. Summary statistics and correlation matrix of main variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Host-oountry type	1																	
2. Innovation capability	-0.41	1																
3. Investment strategy	-0.06	0.01	1															
4. Project designation – ICT and infrastructure	-0.04	-0.03	-0.08	1														
5. Project designation – R&D	0.03	-0.02	-0.01	-0.19	1													
6. Project designation – Technical support	0.01	-0.06	0.01	-0.21	-0.07	1												
7. Project performance	0.03	-0.07	0.01	0.04	0.10	0.02	1											
8. Contiguous	-0.15	0.04	-0.01	0.07	-0.01	-0.03	-0.02	1										
9. Common language	0.05	0.08	0.07	-0.02	-0.01	0.00	-0.15	0.09	1									
10. Colonial ties	-0.18	0.09	0.01	0.02	-0.03	-0.02	-0.05	-0.01	0.28	1								
11. Investment incentives – Home	-0.05	0.23	0.06	-0.04	-0.01	-0.02	-0.12	-0.02	0.20	-0.01	1							
12. Investment incentives – Host	-0.12	0.37	0.03	-0.03	0.03	-0.02	-0.04	0.01	0.26	0.03	0.04	1						
13. R&D expenditure per capita – Host	-0.49	0.47	-0.02	0.13	-0.06	-0.07	-0.03	0.04	0.03	0.08	0.02	0.30	1					
14. R&D expenditure per capita – Home	-0.05	0.12	0.07	-0.03	-0.04	-0.02	-0.06	-0.10	0.05	-0.05	0.33	0.02	0.02	1				
15. Political risk – Home	-0.05	0.08	0.07	-0.02	0.01	-0.02	-0.07	-0.07	0.02	-0.01	0.35	0.02	-0.01	0.51	1			
16. Political risk – Host	-0.52	0.44	0.02	0.04	-0.02	-0.03	-0.02	0.12	0.03	0.07	0.06	0.35	0.70	0.07	0.10	1		
17. Market size	0.33	0.13	0.01	0.22	0.07	0.01	-0.04	0.03	0.10	0.02	0.02	0.15	0.32	0.00	0.03	0.42	1	
18. Market growth	0.46	0.04	0.01	0.14	0.10	0.03	0.01	0.07	0.10	0.12	0.03	0.20	0.39	0.04	0.01	0.32	0.31	1
Mean	0.46	41.54	0.19	0.35	0.06	0.08	8.13	0.09	0.39	0.15	6.52	6.24	575.72	1 117	81.2	76.8	10.90	3.03
Standard deviation	0.50	18.58	0.39	0.48	0.24	0.27	3.16	0.29	0.49	0.36	0.93	1.13	552.17	523.63	6.74	8.92	1.77	3.49
Minimum	0	2.02	0	0	0	0	0.01	0	0	0	0.94	0.67	1.26	0.64	52	45	5.77	-14.40
Maximum	1	68.40	1	1	1	1	13.09	1	1	1	8.98	8.98	2 782	2 782	93	93	14.29	25.10

Source: Authors' estimations.
Note: ICT = information and communication technology,R&D = research and development.

Table 5. Results of regression analysis

Variable	(1)	(2)	(3)
Host-country type	0.184*** (0.059)	-0.120 (0.082)	0.154** (0.060)
Innovation capability	0.006* (0.004)	0.006* (0.004)	0.006* (0.004)
Investment strategy	0.012 (0.048)	0.017 (0.048)	0.129 (0.088)
Host country x Innovation capability		0.008*** (0.002)	
Host country x Investment strategy			0.168** (0.082)
Project designation – ICT and infrastructure	1.538*** (0.043)	1.539*** (0.043)	1.537*** (0.043)
Project designation – R&D	0.322*** (0.085)	0.314*** (0.085)	0.320*** (0.085)
Project designation – Technical support	-0.374*** (0.061)	-0.371*** (0.061)	-0.371*** (0.061)
Project performance	0.056*** (0.007)	0.055*** (0.007)	0.056*** (0.007)
Contiguous	-0.071 (0.087)	-0.075 (0.088)	-0.067 (0.088)
Common language	0.003 (0.041)	0.008 (0.041)	0.001 (0.040)
Colonial ties	-0.082 (0.059)	-0.085 (0.059)	-0.079 (0.058)
Investment incentives – Home	0.031 (0.028)	0.030 (0.027)	0.031 (0.027)
Investment incentives – Host	0.066** (0.026)	0.054** (0.026)	0.068*** (0.026)
R&D expendigure per capita – Home	-0.047 (0.000)	-0.042 (0.000)	-0.049 (0.000)
R&D expenditure per capita – Host	0.300*** (0.000)	0.300*** (0.000)	0.300*** (0.000)
Political risk – Home	0.005 (0.005)	0.005 (0.005)	0.005 (0.005)
Political risk – Host	-0.001 (0.005)	-0.002 (0.005)	-0.001 (0.005)
Market size	0.072*** (0.020)	0.066*** (0.020)	0.074*** (0.020)

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Table 5. Regression results for the main and moderating hypotheses (Concluded)

Variable	(1)	(2)	(3)
Market growth	0.040*** (0.006)	0.020*** (0.006)	0.040*** (0.006)
Constant	2.395*** (0.757)	2.654*** (0.755)	2.426*** (0.756)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects (Communication vs. Software and IT)	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	4 777	4 777	4 777
R-squared	0.541	0.543	0.541

Source: Authors' estimations.

Note: ICT = information and communication technology, IT = information technology, R&D = reseaarch and development. OLS regressions with industry, region and year fixed effects, and with errors clustered at the firm level. Robust standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.10.

by 18.4 per cent. This result, in the context of greenfield investment projects in communications, software and IT services industries, supports the new pattern of R&D internationalization (UNCTAD, 2005a; von Zedtwitz, 2004) that highlights the shift of international R&D by MNEs from developed countries to emerging and developing countries as well as the arguments that the comparatively lower R&D costs and larger investment incentives in developing countries encourage R&D investment projects by digital MNEs (Hitt et al., 1997; Nielsen et al., 2017).

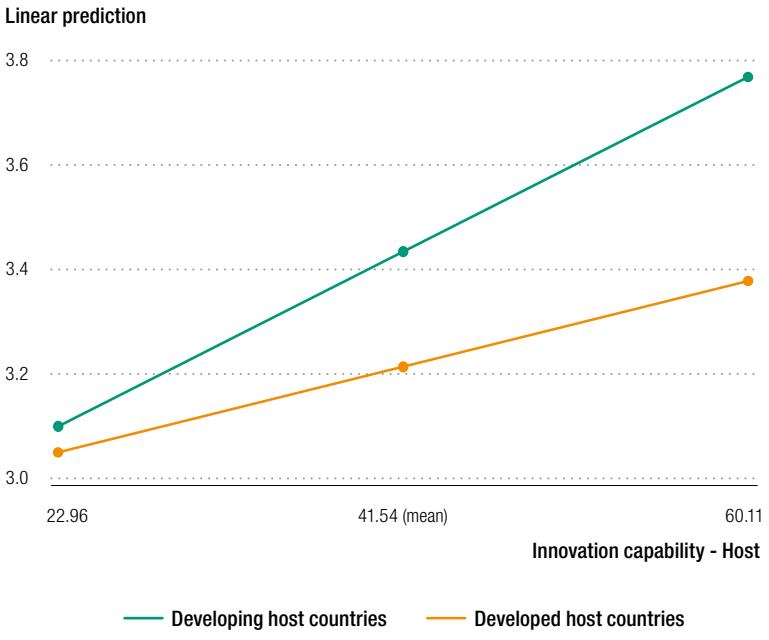
Model 2 investigates the moderating effect of the host country's innovation capabilities. The interaction effect of the *host-country type* with the host country's *innovation capability*, measured by GII, is positive and significant at 1 per cent significance level (model 2: b4 = 0.008, p = 000). Thus, the host country's *innovation capability* positively moderates the effect of developing countries on the size of R&D investment projects, providing support for the arguments leading to RQ2 and further reinforcing the finding that developing host countries attract larger R&D greenfield investment projects in the communications, software and IT service industries than do developed host countries.

The moderating effect of host countries' *innovation capability* is graphically displayed in figure 1, for the *innovation capability* values at the mean, one standard deviation above the mean and one standard deviation below the mean. We see that the predicted values of the size of investment increase as the *innovation capability* increases by one standard deviation along the horizontal axis (from 22.96 to 41.54 or to 60.11). Furthermore, this effect is stronger for developing host countries.

We calculate that an increase in host-country *innovation capability* by one standard deviation (18.57) increases the size of investment projects in developing countries by 17.1 per cent.

Research by Choquette et al. (2021) shows that the magnitude of the effect of the innovation framework in emerging and advanced economies does not differ significantly for investment projects in the pharmaceutical industry. We expand upon this finding and show that for developing and developed host countries at the same innovation level (i.e. at the mean), an increase in the host country's innovation level will lead to larger greenfield investments in developing countries than in developed ones by MNEs in the digital industries. These results, furthermore, support the broader statements in the literature about the importance of host-country innovation, in that host countries with innovation capabilities, such as the ability to innovate and support innovative activities, are able to attract more FDI (Papanastassiou et al., 2020).

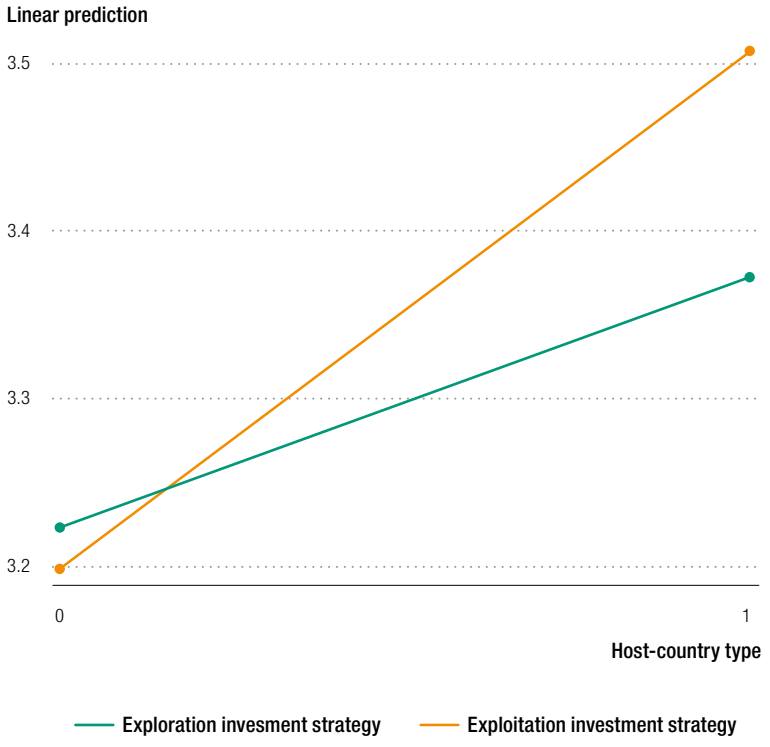
Figure 1. The moderating effect of host-county innovation capability on the relationship between size of R&D investment projects and type of host country



Source: Authors' estimations.

Model 3 tests for the moderating effect of investment strategy, namely, exploitation projects rather than exploration projects (i.e. expansion projects rather than new projects, in the fDi Markets data) (model 3: b5 = 0.168, p = 0.041). The results show that R&D investment projects in developing countries are 16.8 per cent larger for exploitation projects than exploration projects. Indeed, figure 2 shows that R&D investments are larger for exploitation than for exploration projects and that this effect is larger in developing countries than in developed ones. Thus, we find evidence supporting the reasoning behind RQ3. These findings also support prior arguments that developing countries tend to attract exploitation rather than exploration R&D investment due to the lower R&D cost and the incremental knowledge base characterizing such projects (Demirbag and Glaister, 2010).

Figure 2. The moderating effect of MNE investment strategy on the relationship between size of R&D investment projects and type of host country



Source: Authors' estimations.

We also control for a range of project and home- and host-country characteristics. Among the project characteristics, we find that compared with projects dedicated to design, development and testing (the base case), projects dedicated to ICT and infrastructure and R&D are significantly larger, while projects in technical support are significantly smaller. Furthermore, project performance correlates significantly with investment size, suggesting that the more profitable projects are also larger. Among the home- and host-country characteristics, in line with our predictions, host-country investment incentives and expenditure on R&D per capita are significant and positive in sign, suggesting that host countries with stronger incentives for FDI and with higher R&D expenditure per capita attract larger R&D investment projects. In addition, we find that market size and growth are positive and significant in all regressions, providing support for their importance for R&D investment (Grosse, 2019; Nielsen et al., 2017). This finding also provides further support for the trend of upper-middle-income developing countries attracting the substantial share of greenfield R&D investment in developing countries in the communications, software and IT industries.

In our robustness checks, we also consider other measures for host-country innovation capabilities. For instance, we run regressions using patent applications per capita and/or patents granted, as measures of host-country innovation. The results in table 6, models 2 and 4, show supporting evidence for RQ2, as the coefficients of the interaction of the *host-country type* for developing and developed countries with patent applications per capita or with patents granted are significant at 1 per cent significance level.

Table 6. Robustness checks with patent applications and patent granted

Variable	(1)	(2)	(3)	(4)
Host-country type	0.201*** (0.055)	0.119* (0.061)	0.163*** (0.055)	0.086 (0.056)
Patent application per capita	0.001*** (0.000)	0.001*** (0.000)		
Host country x Patent applications per capita		0.003*** (0.001)		
Patents granted			-0.002 (0.003)	-0.022*** (0.003)
Host country x Patents granted				0.042*** (0.004)
Investment strategy	0.055 (0.043)	0.062 (0.044)	0.051 (0.044)	0.059 (0.044)

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Table 6. Robustness checks with patent applications and patent granted (Concluded)

Variable	(1)	(2)	(3)	(4)
Project designation – ICT and infrastructure	1.567*** (0.042)	1.571*** (0.042)	1.573*** (0.042)	1.580*** (0.042)
Project designation – R&D	0.277*** (0.052)	0.276*** (0.052)	0.278*** (0.052)	0.274*** (0.053)
Project designation – Technical support	-0.394*** (0.055)	-0.391*** (0.055)	-0.390*** (0.054)	-0.380*** (0.053)
Project performance	0.055*** (0.006)	0.054*** (0.007)	0.055*** (0.007)	0.053*** (0.007)
Contiguous	-0.076 (0.072)	-0.088 (0.073)	-0.074 (0.072)	-0.134* (0.070)
Common language	0.062* (0.035)	-0.049 (0.036)	0.088** (0.036)	0.090** (0.036)
Colonial ties	-0.028 (0.054)	-0.044 (0.054)	-0.031 (0.054)	-0.019 (0.053)
Investment incentives – Home	0.020 (0.025)	0.021 (0.025)	0.023 (0.025)	0.024 (0.025)
Investment incentives – Host	0.067*** (0.018)	0.056*** (0.018)	0.060*** (0.017)	0.046*** (0.017)
R&D expenditure per capita – Home	-0.090 (0.000)	-0.091 (0.000)	-0.093 (0.000)	-0.110 (0.000)
R&D expenditure per capita – Host	0.450*** (0.000)	0.490*** (0.000)	0.310*** (0.000)	0.140** (0.000)
Political risk – Home	0.006 (0.005)	0.006 (0.005)	0.006 (0.005)	0.005 (0.005)
Political risk – Host	0.011*** (0.004)	0.010** (0.004)	0.011*** (0.004)	0.011*** (0.004)
Market size	0.041** (0.017)	0.032* (0.018)	0.033* (0.018)	0.016 (0.017)
Market growth	0.040*** (0.005)	0.050*** (0.005)	0.040*** (0.005)	0.010* (0.006)
Constant	0.969 (0.596)	1.068* (0.597)	0.948 (0.595)	0.998* (0.593)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effects (Communication vs. Software and IT)	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Observations	4 788	4 788	4 788	4 788
R-squared	0.516	0.517	0.515	0.522

Source: Authors' estimations.

Note: ICT = information and communication technology, IT = information technology, R&D = reseaarch and development. OLS regressions with industry region and year fixed effects, and with errors clustered at the firm level. Robust standard errors in parentheses. Significance levels *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

5. Conclusions and policy implications

In this paper we investigate the importance of host-country characteristics on MNEs' R&D investment decisions and examine the moderating role of host-country innovation capabilities and MNEs' exploiting versus exploring investment strategies. Using greenfield R&D project data for a sample of digital MNEs in communications, software and IT services during the period 2003–2019, we find that the size of R&D investments is larger in developing countries than in developed ones. This effect is positively moderated by host-country innovation capabilities and MNEs' strategies (exploitation versus exploration). Our paper makes three important contributions to the R&D internationalization literature.

First, our findings support the recent shift in the pattern of R&D internationalization from developed to developing countries (von Zedtwitz, 2004) and provide support to the arguments that despite the lack of strong institutions or innovation systems, developing countries pursue digitalization as a means to achieve development (Ayakwah et al., 2021; Senyo and Osabutey, 2020) and that lower R&D costs and larger investment incentives in developing countries encourage digital MNEs' greenfield R&D investment projects (Hitt et al., 1997; Nielsen et al., 2017).

Second, we contribute by showing that an increase in the host country's innovation capabilities leads to larger greenfield R&D investments by digital MNEs in the communications, software and IT service industries in developing countries than in developed countries (Choquette et al., 2021). Furthermore, this finding provides broad support to the argument that host countries with innovation capabilities, such as the ability to innovate and support innovative activities, are able to attract more FDI (Papanastassiou et al., 2020).

Third, our findings suggest that digital MNEs that pursue exploitation strategies in developing versus developed countries tend to engage in larger greenfield investment projects. We argue that in the last decade, most developing-country governments have recognized the benefit of digitalization for development and have incorporated it in their strategic initiatives (Ayakwah et al., 2021), thus encouraging digital MNEs to expand their projects by engaging in larger greenfield investment projects.

Our findings lead to several policy recommendations. First, our finding that the size of greenfield R&D investment projects in the communications, software and IT service industries is larger in developing countries than in developed ones has important policy implications with respect to the importance of developing countries' market size and growth potential for R&D FDI. It follows, as a general policy implication, that maintaining strong growth prospects is necessary to remain an attractive destination for MNEs' greenfield R&D investment. A prerequisite for achieving stable and sustainable economic growth is macroeconomic stability.

To achieve this goal, developing countries must use a set of macroeconomic tools, such as fiscal and monetary policies, appropriate investment and exchange rate regimes, and strong financial industry regulation and supervision.

Our findings that market size and growth play an important role in attracting greenfield R&D investment projects in developing markets, coupled with upper-middle-income countries attracting larger investment projects, imply that upper-middle-income developing countries are more successful in attracting greenfield R&D investment projects. Policies that lead to sustainable growth are thus indispensable for all developing countries that aim to attract greenfield R&D investment. A large literature points to total factor productivity as a major driver of economic growth (Bulman et al., 2014; Daude and Fernández-Arias, 2010; Eichengreen et al., 2012). Among the drivers of total factor productivity, especially for upper-middle-income countries, strengthening innovative activities and building innovative capacities are crucial factors to support continued growth. For lower-income countries, total factor productivity growth seems to be driven more by economic openness, ability to attract FDI, demography and development of the financial system and its ability to support private sector development. The fact that the factors associated with growth differ between types of developing countries suggests that policy prescriptions for attracting greenfield FDI related to R&D are far from homogenous for the group of developing countries in our study.

Second, we find that enhancing innovation capabilities improves a country's ability to attract greenfield R&D-related FDI and its likelihood of doing so. Especially, as stressed earlier, upper income developing countries must increasingly prioritize building innovation capabilities through continued investment in education and training, as well as research and knowledge diffusion. Moreover, policymakers in these countries need to improve their ability to effectively transform inputs into outputs. Policymakers must focus on several areas to ensure sustained improvements on the input side. For instance, inputs in institutional reforms are needed to address key weaknesses in the political, regulatory and business environment. Improvements in the business environment require attention to market sophistication (access to credit, investment climate, trade and competition) and to business sophistication (knowledge workers, innovation system linkages and absorption of knowledge). These factors are key elements of the Global Innovation Index, including both sub-indexes (innovation input and innovation output), as well as the innovation efficiency ratio.

In the digital industries, ideas and knowhow move relatively seamlessly, making country progress dependent on striking a balance between local and imported knowledge and being able to mesh these two sources of knowledge effectively. As such, policymakers need to pay attention to both increasing absorptive capabilities, that is, openness to knowledge from abroad, as well as developing "in-house" research and knowledge capability.

Related to the building up of knowledge capabilities, further investment in tertiary education is required – in terms of both volume and quality. Improving access to tertiary education is clearly an ongoing issue for all developing countries. Tertiary education ranking, measured by tertiary enrolment, science and engineering graduates, and inbound mobility, shows that a few emerging markets – notably China, India and Malaysia – are making notable progress in this respect. Yet, there is an apparent disconnect between ranking on tertiary education and conduct of research. Better linkages between teaching and research could be an important objective going forward.

Third, we find that digital MNEs make larger commitments in exploiting projects than in exploring projects in developing countries. The choice between the two kinds of projects depends on MNEs' strategic intent and their learning over time, as well as the features of the business environment, including the stage of development of a country. While attracting exploiting R&D investments potentially generates benefits for all developing countries, these benefits are likely to more pronounced in advanced developing countries, i.e., upper-middle-income countries, with more sophisticated innovative capabilities in place. This may increase their attractiveness as a location for certain types of exploring R&D investment in digital industries. From the perspective of an upper-middle-income host country, exploiting projects may be less desirable than exploring projects, as the former tend not to bring new and significant knowledge to the table. Policies aimed at further developing and upgrading innovative capabilities are thus important considerations for advanced developing countries for their attractiveness for exploiting R&D investment. In contrast, for low-income countries it will be more beneficial to focus on attracting exploiting investment in the first instance while gradually building innovative capabilities. The key to attracting the desired type of investment projects is to use policy to influence MNEs' choices, understanding what location antecedents are important to MNEs given their strategic intent. Once these factors are understood, policymakers can review and redesign industrial policies, investment policies, education and technology policies, and the like within the framework of their overall development strategy to be conducive for encouraging specific types of R&D FDI.

Although our findings are robust and lead to important policy considerations, we acknowledge that the study has limitations which open up opportunities for future research. First, we pose the research questions on a sample of MNEs from communications, software and IT service industries. Thus, the findings and implications derived from this study do not extend beyond these industries. Future studies should consider samples of MNEs from larger pools of industries, particularly R&D-intensive ones, to investigate the determinants of their R&D investment projects.

Second, we use a dummy to distinguish between developing and developed countries to proxy for differences in market growth potential. However, other differences among countries are worth exploring that can also affect MNE

investment decisions, such as the level of development and political differences. Thus, future research can employ more refined measures of home- and host-country differences or dyadic political or conflict variables to capture variations in R&D investment decisions.

Third, we capture host-country innovation capabilities with the Global Innovation Index, which incorporates the input and output factors of innovation. Although we were interested in the overall innovation capabilities of host countries, future research may focus on its separate dimensions, such as inputs, thus investigating the moderating effect of learning and knowledge accumulation to capture innovative capabilities.

Finally, our sample relates to greenfield investment projects and the findings can thus not be generalized beyond the context of such projects in the communications, software and IT service industries. However, because digital MNEs tend to engage mainly in M&As rather than greenfield investments, unlike traditional MNEs (UNCTAD, 2022), future research when investigating the investment behavior and investment patterns of digital MNEs should also focus on M&As.

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