Globalization of innovation: the moderating role of project-level investment strategy and country type in location choice for R&D-related FDI*

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Abstract

The current stage of globalization involves geographically dispersed research and development (R&D) investments that are not confined to advanced economies. These cross-border R&D investments are driven by multinational enterprises' (MNEs') strategies for exploring and/or exploiting foreign locations. In this paper, we analyse location choice and the moderating effect of project-level investment strategy (i.e. exploration or exploitation) and type of host economy (i.e. advanced or emerging) on the importance of the innovation framework and local innovation capabilities. Our analysis of 588 R&D-related foreign direct investment (FDI) projects in the pharmaceutical and biotech industries during the 2006–2016 period reveals that whereas a host country's innovation framework and capability overall do affect the location decision, their ultimate effects are conditional on the combination of project-level investment strategy and type of economy. Our findings have policy implications for FDI policies aiming at enhancing linkages between MNEs and local actors and national science, technology, innovation and educational policies and programmes.

Keywords: emerging markets, innovation framework, innovation capabilities, investment strategy, R&D internationalization, location choice

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1. Introduction

The innovation activities of multinational enterprises (MNEs) today are dispersed globally and internationalized (D'Agostino, Laursen and Santangelo, 2013; UNCTAD, 2013). Since the turn of the millennium, emerging markets and developing countries (together called emerging markets in this paper) have increasingly been chosen as locations for foreign direct investment (FDI) related to research and development (R&D) (Demirbag and Glaister, 2010; Haakonsson and Ujjual, 2015; UNCTAD, 2005). This change calls for a deeper understanding of the role of locational characteristics in MNEs' decisions to locate R&D investments in emerging markets rather than advanced economies. The policy relevance of this study is twofold. To build or sustain competitiveness in this new geography of innovation, countries must actively create and facilitate a strong position in the global innovation networks driven by MNEs. In addition, creating such a position has more facets than conventional FDI policy as it connects to the institutional framework as well as the innovation capabilities present in the location. This calls for a holistic policy approach that integrates industrial, innovation and educational policy areas while establishing and maintaining an attractive location for R&D-related FDI.

Decades ago, MNEs' internationalization of innovation began a shift from a reliance on exploitation strategies (e.g. seeking access to markets) towards also adopting exploration strategies (Papanastassiou, Pearce and Zanfei, 2020). In an exploitation strategy, the MNE follows a market expansion strategy in which internationalized R&D activities focus on adapting products or services to a new context. More recently, MNEs' strategies have changed into exploration strategies, in which they invest in R&D activities abroad in order to access specialized knowledge and capabilities that are location-bound for a variety of reasons (Papanastassiou et al., 2020). By following exploration strategies, MNEs are able to tap into and connect to knowledge that is not available in their home economy (Archibugi, Howells and Michie, 1999; Kuemmerle, 1999). The interplay between MNE investment strategies and locational factors that create an attractive environment for innovation in host economies, such as the institutional framework and innovation capabilities, is an area that remains underexplored and would benefit from interdisciplinary approaches (Cano-Kollmann et al., 2016; Beugelsdijk and Mudambi, 2013; Kim and Aguilera, 2016).

In this paper, we address this gap by investigating the following research question: How do R&D project investment strategy and type of economy moderate the effect of location characteristics for the location choice in R&D-related FDI?[1]

[1] As explained in section 3.3, we operationalize location choice at the country level. As a result, we use the terms "location" and "country" interchangeably throughout the paper.

We analyse two particular location characteristics that are central for R&D location choice, namely the innovation framework, encompassing *structural* elements, and innovation capabilities, including the capabilities of local industrial *actors*. Drawing on institutional theory and the literature on innovation capabilities, we know that these two factors are essential for successful investment (Lundvall, 2007; Patel and Pavitt, 1994).

Empirically we analyse the location choice of 588 R&D-related FDI projects from the fDi Markets database in the pharmaceutical and biotech industries from 2006 to 2016. Data from fDi Intelligence show that the pharmaceutical and biotech industries had the highest share of R&D-related FDI (19 per cent and 33 per cent of total FDI, respectively) between 2003 and 2016, making them the most internationalized industries in terms of R&D. Not least in light of the COVID-19 crisis, the pharmaceutical and biotech industries stand out, as most products are of global relevance and in some cases even national security (Gereffi, 2020; UNCTAD, 2020). The Pfizer-Biontech COVID-19 vaccine illustrates the global reach of the pharmaceutical and biotech industries. According to Pfizer (2020), development, testing, and manufacturing of the vaccine involves 23 Pfizer sites in 11 countries and draws on Pfizer's global network of 200 suppliers. As such, the development of the Pfizer-Biontech vaccine as well as other COVID-19 vaccines indicates MNEs' role in orchestrating innovation networks and the importance of synergies between actors and locations (Papanastassiou, 2021). In addition, the internationalization of intellectual property rights in the Agreement on Trade Related Aspects of Intellectual Property Rights has contributed to the global dispersion of innovation (Haakonsson, Jensen and Mudambi, 2013; Papageorgiadis, Chengang and Magkonis, 2019). Meanwhile, pharmaceutical MNEs are experiencing significant pressure to reorganize innovation processes by reducing costs and developing new drugs because existing patents (and profits) are being eroded by competing generic products. These features make the pharmaceutical and biotech industries especially interesting, since they show how the globalization of innovation develops in industries that are highly exposed to the forces of economic globalization.

In this paper, we contribute to the literature on R&D internationalization, especially the stream of literature examining why some countries are more attractive than others as destinations for MNEs' R&D investments. Although the literature on R&D internationalization is extensive, there is a continued need to explore the impact of various host-country institutional factors on R&D investment flows (Papanastassiou et al., 2020). In this context, we submit that our contribution lies in the empirical combination of factors in the host-country institutional environment and their influence on the attraction of different types of R&D investment projects. We investigate how firms' investment strategies for R&D projects and host-country type moderate the effects of host-country characteristics on location choice probabilities for R&D investment projects.

While the literature on the role of emerging markets in economic globalization has emphasized differences between emerging markets and advanced economies (Grosse, 2019; Khanna and Palepu, 2010), the findings in this study suggest that the differences between the two types of countries are not as pronounced as they were in the past, when we focus on countries in the emerging market group that are able to attract R&D-related FDI. The gap between advanced economies and some emerging markets in the innovation domain appears to be closing, and this may be rooted in changes in the countries as well as in the investing firms. For emerging markets, the national innovation (eco)-system with innovation capabilities matters for the ability to attract R&D-related investments undertaken with an exploration strategy. This particular type of investment project is important, as it brings the potential for value-creating linkages and spillovers to the local economy (De Beule and Somers, 2017; Hansen, Pedersen and Petersen, 2009; UNCTAD, 2001). However, to benefit from this potential, countries face the challenge of upgrading and sustaining domestic investments in the development of the country's innovation capability. From financial and organizational perspectives, this is especially a challenge for governments in emerging markets.

In section 2, we review the literature on R&D internationalization along with expectations derived from it. To respond to calls for integrative theoretical approaches (Cano-Kollman et al., 2016; Kim and Aguilera, 2016) and adopt a nuanced perspective on the drivers of R&D internationalization, we develop an integrated framework that includes elements from the literature on international business, economic geography, institutions and strategy. In section 3, we introduce the methodology and our econometric approach, together with the data used in the analysis. Section 4 presents the empirical results, followed by a discussion and our conclusions in section 5.

2. Determinants and drivers of the internationalization of innovation

This study builds on a rich literature on the internationalization of innovation (for recent reviews, see Papanastassiou et al., 2020; Santos-Paulino et al., 2014). Previous studies show how cross-border organization of firms' R&D activities and locational choices is orchestrated (Hatem, 2011; Santos-Paulino et al., 2014; UNCTAD, 2005, 2013) and how internationalization of R&D has the potential to positively influence innovation and firm productivity (Nieto and Rodríguez, 2011). Firm-strategic choices influence location choices, as they orient investments towards different types of locations. Nevertheless, there is a gap in the literature as regards research on the geographical dimensions of this process and how those dimensions relate to MNEs' investment strategies (Beugelsdijk and Mudambi, 2013).

2.1 Innovation framework, innovation capability and MNE investment strategy

Location attractiveness for R&D-related investments is determined by a combination of institutional elements related to the innovation framework and the innovation capabilities (D'Agostino et al., 2013; Papanastassiou et al., 2020; Santos-Paulino et al., 2014). We focus on the role of two main locational characteristics, that is, the destination country's innovation framework and its innovation capabilities, for attracting R&D-related FDI from foreign MNEs (Siedschlag et al., 2013). We assume that MNEs placing their R&D investments in a foreign country assess the quality of the host country's *innovation framework*.

In this regard, the literature focusing on national systems of innovation has emphasized the need to understand the role of institutions as "the wider setting" (Lundvall, 2007, p. 102). A national system of innovation builds on institutional elements such as the education system, the labour market, innovation policy, protection of intellectual property rights and competition (Freeman, 2002; Lundvall, 1992; Nelson, 1993). The role of location characteristics differs according to industry variety; for example, for pharmaceuticals and biotech, intellectual property rights are important (Fagerberg, Mowery and Verspagen, 2009). However, the particular advantages of a national system of innovation can be reached through direct interaction as "elements of knowledge important for economic performance are localized and cannot be easily moved from one place to another" (Lundvall, 2007, p. 107).

The interaction between firms, the national system of innovation and its knowledge infrastructure are relevant in defining a country's *innovation capabilities*. These capabilities rest on a foundation composed of the capabilities of individuals and their formal educational backgrounds, their professional experiences, and their firm- and activity-specific knowledge (e.g. UNCTAD, 2004). These capabilities are particularly important in advanced value chain activities, such as R&D, which incorporate both explicit and tacit knowledge, as well as knowledge of routines (UNCTAD, 2005). Furthermore, innovation capabilities are not easily substitutable or transferable (Nelson, 1993).

The importance of innovation capabilities is broadly discussed in the literature on strategy and organization. This literature mentions different dimensions of capabilities, for example the capability to combine organizational knowledge, the importance of higher-order capabilities as a foundation for value creation and the possession of organizational capabilities as a source of innovation (Kogut and Zander, 1992; Subramaniam and Youndt, 2005). Fagerberg and Srholec (2008) have conceptualized the national systems of innovation literature to include industry-level phenomena of social and technological capabilities as well as absorptive capacity. Innovation capabilities are linked to the innovation framework as it includes the degree to which the framework conditions are used.

The distinction between exploration and exploitation, originating from James March's (1991) seminal work on organizational learning, has profoundly influenced theoretical constructs across different literature, including that on the internationalization of R&D (Papanastassiou et al., 2020). In a seminal article on R&D internationalization, Kuemmerle (1999) developed a typology in which the strategies for internationalizing innovation fall into two main categories. The first is the "home-base-exploiting" strategy, which occurs when an MNE aims to introduce innovative products developed at home to new markets, increase embeddedness in a market or adopt a cost-out strategy and thereby increase efficiency. This process may involve some adjustment to local demands or co-location in new markets. The second strategy is the "home-base-augmenting" strategy, which occurs when an MNE taps into new knowledge sources in foreign locations to enrich and further develop the knowledge of the MNE as a whole. In the remainder of the paper, we refer to these investment strategies as, respectively, *exploitation* and *exploration* strategies.

Although host-country factors have been shown to play a role in the attraction of R&D projects (Demirbag and Glaister, 2010; Jensen and Pedersen, 2011; Papanastassiou et al., 2020), we expect that the two different types of investment strategies will moderate the role of the host country's innovation framework and innovation capabilities as determinants of location choices differently. Investment projects following an exploration strategy are likely to be more demanding in terms of the input needed from factors in the host countries than investment projects driven by an exploitation strategy. Therefore, locations characterized by relatively strong innovation frameworks and capabilities are more attractive for exploration projects. On the basis of these expectations, we present our first hypothesis:

> H1: The effects of innovation framework (H1a) and capability (H1b) on location choice are stronger for projects driven by an exploration strategy than for projects driven by an exploitation strategy.

2.2 Placing investments in advanced economies and emerging markets

Advanced economies have been attractive locations for the offshoring of R&D activities for decades. In fact, throughout earlier phases of globalization the advanced economies in North America, Western Europe (EU15) and Japan experienced the most significant growth as destinations for R&D activity (e.g. Ohmae, 1985; Hatem, 2011; Santos-Paulino et al., 2014). As advanced economies fostered industrial clusters and world-class research environments focused on highly specialized technological fields and were characterized by high purchasing power, they were the most attractive locations for R&D-related FDI until the turn of the millennium. R&D investments in emerging markets are a more recent phenomenon (D'Agostino et al., 2013; Grosse, 2019). Although advanced economies are still preferred as locations for offshored R&D, there has been a clear shift, with relatively more R&D-related investment projects placed in emerging markets, especially in Asia (Grimes and Miozzo, 2015; D'Agostino et al., 2013).

The literature on emerging markets emphasizes the importance of institutions and institutional voids that exist in these countries and influence domestic and foreign firms operating there (e.g. Khanna and Palepu, 2010). We may extend this argument to the field of innovation, meaning that the characteristics of the host country's innovation framework create the environment in which R&D-related FDI is placed.

For emerging markets, the more severe the innovation-related institutional voids in a country, the less attractive the country will appear as a potential destination for R&D-related FDI. However, emerging markets have become more attractive for investment and the roles of the innovation framework and innovation capabilities in emerging markets are different than in the past. Today, emerging markets are part of the global flow of innovation activities. However, in general, emerging markets still have poorer institutions and capabilities. This implies that in a context where institutional voids are on average large (i.e. emerging markets), a better quality of institutional framework and capabilities means more for the location decision than in a context where institutional voids are generally very low (i.e. advanced economies). Therefore, we expect the type of host country (advanced versus emerging) to have a moderating effect on the importance of the innovation framework and innovation capabilities in location decisions. We expect this moderating effect to show that the innovation framework and capabilities have stronger effects when emerging markets are selected as destination countries than when advanced economies are selected.

> H2: The effects of the innovation framework (H2a) and capability (H2b) on location choice are stronger for projects placed in emerging markets than for projects based in advanced economies.

Prior research asserts that the understanding of the global strategies of MNEs by nature includes multilevel factors at macro (e.g. country), meso (e.g. firm, industry) and micro levels (e.g. individual managers, employees, projects, activities) and that interrelations between such factors influence the strategies of MNEs (Contractor et al., 2019; Johnson, Melin and Whittington, 2003). Especially micro-level factors are important in this respect and have found some application in global strategy research – for example concerning the innovation capability (Nuruzzaman, Gaur and Sambharya, 2019), and absorptive capacity (Lewin, Massini and Peeters, 2011) of MNE subsidiaries, yet they remain underexplored in the field (Contractor et al., 2019). We therefore proceed with a more exploratory approach for our final hypothesis about the interrelations between micro-level (project investment strategy), meso-level (innovation framework, innovation capability) and macro-level (type of economy) factors and the resulting location choice in the following way:

H3a: The moderating effect of project-level investment strategy on the relationship between innovation framework and location choice (H1a) is in turn moderated by the type of economy in which an investment is made.

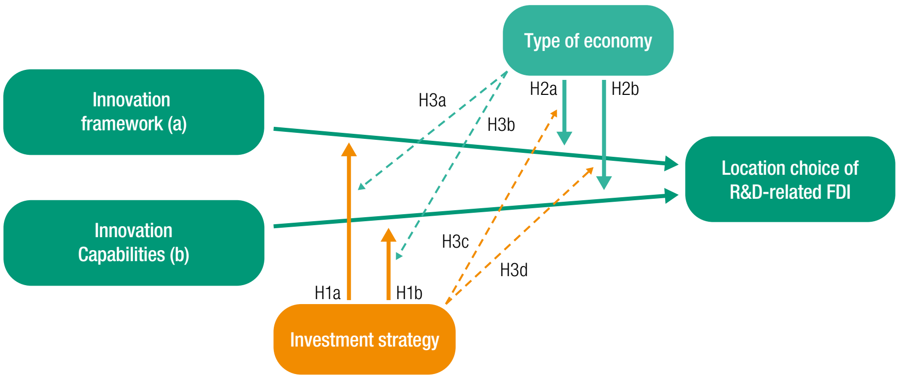
H3b: The moderating effect of project-level investment strategy on the relationship between innovation capability and location choice (H1b) is in turn moderated by the type of economy in which an investment is made.

H3c: The moderating effect of type of economy on the relationship between innovation framework and location choice (H2a) is in turn moderated by the investment strategy of a given project.

H3d: The moderating effect of type of economy on the relationship between innovation capability and location choice (H2b) is in turn moderated by the investment strategy of a given project.

We summarize the three sets of hypotheses in figure 1.

Figure 1. Analytical framework for location choice in R&D-related FDI



Source: Authors' elaboration.

Note: The full lines represent relationships already established in the literature. Our paper focuses on testing the moderating effects of investment strategy and type of economy and their interrelationships, represented by the dashed lines (H1a-b; H2a-b) and the dotted lines (H3a-d) respectively.

3. Data and methodology

3.1 Sample and data

Our analysis relies on data from three main sources. At the core, we use the fDi Markets data from fDi Intelligence, a division of the Financial Times Ltd., which provides detailed information on cross-border investment projects over time and across different activities, industries and countries. In our analysis, we use R&D-related cross-border investment projects by firms within the biotech and pharmaceutical industries between 2006 and 2016.[2] In addition to providing information on the investing firms, their origin and the location of each cross-border investment, the fDi Markets data provide a description of each of the investment projects. This database has previously been used by international organizations investigating the development of FDI in different industries and regions (e.g. UNCTAD, 2005) and by scholars interested in understanding R&D investment across countries (e.g. Castellani, Jimenez and Zanfei, 2013; Demirbag and Glaister, 2010; Castellani and Lavoratori, 2020).

We combine the project-level data from fDi Markets with country-level data from the World Competitiveness database of the Institute for Management Development (IMD) and patent data from the United States Patent and Trademark Office (USPTO). The combination of project-level data with country-level data allows us to look at how host-country characteristics affect location decisions for R&D-related cross-border investments and to uncover the moderating effects of project-specific investment strategies and types of economy.

The complete sample of R&D-related cross-border investment in the biotech and pharmaceutical industries for the 2006–2016 period includes 622 projects. Unfortunately, the IMD's World Competitiveness database is missing data for some of the countries in some years included in our sample. As a result, we omit investments for which the necessary data from IMD are missing for the chosen location.[3] Moreover, we could not identify the investment strategy for a few projects from the description provided in the fDI Markets data. As a result, our final sample consists of 588 R&D-related cross-border investment projects,

[2] Our sample consists of cross-border investment projects that are classified by FDI Intelligence as R&D projects.

[3] In cases where missing data affect a non-chosen location, we delete the location from the choice set for the given investment.

carried out by 314 firms in 44 countries.[4] In our sample, 73 per cent of the firms conducted only one R&D-related cross-border investment project between 2006 and 2016, whereas one of the firms conducted up to 16 investment projects. On average, firms with multiple investment projects conducted around four investments in our sample period.[5]

In our sample, the proportion of projects going to emerging markets remained rather stable between 2006 and 2016, accounting for 31 per cent of all projects. Not surprisingly, given the context of high-tech industries of this study, most of the emerging markets included in our sample are high-income or upper-middle-income countries. Our sample also shows a slight increase in exploitation-driven cross-border R&D investment within the two industries over time, though exploration-driven investment projects account for a slight majority (51 per cent) of the projects.

3.2 Empirical approach

To model the location choice for each investment project in our sample, we follow recent research and use mixed logit models (e.g. Castellani and Lavoratori, 2020). This way of modelling location choices is very close in spirit to the widely used conditional logit model (CLM) (McFadden, 1974), but carries the advantage of not relying on the strict, and likely violated, assumption of independence of irrelevant alternatives. When using the mixed logit model, one assumes that a firm chooses the location in a given choice set that maximizes its utility (i.e. its profit function[6]). In our paper, the expected utility to firm f of placing R&D-related investment i in location j is given by the following equation:

$$U_{fj,i} = \beta_f' x_{fj,i} + \varepsilon_{fj,i}$$

[4] The investments are made within the following 44 countries (respective number of investment policies in parenthesis): United States (96), United Kingdom (73), China (66), India (55), Singapore (36), France (23), Canada (22), Germany (22), Belgium (17), Ireland (17), Spain (16), Hungary (11), Italy (10), Netherlands (10), Switzerland (9), Austria (8), Brazil (8), Malaysia (8), Republic of Korea (8), Colombia (6), Czechia (6), Japan (6), Poland (6), Sweden (6), Australia (4), Chile (4), Hong Kong (China) (4), Mexico (4), Denmark (3), Israel (3), Thailand (3), Bulgaria (2), Finland (2), Russian Federation (2), Taiwan Province of China (2), Turkey (2), Croatia (1), Estonia (1), Lithuania (1), New Zealand (1), Peru (1), Philippines (1), Romania (1), Ukraine (1).

[5] We account for the presence of multiple investments by the same firm by clustering standard errors at the firm level in our estimations.

[6] Our choice set contains a maximum of 57 alternative locations (i.e., countries). In addition to the countries stated in footnote 4, the choice set contains Argentina, Greece, Iceland, Indonesia, Kazakhstan, Luxembourg, Mongolia, Norway, Portugal, Qatar, Slovakia, Slovenia, and the Bolivarian Republic of Venezuela. The number of locations in the choice set varies depending on the country of origin of the investing firm (we exclude the country of origin from the choice) and data availability at the country-year level.

where $x_{fj,i}$ is a vector of observable location characteristics that may vary over firms, β_f is a vector of estimated coefficients for these characteristics and represents the preference of firm f at the time of making the choice i, and $\varepsilon_{fj,i}$ is a random term that is extreme value (Train, 2009). Contrary to the classic linear model, the mixed logit model allows for β to vary over the population of investing firms with a density $f(\beta)$ (Train, 2009). Assuming that $f(\beta)$ follows a normal distribution, β_f can be decomposed into its mean (fixed part) and standard deviation (random part). In this paper, we focus primarily on the estimated mean coefficients of our covariates of interest, allowing for heterogeneity in the drivers of location choice over firms.

As 27 per cent of the companies in our sample were involved in more than one FDI project, we use firm-level clustered standard errors in the statistical tests to account for the dependence between choices made by the same company.[7]

3.3 Dependent variable

In line with our research question and hypotheses, our outcome variable is based on a categorical variable reflecting the chosen location for each R&D-related cross-border investment contained in our sample (Croissant, 2020; Castellani and Lavatori, 2020).

Consistent with the dominant practice in international business research (for reviews, see Kim and Aguilera, 2016; Rugman and Verbeke, 2003), we look at firms' choice of country when locating R&D activities abroad. As such, our location choice variable is at the country level. Admittedly, recent studies have begun exploring questions pertaining to location factors and choice at subnational levels, e.g. industry clusters and "global cities" (e.g. Goerzen, Asmussen and Nielsen, 2013). Since the country level of analysis is a crude measure, especially for large countries with large subregional diversity, more detailed research on locational aspects can provide richer accounts. There is a literature stream consisting of qualitative studies of industry clusters; however, data limitations in conducting quantitative studies at the subnational level continue to pose methodological challenges (Nielsen, Asmussen and Weatherall, 2017). In view of these limitations, analysing location choice at the country level still provides better opportunities for including other variables at the country level, and it relates directly to policy implications at the national level.

[7] We run the models in R, using 10,000 simulations and 140,668 as the random seed.

3.4 Explanatory variables

3.4.1 Innovation framework

In this paper, we refer to a location's innovation framework as the institutional environment surrounding innovative activities. In line with that, we operationalize *innovation framework* by averaging three indicators:[8] the extent to which intellectual property rights are enforced (e.g. Castellani and Lavatori, 2020), the extent to which the legal environment supports the development and application of technology, and the extent to which laws related to scientific research encourage innovation.[9] The three indicators are taken from the IMD World Competitiveness Executive Opinion Survey and range between 0 and 10, where 0 is the lowest and 10 is the highest.[10] The Cronbach's alpha for this score is 0.93.

3.4.2 Innovation capability

We consider a location's innovation capability as being the result of the use and combination of resources available for innovation activities in the country. As such, we operationalize innovation capability by using the number of patents within biotechnology (including drugs) granted by the USPTO in a given location. We use the $log(\#\ patents\ granted) + 1$ to ensure that the variable is defined also for those locations without patents.[11] We argue that the number of patents granted by the USPTO, which we see as a measure of innovation output, captures the presence of R&D-related capabilities in the country and signals that domestic actors are capable of developing patentable innovations. Patents are commonly used to measure the innovation capabilities and/or performance of a region, country or city (see e.g. Castellani and Lavatori, 2020; Papanastassiou et al., 2020).

3.4.3 Investment strategy

In line with our research question, we categorize each cross-border investment project according to whether it is driven by an exploitation or an exploration strategy (e.g. Kuemmerle, 1999). *Investment strategy* is defined at the project level, meaning that a firm that has made several investments during our sample period may be associated with both strategies.

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[8] As these indicators are highly correlated, we average them into one indicator to avoid multi-collinearity.

[9] Previous literature on location choice commonly used the rule of law to capture the strength of the institutional environment of a given location (e.g. Castellani and Lavatori, 2020). While we acknowledge that a country's broader institutions possibly matter for the location of R&D activities, we exploit the fact that our sample contains only R&D investment projects within the pharmaceutical and biotech industries and instead use indicators that are more closely related to the institutional environment relevant for the context of our study.

[10] As a result, *Innovation framework* has a theoretical range of 0 to 10.

[11] The theoretical range of *Innovation capability* is therefore 0 to infinity.

To categorize the projects, we use the description of each investment provided in the fDi Markets database. To ensure the validity of our categorization, two of the authors individually coded each investment project and then compared their results. In the event of disagreement, the case was discussed until consensus was reached. R&D-related cross-border investment projects identified as driven by exploration strategies included investments aimed at establishing an R&D centre or facility, and those focused on discovery, development and proximity to universities. Projects based on exploitation strategies included those focused on providing services for another company (affiliated or not), handling market-specific clinical trials and establishing offices centred on a particular market; those described as phases two or three of clinical trials; and those established for conducting clinical development.

3.4.4 Type of economy

To test hypotheses 2 and 3, we categorized the 57 potential locations in our choice set according to whether they are emerging and developing economies (considered together as emerging economies) or advanced economies. To determine which countries fall into the category of emerging economies, we use the classification of the International Monetary Fund, which classifies the world into advanced economies or emerging market and developing economies, according to each country's (i) per capita income level, (ii) export diversification and (iii) degree of integration into the global financial system (IMF, 2018).

3.4.5 Control variables

Following previous literature, we include a series of control variables that are related to the location choice for (R&D-related) cross-border investments. First, in view of the FDI literature's focus on the role of the host country's market size in attracting FDI (Nielsen et al., 2017), we control for market size. In previous research, GDP and/or GDP per capita have commonly been used as proxies for market size (see e.g. Castellani and Lavoratori, 2020). One strength of exclusively focusing on the pharmaceutical and biotech industries though is that we can meaningfully apply industry-specific proxies for constructs known to influence firms' location decision. As such, we use the log of a location's total health expenditure per capita (in United States dollars) as a measure of a location's market potential (or local demand) in the particular context of the pharmaceutical and biotech industries. This variable is available from the IMD World Competitiveness Executive Opinion Survey.

Second, we control for economic factors that could favour particular locations over others. More precisely, we control for the tax rate and wage costs in a given location (Nielsen et al., 2017). And more particularly, we control for the corporate tax rate on profit in a given location[12] (Castellani and Lavatori, 2020) as well as for the remuneration of engineers in managerial positions (total base salary plus bonus and long-term incentives, in dollars) as a proxy for wage costs relevant to R&D-related cross-border investments within the pharmaceutical and biotech industries.[13] Both variables are available from the IMD World Competitiveness Executive Opinion Survey.

Third, we control for potential agglomeration effects associated with a particular location (Nielsen et al., 2017; Castellani and Lavatori, 2020). We capture these effects by including a variable (called *agglomeration*) that indicates the cumulative number of R&D-related FDI investment projects made in a particular location within a running three-year window prior to a given investment being made. To do so, we rely on the fDi Markets data from as far back as 2003 for the first year of our sample.

Finally, since international experience is one of the most studied characteristics in international business research (Xu et al., 2021), we control for an investing firm's experience within a given location. Following recent studies (e.g. Castellani and Lavatori, 2020), we consider a firm has within-country experience if, according to the fDi Markets data, the firm has made an R&D-related investment in a given location between 2003 and $t-1$, and that otherwise it has no within-country experience.[14]

We acknowledge that the decision to make an investment is not made overnight and therefore all time-varying variables are calculated for the year prior to the investment. We also mean-centre the variables for numerical stability and to remove some collinearity. Table 1 presents summary statistics for the explanatory and control variables. Despite some of the variables being correlated, collinearity is a minor issue for our results as the variance inflation factors for innovation framework and capability are generally below 10 (Kennedy, 1992).[15] However, as there are high correlations between the innovation framework and innovation capability variables, we run two separate models for each hypothesis: one to test the hypothesis in relation to innovation framework, and another to test the hypothesis in relation to innovation capability.

[12] We acknowledge that some countries may have policies to particularly attract FDI (e.g., favourable tax rate for foreign-owned firms) but owing to data limitations, we are unable to control for this aspect. We invite future research to investigate the presence and effect of such policies on the location decision for R&D FDI.

[13] Previous research commonly used average wage at the country level (see e.g. Hatem, 2011). As our study focuses on the pharmaceutical and biotech industries only, we use a proxy that is more closely connected to the location decisions for the firms in our sample.

[14] Admittedly, a firm may gain country-specific experience from activities other than R&D-related activities located in the host country (Castellani and Lavatori, 2020). Unfortunately, we do not have access to information related to prior investments of the firms in our sample, other than R&D-related investments.

[15] Only when estimating the effect of innovation capability for exploration-driven projects in advanced locations is the variance inflation factor slightly above 10.

Table 1. Summary statistics for explanatory and control variables with correlations

Descriptive	Mean	Standard deviation	Minimum	Maximum	Advanced economy	Health expenditure	Corporate tax	Wage costs	Agglomeration effects	Innovation framework	Innovation capability
Advanced economy	0.619	0.486	0	1	1						
Health expenditure	7.215	1.312	3.444	9.212	0.789	1					
Corporate tax	25.364	6.746	10	48	0.063	0.052	1				
Wage costs	11.193	0.621	8.021	12.199	0.460	0.670	0.273	1			
Agglomeration effects	3.269	5.926	0	36	0.074	0.015	0.243	0.125	1		
Innovation framework	5.955	1.408	2.173	8.647	0.632	0.680	0.085	0.538	0.242	1	
Innovation capability	2.714	2.097	0.000	8.910	0.470	0.548	0.411	0.538	0.487	0.586	1

Source: Authors' calculations based on data sources introduced in section 3.

4. Empirical results

To put our findings into perspective, we start by showing how the location choice probabilities depend on a location's innovation framework and capability without taking into account the moderating effect of investment strategy and type of economy. We use these results as a basis for comparison with our subsequent findings. As expected, our findings show that companies prefer locations characterized by a better innovation framework (table 2, column 1) and possessing better innovation capability (table 3, column 1).

To investigate the moderating effect of project-level investment strategy on the importance of a location's innovation framework and capability for location choice of R&D-related FDI projects, we use the same model as above but run it on subsamples consisting of exploration-driven projects and exploitation-driven projects respectively. The estimation results are presented in table 2, columns 3 and 5 for innovation framework, and in table 3, columns 3 and 5 for innovation capability. From these tables, we can see that the quality of a location's innovation framework and capability matter for both exploration- and exploitation-driven projects. In table 6, we provide test statistics and p-values for tests of effect modification. The null hypothesis for these tests is that there is no difference between the effects for projects with exploration strategies and for those with exploitation strategies. Table 6, column 1 shows us that whereas the preference for locations with innovation framework of higher quality and stronger innovation capability applies to both types of projects, the magnitude of the effects is not significantly different across project-level strategies. These results contrast with our expectation that a location's innovation framework and capability would matter more for exploration-driven projects than for exploitation-driven projects. We therefore conclude that H1a and b are not supported.

To assess the moderating effect of type of economy on the importance of a location's innovation framework and capability for the location choice of R&D-related cross-border investments, we run our baseline model but allow the effects to depend on the type of economy. The estimation results are presented in table 4, column 1 for the effect of innovation framework and table 5, column 1 for that of innovation capability. To our surprise, the results show that the quality of a location's innovation framework is positive and significant for advanced locations only, which means that only in such locations does an innovation framework of higher quality increase the probability of choosing a particular location. However, the test of effect modification presented in table 6, column 2 shows that the magnitude of the effect of the innovation framework in emerging and advanced locations is not significantly different. This result diverges from what we expected and therefore we conclude that H2a is not supported. When it comes to the effect of a location's innovation capability, the results in table 5 tell us that innovation capability matters in both emerging and advanced locations. However, the size of the effects appears not to be significantly different across types of economy (see table 6, column 2), which leads us to also reject H2b.

Table 2. Effect of innovation framework – estimates by project-level investment strategy

	All projects		Exploration		Exploitation	
	Mean	StdDev	Mean	StdDev	Mean	StdDev
Innovation framework	0.260*** (0.057)	0.257*** (0.066)	0.175* (0.083)	0.153 (0.226)	0.292*** (0.086)	0.219 (0.134)
Advanced economy	-0.524* (0.210)	0.049 (2.816)	-0.219 (0.408)	0.009 (13.217)	-0.440 (0.266)	1.328 (0.710)
Health expenditure	0.107 (0.070)	0.006 (1.684)	0.189 (0.115)	0.002 (3.851)	-0.069 (0.097)	0.022 (1.305)
Corporate tax	0.033*** (0.008)	0.045** (0.016)	0.028* (0.013)	0.007 (0.145)	0.027* (0.011)	0.075*** (0.020)
Wage costs	0.332 (0.200)	0.014 (3.598)	0.592 (0.353)	0.006 (14.865)	0.244 (0.241)	0.002 (3.647)
Within-country experience	1.111*** (0.128)	0.303 (0.511)	1.641*** (0.182)	0.006 (12.675)	0.522** (0.181)	0.626* (0.295)
Agglomeration effects	0.108*** (0.005)	0.019 (0.015)	0.106*** (0.008)	0.002 (0.214)	0.117*** (0.009)	0.040** (0.013)
Projects	588		302		286	
Log Likelihood	-1809.881		-882.290		-889.344	

Source: Authors' calculations based on data sources introduced in section 3.
Note: Coefficients from mixed logit estimation with clustered standard errors in parentheses. * p<0.05 ** p<0.01 *** p<0.001.

Table 3. Effect of innovation capability – estimates by project-level investment strategy

	All projects		Exploration		Exploitation	
	Mean	StdDev	Mean	StdDev	Mean	StdDev
Innovation capability	0.422*** (0.051)	0.166** (0.056)	0.328*** (0.073)	0.011 (0.990)	0.479*** (0.078)	0.177 (0.105)
Advanced economy	-0.180 (0.216)	0.040 (3.612)	0.047 (0.443)	0.009 (13.536)	-0.193 (0.253)	1.114* (0.450)
Health expenditure	-0.191* (0.088)	0.001 (1.603)	-0.070 (0.149)	0.003 (3.896)	-0.344** (0.120)	0.009 (1.264)
Corporate tax	-0.033*** (0.010)	0.035 (0.018)	-0.023 (0.016)	0.003 (0.387)	-0.046** (0.015)	0.063** (0.020)
Wage costs	0.446* (0.203)	0.017 (5.196)	0.703 (0.397)	0.008 (14.386)	0.290 (0.266)	0.011 (4.308)
Within-country experience	1.017*** (0.126)	0.311 (0.439)	1.525*** (0.182)	0.004 (13.263)	0.435* (0.181)	0.725** (0.262)
Agglomeration effects	0.074*** (0.007)	0.009 (0.029)	0.078*** (0.011)	0.002 (0.218)	0.078*** (0.011)	0.037** (0.013)
Projects	588		302		286	
Log Likelihood	-1774.026		-868.049		-868.203	

Source: Authors' calculations based on data sources introduced in section 3.
Note: Coefficients from mixed logit estimation with clustered standard errors in parentheses. * p<0.05 ** p<0.01 *** p<0.001.

Table 4. Effect of innovation framework – estimates by type of economy and project-level investment strategy

	All projects		Exploration		Exploitation	
	Mean	StdDev	Mean	StdDev	Mean	StdDev
Advanced economy	286 -882.147	0.016 (4.907)	-1.005 (1.760)	0.005 (12.861)	-0.937 (1.044)	0.021 (5.542)
Advanced economies						
Innovation framework	0.250*** (0.067)	0.351** (0.108)	0.112 (0.092)	0.328 (0.192)	0.413*** (0.105)	0.337 (0.227)
Health expenditure	0.040 (0.160)	0.373 (0.302)	0.248 (0.224)	0.012 (5.374)	-0.390 (0.286)	0.625 (0.434)
Corporate tax	0.033** (0.011)	0.002 (0.158)	0.026 (0.014)	0.00004 (0.476)	0.028 (0.019)	0.055* (0.023)
Wage costs	0.472 (0.321)	0.238 (1.098)	1.136* (0.495)	0.011 (21.656)	0.057 (0.444)	0.009 (6.747)
Within-country experience	1.113*** (0.163)	0.206 (0.707)	1.550*** (0.221)	0.004 (20.001)	0.441 (0.258)	0.091 (4.382)
Agglomeration effects	0.109*** (0.008)	0.034* (0.016)	0.105*** (0.010)	0.002 (0.314)	0.120*** (0.015)	0.060* (0.024)
Emerging markets						
Innovation framework	0.258 (0.140)	0.015 (2.994)	0.246 (0.233)	0.005 (19.514)	0.246 (0.198)	0.018 (2.645)
Health expenditure	-0.039 (0.239)	0.088 (0.367)	0.158 (0.517)	0.001 (7.457)	-0.110 (0.260)	0.383 (0.198)
Corporate tax	0.0005 (0.037)	0.0001 (0.227)	-0.009 (0.083)	0.0001 (0.598)	0.007 (0.046)	0.010 (0.077)
Wage costs	0.371 (0.380)	0.018 (3.835)	-0.171 (0.722)	0.004 (31.396)	0.630 (0.502)	0.029 (4.088)
Within-country experience	0.974*** (0.212)	0.333 (0.534)	1.894*** (0.319)	0.011 (17.671)	0.339 (0.296)	0.815 (0.451)
Agglomeration	0.098*** (0.012)	0.001 (0.158)	0.111*** (0.025)	0.00002 (0.708)	0.100*** (0.016)	0.006 (0.093)
Projects	588		302		286	
Log Likelihood	-1808.504		-875.716		-882.147	

Source: Authors' calculations based on data sources introduced in section 3.
Note: Coefficients from mixed logit estimation with clustered standard errors in parentheses. * p<0.05 ** p<0.01 *** p<0.001.

Table 5. Effect of innovation capability – estimates by type of economy and project-level investment strategy

	All projects		Exploration		Exploitation	
	Mean	StdDev	Mean	StdDev	Mean	StdDev
Advanced economy	-0.080 (0.810)	0.032 (4.390)	-0.176 (1.921)	0.010 (13.983)	1.035 (1.124)	0.006 (3.349)
Advanced economies						
Innovation capability	0.389*** (0.063)	0.123 (0.104)	0.258** (0.098)	0.052 (0.248)	0.569*** (0.103)	0.008 (2.312)
Health expenditure	-0.283 (0.196)	0.179 (0.785)	-0.004 (0.325)	0.005 (8.373)	-0.662* (0.310)	0.365 (0.691)
Corporate tax	-0.033** (0.013)	0.002 (0.115)	-0.016 (0.016)	0.0003 (0.443)	-0.074*** (0.022)	0.057** (0.020)
Wage costs	0.756* (0.323)	0.654 (0.418)	1.258* (0.524)	0.017 (21.387)	-0.002 (0.466)	0.015 (14.182)
Within-country experience	1.040*** (0.152)	0.386 (0.376)	1.496*** (0.222)	0.008 (16.223)	0.401 (0.290)	0.144 (2.809)
Agglomeration	0.080*** (0.009)	0.035* (0.015)	0.083*** (0.013)	0.011 (0.067)	0.084*** (0.016)	0.052 (0.028)
Emerging markets						
Innovation capability	0.819*** (0.237)	0.312 (0.639)	1.598*** (0.416)	0.011 (21.484)	0.295 (0.333)	0.740 (0.535)
Health expenditure	-0.175 (0.225)	0.001 (3.736)	0.042 (0.562)	0.0003 (8.127)	-0.240 (0.285)	0.258 (0.288)
Corporate tax	-0.025 (0.036)	0.0003 (0.186)	-0.034 (0.088)	0.0003 (0.553)	-0.019 (0.046)	0.006 (0.123)
Wage costs	0.288 (0.360)	0.008 (9.730)	-0.720 (0.788)	0.005 (31.736)	0.639 (0.444)	0.049 (10.240)
Within-country experience	0.056*** (0.015)	0.0005 (0.451)	0.058* (0.028)	0.00002 (0.578)	0.061** (0.021)	0.0004 (0.385)
Agglomeration effects	0.481*** (0.098)	0.148 (0.216)	0.704*** (0.202)	0.008 (5.075)	0.416** (0.154)	0.188 (0.239)
Projects	588		302		286	
Log Likelihood	-1773.665		-858.094		-861.799	

Source: Authors' calculations based on data sources introduced in section 3.
Note: Coefficients from mixed logit estimation with clustered standard errors in parentheses. * p<0.05 ** p<0.01 *** p<0.001.

Table 6. Innovation framework and capability – tests of effect modification

Effect modification by	All projects strategy	All projects, type of economy	Emerging markets strategy	Advanced economy strategy	Exploration projects, type of economy	Exploitation projects, type of economy
Innovation framework	0.946 (0.331)	0.003 (0.956)	0.00000 (0.999)	4.644* (0.031)	0.292 (0.589)	0.568 (0.451)
Innovation capability	2.013 (0.156)	0.685 (0.408)	1.289 (0.256)	4.793* (0.029)	4.441* (0.035)	0.797 (0.372)

Source: Authors' calculations based on data sources introduced in section 3.
Note: Wald test using clustered standard errors with p-values in parentheses. * $p<0.05$ ** $p<0.01$ *** $p<0.001$.

To investigate in greater detail the interplay between the moderating effects of project-level investment strategy and type of economy, we estimate similar models as above but this time we allow the effects of the covariates to depend on both the type of economy and the project-level investment strategy. The results are provided in table 4, columns 3 and 5 for the effect of innovation framework. The table reveals that innovation framework only has a positive and significant effect for exploitation-driven projects in advanced locations. This result is particularly interesting as one may intuitively have expected that the effect of the innovation framework would be stronger in exploration-driven projects in emerging markets. The tests of effect modification presented in table 6, columns 3 and 4 confirm that, when comparing the effect of the innovation framework across project-level investment strategies, it is statistically different for projects located in advanced locations. As such, the type of economy in which an investment project is located appears to influence the moderating effect of project-level investment strategy on the relationship between innovation framework and location choice. H3a is therefore supported.

Table 5, columns 3 and 5 report the results for the effect of innovation capability. Contrary to the results for the effect of the innovation framework, our results reveal that innovation capability has a positive and significant effect across project-level investment strategies and types of economy (except for exploitation-driven projects in emerging locations). When comparing the effect of innovation capability across project-level investment strategies, the magnitude of the effect of a location's innovation capability differs only in advanced locations, as shown by the significant tests of effect moderation presented in table 6, column 4. More particularly, we find that innovation capability has a larger effect on location choice when it comes to exploitation-driven projects within advanced locations. As such, the type of economy in which an investment project is located appears to influence the moderating effect of project-level investment strategy on the relationship between innovation capability and location choice. H3b is therefore also supported.

If we compare across types of economy, the magnitude of the effect of a location's innovation framework does not appear to differ depending on the combination of project-level investment strategy and type of economy (see table 6, column 5). These findings lead us to conclude that H3c is not supported.

Finally, if we compare across types of economy, the magnitude of the effect of a location's innovation capability differs only for exploration-driven investment projects (see table 6, column 5). More particularly, our results show that, for exploration-driven projects, innovation capability has a larger effect on location choice for projects located in emerging countries. These findings lead us to conclude that H3d is supported.

An overview of our hypotheses and results is provided in table 7. The effects of the innovation framework and innovation capability mentioned here are furthermore illustrated in figure 2. As the effect of a covariate in a mixed logit model is non-linear in the choice probabilities (with larger effects for probabilities close to 50 per cent), we show how each possible value of the choice probability is changed when the value of innovation framework (or innovation capability) is increased by one. The figure reads in the following way: one selects a value for the choice probability on the horizontal axis and reads off the corresponding value of the choice probability when innovation framework or capability is increased by one on the vertical axis.

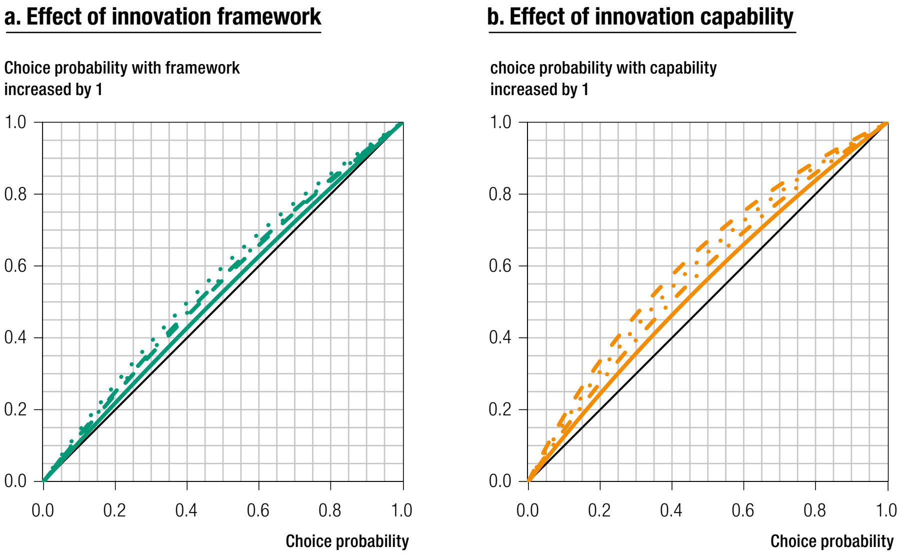
Table 7. Summary of hypotheses and conclusions

Hypothesis		Result
H1a	The effect of innovation framework on location choice is stronger for projects driven by an exploratory strategy than for projects driven by an exploitation strategy.	Not supported
H1b	The effect of innovation capability on location choice is stronger for projects driven by an exploratory strategy than for projects driven by an exploitation strategy.	Not supported
H2a	The effect of innovation framework on location choice is stronger for projects placed in emerging markets than for projects based in advanced economies.	Not supported
H2b	The effect of innovation capability on location choice is stronger for projects placed in emerging markets than for projects based in advanced economies.	Not supported
H3a	The moderating effect of project-level investment strategy on the relationship between innovation framework and location choice (H1a) is in turn moderated by the type of economy in which an investment is made.	Supported
H3b	The moderating effect of project-level investment strategy on the relationship between innovation capability and location choice (H1b) is in turn moderated by the type of economy in which an investment is made.	Supported
H3c	The moderating effect of type of economy on the relationship between innovation framework and location choice (H2a) is in turn moderated by the investment strategy of a given project.	Not supported
H3d	The moderating effect of type of economy on the relationship between innovation capability and location choice (H2b) is in turn moderated by the investment strategy of a given project.	Supported

Source: Authors' elaboration.

The figure therefore shows the effect of a one-unit increase and shows how it depends on the combination of type of economy and project strategy, keeping everything else constant. For instance, figure 2-B shows that for a choice probability of 10 per cent, a one-unit increase in a location's innovation capability raises the choice probability to slightly below 20 per cent for exploration-driven projects in emerging markets (dashed curve), compared with about 12.5 per cent exploration-driven projects in advanced locations (solid line) and with about 15 per cent for exploitation-driven projects in either advanced or emerging locations (dotted and dashed-dotted lines). Moreover, judging from the curvature of the two graphs, figure 2 suggests that the effect of innovation capability is generally more pronounced than the effect of the innovation framework.

Figure 2. Effect of country characteristics on location choice for R&D-related FDI in emerging markets and advanced economies



Source: Authors' calculation based on tables 4 (for figure 2A) and 5 (for figure 2B).

5. Discussion and conclusions

5.1 Location choice and destination-country characteristics in R&D-related FDI

The main conclusions of the study concern the relationship between host-country characteristics and investment strategy (exploration- or exploitation-driven) and type of destination country (emerging market or advanced economy), and their influence on MNE location choice for R&D-related FDI projects.

Our analysis showed that innovation framework and capabilities in the host economy matter for attracting FDI related to exploitation as well as exploration strategies. Hence, contrary to our expectations, the importance of the locational characteristics for location attractiveness turned out not to be moderated by type of strategy. Given the nature of the investment as contact point in the firms' global innovation networks, we expected exploration-driven investments to be more demanding in terms of the requirements of the host country, whereas exploitation strategies are undertaken with a more narrowly defined purpose, such as a need to adjust products to new host markets. Regardless of the strategy behind the R&D-related FDI investment project, however, innovation framework and innovation capability both have an effect on location choice. As expected, these activities in general demand the presence of a solid infrastructure in a location to make it attractive for R&D investments.

Contrary to our expectations, the analysis showed that while innovation framework and innovation capabilities matter in general, they are not significantly different in emerging markets compared with advanced economies. This finding contrasts with previous research, which has emphasized that weak and volatile institutions in emerging markets discourage MNEs from choosing the location for foreign investments (Khanna and Palepu, 2010). In fact, in our analysis, the innovation framework was shown to be insignificant in emerging markets, indicating a variation among emerging-market countries capable of attracting R&D-related FDI. Innovation capability was shown to be important in both types of destination country. Hence, the innovation capabilities of local actors play a more important role for foreign MNEs than institutions related to the national system of innovation. Although ample evidence in previous research shows that weak institutions in the host country generally have a negative influence on incoming FDI, that may not be the case across all countries and industries. At least our findings indicate that MNEs in the pharmaceutical and biotech industries that invest in emerging markets in the upper-middle- to high-income segment are not particularly deterred by institutional constraints. Part of the explanation could be the implementation of international agreements on intellectual property rights (Papageorgiadis et al., 2019).

These findings raise the question whether the traditional configuration of national systems of innovation is adequate to fully grasp the dynamics of a globalized flow of innovation activities. Having domestic firms capable of developing new products and filing international patents has a stronger effect on the attractiveness of a location than the innovation framework conditions alone. This observation points in the same direction as previous research emphasizing the importance of local firm capabilities and capabilities in the labour force (e.g. Haakonsson et al., 2013). The effect of innovation framework on location attractiveness was shown to be significant in advanced economies only.

Furthermore, the relatively marginal differences between advanced economies and emerging markets when considering location characteristics as well as the moderating role of project investment strategy suggest that some emerging markets have matured as destinations for R&D-related FDI. Meanwhile, as MNEs have reorganized activities globally for decades, these firms may also have gained more knowledge on and experience in how to operate in emerging markets.

5.2 Policy implications

Overall, the results are consistent with previous research as they show that MNEs investing in R&D abroad prefer locations with better innovation frameworks *and* better innovation capabilities. It follows as a general policy implication that enhancing the innovation framework and capability of a country will increase the country's likelihood of attracting R&D-related FDI. Aligning policies for science, technology and innovation and industrial policies is at the core of building attractiveness for R&D-related FDI in emerging markets. While this general relation is clear, it is also evident that taking on this task is a major financial, organizational and educational policy challenge, especially for governments in emerging markets. International alliances and linkages are crucial for building innovation capabilities and increase the effects of technology transfer to an emerging-market location. This supports the work by Papanastassiou et al. (2020), as they discuss policy challenges in the current globalization of innovation. They also point out that the foundation for appropriate policies in the current era is still emerging.

In order to push this frontier and identify more specific policy implications, and in contrast studies focusing on institutional framework alone, innovation capability was shown to be an important factor in determining a host location's ability to attract R&D-related FDI. This raises the question of how countries most effectively can develop innovation capabilities. Until now, the literature on national systems of innovation has emphasized the importance of having a developed national innovation framework. Our findings reveal the lack of a clear connection between the quality of the innovation framework and the attraction of R&D-related investment.

However, the innovation framework does play an indirect role in developing innovation capability, which seems to have a more direct effect. Therefore, investing in innovation capabilities through industrial policy has a significant effect on increasing the probability for attracting R&D-related FDI. This is particularly the case in emerging-market economies since an improvement in innovation capability increases the likelihood of attracting investment projects. Here the effect is more pronounced than in advanced economies (see figure 2).

As shown in earlier research, the attraction of advanced activities with a high value added has the potential to lead to further benefits for the destination country in terms of linkages and spillover effects between the foreign MNE and local firms (Hansen et al., 2009). Furthermore, MNEs' initial investments are frequently followed by additional investments in order to benefit from co-location of value chain activities (Castellani and Lavoratori, 2020). These investments may lead to further linkages and spillover effects. This is important since the net benefits of FDI depend on the quality of FDI. FDI quality is, in turn, related to the motivation driving MNE investment and the mandate and autonomy of MNE subsidiaries; it also depends on the capacity of actors in the host countries to absorb, internalize and upgrade their knowledge assets (Narula and Pinelli, 2016). The reciprocal relationship between the strategies of MNEs and the innovation capabilities of the host country alludes to the existence of a positive spiralling effect: R&D-related FDI can contribute to host-country innovation capabilities – and vice versa. Where such innovation capabilities exist, more R&D-related FDI driven by exploration motives are likely to follow.

Two policy implications may be derived from this study. First, national FDI policy can prioritize augmenting the local embeddedness and ties between the MNE and local actors through linkage-building initiatives and programmes. While this is not per se a new type of policy initiative (see UNCTAD, 2001), it remains relevant, especially in the context of development (see also Narula and Pinelli, 2016). Second, the presence of innovation capabilities in a country is the outcome of science, technology, innovation and educational policies and programmes. Building and maintaining such capabilities require continuous policy attention and domestic investments. As UNCTAD's recent Technology and Innovation Report (UNCTAD, 2021) stresses, this is a particular challenge for developing countries. Here, it is relevant to mention again that the emerging markets attracting R&D-related FDI mainly consist of high-income or upper-middle-income countries. In general, the higher the developmental level of the country the better the possibilities of investing in domestic innovation capabilities.

5.3 Limitations and future research

The pharmaceutical and biotech industries have had the highest share of R&D-related FDI over the decade, making them the most internationalized in terms of R&D. These characteristics position the industries as highly relevant and comparable, but extreme, cases. Hence, from a policy perspective, the implications derived from this study do not necessarily extend beyond the boundaries of the two industries. It would therefore be relevant to test whether our results hold for R&D-related cross-border investments made by MNEs in other industries. Furthermore, our paper focuses on project-level investment strategy and type of economy as moderators of the effect of two location characteristics (i.e. innovation framework and capability). Another obvious avenue for further research would be investigating firm-level learning and the resulting accumulation of experience. The research domain on globalization of innovation would gain from better understanding the role of experience in the globalization of R&D. It remains relevant to further uncover the role of MNEs in constructing innovation networks and the implications for emerging markets and developing countries.

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