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R&D MANAGEMENT

R&D investments in knowledge intensive sectors in developing countries and the role of host country political uncertainty

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Multinational enterprises (MNEs) persistently navigate environments characterized by political uncertainty. Yet, it is unclear how such uncertainty affects the location and sectoral spread of MNEs' overseas research and development (R&D) investments. This study delves into the influence of political uncertainty on R&D investments within knowledge-intensive sectors, particularly in developing nations, thus enhancing our understanding of the contextual variables at play. Using a unique data set of MNE greenfield R&D global investment projects over the period 2003–2019, we show that political uncertainty has a negative effect on R&D capital investments. Additionally, we explore sector and host country location-specific boundary conditions that moderate this relationship and find support for our hypotheses. Our findings show that MNE R&D investments in science-based sectors (SBS) and knowledge-intensive business services (KIBS) sectors in developing countries are less susceptible to political uncertainty compared to developed countries. Our results call for more attention from MNEs' managers and policymakers to political developments in their investing countries.

1. Introduction

Over the last decades, multinational enterprises (MNEs) have evolved as the key creators of technology, operating through a network of overseas R&D and production operations as part of their global value chains (Meyer et al., 2020; Ambos et al., 2021). As significant players within the global, national, regional, and sectoral innovation systems, MNEs encounter and must adapt to uncertainties stemming from various disruptions affecting these systems. For instance, forces driven by emerging technologies such as Industry 4.0 and/or agglomeration determine the location and sectoral distribution of MNEs overseas R&D operations, resulting in new interdependent technological paradigms and trajectories (Perez, 2010; Pedota et al., 2021). Hence, MNEs continuously operate amid uncertainty due

to political, technological, and market disruptions (Moehrle and Walter, 2008; Ansari and Krop, 2012; Ansari et al., 2016; Wang, 2017). Yet, while the role of disruptions and uncertainty is widely understood, it is unclear how different types of uncertainty affect the location and sectoral distribution of MNEs overseas R&D investments.

Prior research has shown that uncertainty can affect various aspects of R&D investments, such as R&D collaborations (Banerjee and Siebert, 2017; Fu et al., 2021), strategic alliances (Kelly et al., 2002; Martínez-Noya and Narula, 2018), R&D performance evaluation (Bremser and Barsky, 2004), and industry emergence (Moeen et al., 2020). However, our understanding of how uncertainty, particularly political uncertainty, influences various types of R&D capital investments remains limited, as does our knowledge of why MNEs pursue R&D investments in specific industries and host countries despite facing political uncertainty. Furthermore, industries differ in their propensity to innovate or the mode through which they engage in innovative activities, be it through R&D, learning by doing, or learning by using (Dosi et al., 2009). These disparities lead to different sectoral technological trajectories, which subsequently affect how these sectors respond to instances of political uncertainty.

Thus, the purpose of this study is to unpack the role of political uncertainty in MNEs' overseas R&D investments in knowledge-intensive sectors, especially when such investments are made in developing countries. Exploring these boundary conditions is important because MNEs that can navigate political uncertainty effectively can gain a competitive advantage and stay ahead of competitors who might struggle to adapt. Furthermore, R&D investments are essential for innovation and driving long-term growth. Understanding how political factors impact R&D investments enables businesses to continue fostering innovation even amid uncertain times. To this end, we distinguish between science-based sectors (SBS) and knowledge-intensive business services (KIBS) sectors to account for how the type of knowledge and innovation engendered by certain R&D investments affects the size of MNEs' investments in the presence of host country political uncertainty. Furthermore, we also distinguish between developing versus developed host countries to account for the location differences in R&D investments in KIBS and SBS. Indeed, recent decades have seen a shift in overseas R&D investments from developed to emerging and developing countries (Papanastassiou et al., 2020; Dachs and Zahradnik, 2022; Morris et al., 2023). This rise of developing countries as host locations of foreign R&D has challenged the consensus on host countries' technological and knowledge capacities as key determinants of R&D internationalization (Lamin and Livanis, 2013; Castellani and Lavoratori, 2020). In fact, the determinants of innovations in developing countries differ significantly from those in developed countries (Ernst et al., 2015; Bortoluzzi et al., 2018; Anand et al., 2021), and the location factors can explain the "locational spread" of MNE innovative activities (Alcácer et al., 2016). Therefore, host-country location characteristics are important for R&D investment decisions and can affect how MNEs respond to political uncertainty.

We posit that political uncertainty is a significant determinant in the location choice for cross-border R&D investments. We define political uncertainty as fluctuations in government policies (for instance, economic and fiscal policies), the stability of rule of law (for instance, regularity of elections), corruption, and the protection of property rights (Carmignani, 2003; Cuervo-Cazurra and Dau, 2009; Witte et al., 2020; Hanousek et al., 2021) and argue that these fluctuations are expected to act as a deterrent to innovative activity (Jalonen, 2012), posing challenges to fundamental aspects of innovation, such as the quality of scientific institutions, partnerships between academia and industry, and the abundance of talented scientists and engineers within a society (Allard et al., 2012).

This study makes two important contributions to the R&D and innovation literature on the impact of political uncertainty (Pertuze et al., 2019; Cao et al., 2022; Krammer and Kafouros, 2022). First, we bring new evidence on the conditions that determine the impact of political uncertainty on MNE R&D investments. Particularly, we argue that political uncertainty does not affect all R&D investments uniformly; rather, its effect varies depending on the nature of R&D investment in question. Our findings suggest that R&D investments in SBS are less affected by host-country political uncertainty, while investments in KIBS are more affected by host-country political uncertainty. Thus, we provide new evidence on the sensitivity and resilience of MNE R&D investments across sectors.

Second, we offer evidence of why some countries with high political uncertainty still manage to attract R&D investments from MNEs. Thus, we contribute to the debate on the location differences of the determinants of R&D activities (Ernst et al., 2015; Anand et al., 2021). Our findings show that MNE R&D investments in SBS and KIBS sectors in developing countries are less susceptible to political uncertainty compared to developed countries, implying that developing countries create opportunities for cost-effective and frugal innovations, thus, attracting MNE R&D investments that offer greater value at a

lower price, which are in great demand. We consequently expand the discussion on the impact of location factors on overseas R&D investments and how these affect sectoral technological trajectories by showing where political uncertainty exerts the most influence on MNE R&D investments.

2. Theory and hypothesis development

2.1. Political uncertainty and MNE overseas R&D investments

MNEs operate within a multitude of diverse environments characterized by differences in institutions, culture, and economic development. Location characteristics have played an important role in the R&D investment decisions (Thursby and Thursby, 2006; De Backer and Hatem, 2010; Siedschlag et al., 2013; Ascani et al., 2016). R&D investments in knowledge-intensive industries are driven by supply-side factors, such as talent pools, infrastructure, and regulatory frameworks, which depict host location advantages not available at home (Narula, 2002; Wang et al., 2012). Furthermore, the creation, generation, and dissemination of knowledge are predominantly tacit, hard to codify, and hold strategic significance for a firm's competitiveness. Thus, firms seek to maintain control over this process by locating R&D activities near their headquarters, or in proximity to a subsidiary capable of ensuring optimal monitoring and control over its operations (Narula, 2002; Papanastassiou et al., 2020).

The location of R&D investments is also affected by the nature of market demand (i.e., heterogeneous vs. homogeneous), which may (de)centralize R&D activities in specific locations to leverage specialized expertise and infrastructure; by host country risk and uncertainty reflected, for instance, in the enforcement of IPRs across different industries (Lu et al., 2014; Cui et al., 2022); and by collaborative networks and knowledge spillovers within industries that can influence the clustering of R&D activities (Montoro-Sá Nchez et al., 2011; Broekel et al., 2015). Thus, the spread of R&D investments in knowledge-intensive sectors is due to a complex interplay of factors encompassing resource availability, market dynamics, regulatory environments, collaborative networks, and global strategies pursued by companies within each sector.

Among the host country's locational characteristics, political uncertainty is known to deeply influence a country's ability to generate new knowledge and technologies (Dosi, 1982; Pertuze et al., 2019). Political uncertainty fosters mistrust that permeates in society, affecting trust and confidence in authority figures, the integrity of institutions, and of rules and regulations (Allard et al., 2012; Alam et al., 2019). For instance, prior research shows that R&D investments in China by EU MNEs increased after China's entry into the WTO, reflecting an increased level of trust in the rule of law on behalf of foreign investors (Cai et al., 2019).

Political uncertainty can impact various dimensions of R&D investment, including collaborations, intellectual property rights (IPRs), the persistence or "stickiness" of investment in R&D, and the nature of innovation (new vs. incremental). Specifically, political uncertainty poses significant challenges to R&D collaborations, which are crucial for driving innovation. Collaborative partnerships among universities, governments, and businesses play a pivotal role in fostering innovation within foreign affiliates and tapping into local expertise. However, these collaborations often falter in politically uncertain environments, impeding the formation of the sustained, cooperative relationships among government, industry, and academia that are essential to cultivating a thriving innovative ecosystem (Leydesdorff and Meyer, 2006; Sofka et al., 2022). Political uncertainty can also result in shifts in government priorities and funding for innovation, affecting the availability of grants, subsidies, and other incentives that support R&D efforts (Bhattacharya et al., 2017).

Additionally, political uncertainty can undermine the enforcement of IPRs, disincentivizing investment in R&D in certain locations as firms might fear that their innovations could be easily copied or infringed upon. Since IPR regulation matters more for knowledge-intensive MNEs, they tend to invest in regions and industries with high R&D intensity (Chung and Alcácer, 2002), prioritizing locations with strong IPRs. A weak IPR regime affects the reputation of MNEs (Zaheer, 1995; Zaheer and Mosakowski, 1997; Tung, 2007) and their ability to recruit talent, impacting the firm's innovative capabilities.

Another feature of R&D investments that makes them sensitive to political uncertainty is their "stickiness." The evidence shows that R&D investments in knowledge-intensive industries are long-term and often "sticky," irreversible investments, with high adjustment costs and considerable degrees of uncertainty and risk (Czarnitzki and Toole, 2013; Cho and Lee, 2021). A key factor behind this "stickiness" or "inertia" in R&D operations of MNEs is the tacit nature of knowledge (Criscuolo and Narula, 2007; Castellani et al., 2022), and strong embeddedness in a particular innovation system (Narula, 2002). However, inertia may also

happen within an industry across firms, as well as across countries, perpetuating the use of specific technologies or products. Location inertia can lead to a concentration of R&D activities in certain geographic regions or industry clusters (Narula, 2002). When companies are deeply entrenched in specific R&D activities and locations, they often exhibit a greater reluctance to alter their operations in response to political uncertainty. This may render companies more vulnerable to political uncertainty in the long run, as they may be less prepared to adapt to shifting regulatory environments, changes in government support, or disruptions to international collaborations.

Finally, political uncertainty matters more for certain types of innovations than others. R&D investments in new products or services are generally riskier due to their novelty and untested nature (Grimpe et al., 2017). Political uncertainty exacerbates these risks by contributing to unpredictable market conditions, making it difficult to forecast the potential success of new products (Krammer and Jimenez, 2020; Krammer and Kafouros, 2022). In contrast, incremental innovations often require less investment and shorter development cycles, making them more adaptable to changing political climates. Since incremental innovations built on existing products or processes, they are less likely to be disrupted by political uncertainty. Firms may continue to pursue these smaller improvements to maintain competitiveness and efficiency. Thus, greenfield R&D investments, often carried out to create new products and processes, are more sensitive to political changes and political uncertainty.

These arguments point to political uncertainty reducing the levels of R&D investments. Thus, in line with prior research, our baseline hypothesis is:

> H1 The higher the political uncertainty in the host country, the lower the size of MNEs' overseas R&D capital investments in that country.

2.2. *Political uncertainty and R&D investments in knowledge-intensive sectors*

2.2.1. *Political uncertainty and R&D investments in knowledge intensive business services (KIBS)*

MNEs consistently invest overseas in KIBS activities (Lavoratori et al., 2020) in software, IT, or communication service sectors. KIBS are service providers that rely heavily on professional knowledge and serve as primary sources of information and expertise to firms (Boden and Miles, 2000). In the innovation process, KIBS play crucial roles as facilitators, carriers, or sources of innovation (den Hertog, 2000). They facilitate innovation by indirectly supporting clients in their innovation endeavors, and act as carriers when KIBS transfer existing innovations, not originated by themselves, to clients or users (Howells, 2006; Muller and Doloreux, 2009; den Hertog and Bilderbeek, 2019). As versatile innovation drivers, KIBS contribute significantly to the technological change in various industries and overall growth.

Thus, MNE investments in KIBS play an important role in the development of technology and a country's innovation system (Howells, 2006; den Hertog and Bilderbeek, 2019) by shaping knowledge dynamics through the interactive behavior of KIBS and their integration into clients' industries (Muller and Zenker, 2001). For instance, cooperation with firms from other sectors engenders innovations that increase the performance of these firms and their regions (Leiponen, 2005; Kohtamäki and Partanen, 2016; Bustinza et al., 2019). Therefore, KIBS can contribute to the dissemination and application of knowledge across sectors.

The role of political uncertainty becomes particularly crucial as the evolution of the KIBS sector heavily relies on intricate, and at times long-term, relationships with client firms in various sectors of the economy (Strambach, 2001; Miozzo and Grimshaw, 2006; Simmie and Strambach, 2006). For instance, political stability and the enforcement of strong IPRs provide support for innovation and R&D, encouraging KIBS to develop cutting-edge solutions and technologies that benefit their clients (Miozzo and Grimshaw, 2006; Simmie and Strambach, 2006). In contrast, the underdevelopment or the complete lack of proper legal frameworks, as well as weak and/or unenforced IPRs, will lead to fewer KIBS contacts and projects with their clients (Pereira and Vence, 2021), and raise questions on whether the clients have the expertise to handle the contracts with their suppliers (Grimshaw and Miozzo, 2006).

Therefore, we argue that MNE R&D investments in KIBS are highly sensitive to political uncertainty. For instance, political uncertainty can disrupt cross-border trade and business activities (Duanmu, 2014; Montes and Nogueira, 2022), leading to reduced foreign investments in KIBS and lowered KIBS activities. Furthermore, political uncertainty could lead to changing patterns in client's demand. For example, changes in government policies might generate a mixed response, with drops in demand for some KIBS, but an increase in demand for other KIBS, such as legal KIBS (Miles, 2005). Accordingly, political uncertainty may create hesitancy in foreign MNEs in

starting KIBS projects, as clients may be uncertain about the potential impacts of political events on the enforcement of IPRs and their impact on their businesses. Thus, there may be delays in seeking KIBS' services, cancelations of projects, or putting these projects on hold altogether. Clients may even seek alternative KIBS providers or attempt to negotiate lower service fees, impacting the profitability and market share of KIBS. Thus, we expect that MNE R&D investments in KIBS sectors will be more susceptible to the negative effects of political uncertainty, hypothesizing that:

> H2 MNEs' overseas R&D investments in KIBS amplify the negative effect of political uncertainty on R&D capital investment.

2.2.2. *Political uncertainty and R&D investments in science-based sectors (SBS)*

SBS (Pavitt, 1984; Niosi, 2000) play an important role in the creation of new knowledge, technologies, and products. These sectors typically include the chemical, pharmaceutical, and biotech industries, as well as the manufacturing of electrical and electronic engineering products. They rely on intensive knowledge exchange with the key actors of a country's system of innovation, such as universities and research centers, to foster cutting-edge technologies and novel solutions, and use collaborative relationships to assess and leverage emerging knowledge and technologies globally (Pla-Barber and Alegre, 2007; Bruni and Verona, 2009). For instance, in the pharmaceutical industry, knowledge is often sourced from or developed in cooperation with external research partners at universities and companies in different countries (Olk and West, 2020), while the biotechnology sector pioneers advancements revolutionizing agriculture and environmental sustainability (Chaudhary and Kumar, 2022). Such innovations require long-term joint R&D activities with host-country organizations or at least a constant exchange between researchers in enterprises and in science (Díaz-Díaz et al., 2022).

However, a country's public/political institutions play an important role in the knowledge exchange and collaborations among science-based firms, universities, and research centers (Dosi, 1982). Indeed, "pushing" discoveries from labs to the marketplace is a challenging process that succeeds with successful collaborations across all actors and in the presence of strong and enforceable IPRs (Garud et al., 2018). For instance, developing and deploying the wind turbines in Denmark was more successful than in the US because the institutions that oversee the collaborations between the wind turbine entrepreneurs, research centers, and organizations, were stronger in Denmark (Karnøe and Garud, 2012; Garud et al., 2018).

We argue that SBS are less receptive to political uncertainty. These sectors often involve long-term R&D cycles (as they mainly concentrate their innovative activities on basic research), and significant capital investments. They also typically engage in long-term collaborations, plan their activities over extended time horizons, and their projects may span several years or even decades (Guimón, 2013). As a result, they may be less susceptible to short-term political fluctuations. Furthermore, researchers and institutions typically focus on advancing knowledge and solving complex problems of global nature, which are often less influenced by political changes in a particular country. Although funding decisions may still be influenced by politics to some extent (Guimón, 2013), the overall direction of scientific research tends to be less affected by short-term political fluctuations. In addition, many SBS, such as healthcare, pharmaceuticals, and biotechnology, address critical societal needs and challenges (De Silva et al., 2021). The demand for advancements in these areas remains relatively stable, regardless of political changes. Governments and societies recognize the long-term benefits of scientific progress and may continue to support these sectors even during periods of political uncertainty. Therefore, we posit that R&D investments in SBS will be less susceptible to the negative effects of political uncertainty, hypothesizing that:

> H3 MNEs' overseas R&D investments in SBS alleviate the negative effect of political uncertainty on R&D capital investments.

2.3. *Political uncertainty and MNE R&D investments in developing countries*

In an interconnected world, technological advancements within each country are intertwined, leading to the anticipation of technological complementarity among different nations (Dunning and Lundan, 2009). However, there persists a widespread misconception that developing countries are mere followers of technological progress rather than active contributors. Consequently, many fail to recognize their significant role as vital components of an innovation-centric, interconnected world (Dividino et al., 2022). While many developing countries might fit this conjecture, this is not the case for all (Jha et al., 2018). For example, according to the World Intellectual Property Organization (WIPO), China

leads in all categories of IPRs over other developed countries (Luo, 2022) with India also being a dynamic competitor (Grosse, 2019).

Innovation activities in developing countries are considerably different from innovations in developed countries, due to differences in institutions, infrastructure, resources, and consumers, but also faster market growth (Ernst et al., 2015; Anand et al., 2021). They are more often driven by resource scarcity, affordability, and the pursuit of niche products (Steinfield and Holt, 2019). Firms reap the advantages of reduced costs and frequently capitalize on these cost benefits to create products with fewer resources, thereby offering greater value at a lower price (Subramaniam et al., 2015). The focus is mainly on "new-to-the-firm" and "new-to-the-market" innovations, rather than pushing the technological frontier as seen in developed countries (Bortoluzzi et al., 2018; Shankar and Narang, 2020). Furthermore, recent research indicates a growing trend of reverse innovation, where innovation is initially embraced in developing countries and subsequently replicated worldwide, including in developed countries (Govindarajan and Ramamurti, 2011; Von Zedtwitz et al., 2015). Thus, MNE R&D investments in KIBS and SBS in developing countries could generate knowledge that not only leads to cost-saving innovations that reduce the price of a product offered in developed countries and frugal innovations developed uniquely for resource-constrained environments but that can also be adopted in developed countries (Bortoluzzi et al., 2018; Shankar and Narang, 2020; Zhao et al., 2020). For instance, KIBS firms capture value from innovations by identifying, selecting and solving client problems through efficient cost-effective processes (Nickerson and Zenger, 2004; Desyllas et al., 2018) while biotech innovations in agriculture generate cost savings for farmers (Barrows et al., 2014). In fact, some MNEs are generating successful innovations in developing countries and leveraging that knowledge and progress to expand into other countries (Yip and McKern, 2016).

In the presence of political uncertainty innovators may be hesitant to invest in R&D efforts, fearing that their inventions could be easily copied or stolen. However, in case of reverse innovations, where innovations originate in developing countries and are implemented in developed countries, the influence of political uncertainty tends to diminish. This is attributable to the nature of these innovations, which are typically cost-effective and frugal, providing competitive advantages to firms in developing countries, potentially leading to less emphasis on IPR protection. Indeed, prior research shows that MNEs can navigate through developing countries without compromising their access to knowledge sources (Choquette et al., 2021; Mavroudi et al., 2023). Hence, we posit that MNE R&D investments in KIBS and SBS in developing countries will not be deterred by political uncertainty, given their potential to generate innovations that create competitive advantages that surpass the drawbacks of political uncertainty. Therefore, we hypothesize:

H4a The negative moderating effect of KIBS on the impact of political uncertainty on R&D capital investments is alleviated (becomes less negative) in developing vs. developed countries.

H4b The positive moderating effect of SBS on the impact of political uncertainty on R&D capital investments is amplified (becomes more positive) in developing vs. developed countries.

3. Data and methods

3.1. Data description

Our analysis is based on 11,640 cross-border greenfield R&D investment projects made by 3260 MNEs over the period 2003–2019. Information on projects is obtained from fDi Markets, a database maintained by fDi Intelligence, a division of the Financial Times Ltd, which is widely used in international business research (Castellani et al., 2013; Castellani and Lavoratori, 2020; Albino-Pimentel et al., 2021; Georgallis et al., 2021). fDi Markets reports the investment project's sector; whether the project is new or an expansion project; the home country of the investing company; the host country where the investment takes place (including regions and cities); as well as information on the R&D project's capital investment, revenue and the number of new jobs created.

The distribution of R&D investments by home country (Table 1), shows that most investments originate from the United States, the United Kingdom, Japan, and Germany. However, the size of R&D investments is larger for projects by Portuguese, Mexican, Italian, or Greek MNEs, which engage in fewer but larger R&D investments. Most R&D investments take place in the communication, software, and IT services industries, followed by investments in pharmaceuticals, industrial equipment, chemicals, and automotive components (Table 2).

Our dependent variable is capital investment, which is measured as the logarithm of the capital investment of each R&D investment project. Thus, as in King

Table 1. Distribution of average capital investments (in millions USD) and the number of investment projects by home countries

Home country	Mean	Nr. Projects	Home country	Mean	Nr. Projects
Argentina	7.35	4	Malaysia	29.55	11
Australia	37.84	28	Mexico	193.69	41
Austria	24.39	44	Netherlands	37.12	288
Belgium	17.82	85	New Zealand	7.46	5
Brazil	19.98	14	Norway	36.78	74
Bulgaria	17.5	1	Philippines	9.5	1
Canada	35.13	225	Poland	51.15	11
Chile	78.49	8	Portugal	121.95	4
China	40.52	396	Russia	40.34	30
Czech Republic	5.78	7	Singapore	49.77	73
Denmark	24.58	82	Slovakia	47.4	2
Estonia	24.7	1	Slovenia	15	2
Finland	50.11	145	South Africa	35.09	15
France	47.11	678	South Korea	35.58	186
Germany	33.92	1279	Spain	126.1	176
Greece	119.89	10	Sweden	46.42	266
Hungary	33.23	4	Switzerland	29.22	123
India	47.61	224	Thailand	16.05	4
Ireland	31.07	136	Turkey	22.97	5
Israel	23.44	56	UAE	4.9	1
Italy	128.62	90	United Kingdom	50.65	835
Japan	34.78	953	United States	48.2	4977
Lithuania	45.5	1	Total	45.87	11,640
Luxembourg	75.75	39			

et al. (2021), we investigate the impact of political uncertainty on "how much" is invested, considering the size of investment as an appropriate measure to capture the MNE's overall commitment into a host economy.

Independent variables include:

Political Uncertainty—Host is the 3-year standard deviation of political risk scores provided by the International Country Risk Guide (ICRG).[1] The ICRG's political risk ranks the countries from the least risky to the riskiest in terms of the unfavorable political changes for the business environment. Accordingly, scores range from zero, for the highest-risk countries, to 100, for the lowest-risk countries.

KIBS is a dummy equal to one if the R&D investment is made in business services, communication, financial services, healthcare services, and software & IT services and zero otherwise (Simmie and Strambach, 2006).

SBS is a dummy equal to one if the R&D investment is made in biotechnology, business machines & equipment; consumer electronics; electronic components, pharmaceuticals, and semiconductor sectors, and zero otherwise (Zahra et al., 2000; Marsili and Verspagen, 2002).

Dummy Developing equals one if the host country is developing, zero otherwise. We classify countries in developed versus developing based on the OECD classification.[2]

3.1.1. Control variables

At the project level, we control for *performance* measured by the logarithm of the revenues generated by the investment; *project type* defined as a dummy equaling one if the investment is a new R&D project, and zero if it is an expansion project; and *skilled jobs created* measured by the logarithm of the number of jobs created by each R&D investment.[3] The source of these variables is the fDi Markets data.

At the home and host country levels, we control for various economic, political, cultural, and other institutional factors that influence MNE's investment decisions (Castellani and Lavoratori, 2020; Albino-Pimentel et al., 2021). For instance, we control for home and host country heterogeneity in economic development with the home-host country difference in *GDP per capita*; and the home–host country difference in *R&D expenditure per capita* and *in patents granted*. The source of the data for

Table 2. Distribution of R&D investment projects by business sectors

Sectors	Nr investments
Aerospace	131
Automotive OEM	311
Automotive components	529
Biotechnology	226
Building materials	21
Business machines & equipment	184
Business services	349
Ceramics & glass	12
Chemicals	592
Coal, oil & gas	69
Communications	2296
Consumer electronics	146
Consumer products	104
Electronic components	303
Engines & turbines	75
Financial services	54
Food & Beverages	264
Healthcare	36
Hotels & tourism	8
Industrial equipment	544
Medical devices	170
Metals	84
Minerals	10
Non-automotive transport OEM	50
Paper, printing & packaging	34
Pharmaceuticals	523
Plastics	147
Rubber	77
Semiconductors	442
Software & IT services	3696
Space & defense	79
Textiles	51
Transportation & Warehousing	19
Wood products	4
Total	11,640

all three variables is IMD World Competitiveness Online.

In addition, we control for home-host country differences in political, cultural, and various other institutional variables. To this end, we capture political differences with home and host country political uncertainty, political regime, and political affinity. We define home country's political uncertainty similarly to the host country's *political uncertainty* (see above). We control for a *political regime* with the polity score (Polity V), which ranges from −10 (fully autocratic) to + 10 (fully democratic) (Marshall et al., 2018). Furthermore, we also account for *political affinity* that reflects the similarity of national interests in global affairs between the home and the host country, as captured by their respective voting in the United Nations General Assembly (UNGA) (Gartzke, 1998; Bertrand et al., 2016). The affinity score ranges from −1 (dyadic countries have completely opposing views) to 1 (dyadic countries fully agree on world affairs). The data on voting patterns is obtained from Voeten et al. (2009).

We also account for home–host country *cultural similarities* with a dummy equal to 1 if the home and host countries are in the same cultural cluster, and 0 otherwise. We construct the cultural clusters from (Ronen and Shenkar, 1985, 2013). Countries in the same cultural cluster share cultural similarities.

Finally, we account for other institutional (legislation) differences with *IPRs* and *investment incentives* which are available from the IMD World Competitiveness Online (WCO). *IPRs* are measured by an index that ranges from 0 to 10 and rates countries in terms of whether IPRs are adequately enforced. *Investment incentives* are an index that ranges from 0 to 10 and rates countries in terms of how attractive their business legislation on investment incentives is to the foreign investors.

At the home–host country dyad level we also control for whether home and host country share a common border (*contiguity*) with a dummy that equals 1 if home and host country share a border, 0 otherwise; and for the geographical distance between their capitals (in thousands of km). The data on these variables is available from the Centre d'Études Prospectives et d'Informations Internationales (CEPII).[4]

A correlation matrix and summary statistics (Table 3) of all main variables used in the analysis shows that there are no collinearity issues among the independent variables.

3.2. *Estimation strategy*

In our regression analysis, we estimate the following model:

$$I_{\mathrm{ijt}} = a_0 + b_1 \mathrm{PU}_{ct} + b2\ \mathrm{PU}_{ct} * \mathrm{KIBS}_j + b3\ \mathrm{PU}_{\mathrm{ct}} * \mathrm{SBS}_j + b4\ \mathrm{PU}_{\mathrm{ct}} * \mathrm{KIBS}_j * \mathrm{Developing}_c + b5\ \mathrm{PU}_{ct} * \mathrm{SBS}_j * \mathrm{Developing}_c + z_{\mathrm{it}} + v_{\mathrm{ct}} + e_{\mathrm{it}}$$

where I_{ijt} represents the size of R&D investment i, made in sector j at time t; PU represents political uncertainty in host country c, at time t; KIBS is the dummy for KIBS sectors; SBS is the dummy for SBS; z_{it} is a vector of R&D investment

Table 3. Correlation matrix of main variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Political uncertainty-host	1																				
2. KIBS	−0.00	1																			
3. SBS	−0.02	−0.48	1																		
4. Dummy developing	0.08	−0.01	−0.01	1																	
5. Project type	−0.04	0.10	−0.02	0.11	1																
6. Performance	−0.01	−0.11	−0.05	0.04	−0.06	1															
7. Skilled jobs created	0.03	0.14	−0.06	0.28	0.03	0.12	1.00														
8. Diff GDP capita	−0.01	0.06	−0.02	−0.52	−0.04	−0.00	−0.18	1													
9. Diff patent granted	0.03	0.12	−0.01	0.12	−0.01	0.06	0.02	−0.03	1												
10. Diff R&D expenditure	0.10	0.04	−0.03	0.43	−0.00	0.07	0.16	−0.32	0.51	1											
11. Contiguity	−0.05	0.04	−0.02	−0.20	−0.02	−0.04	−0.05	0.11	−0.04	−0.07	1										
12. Distance	0.04	−0.02	0.04	0.38	0.07	0.04	0.17	−0.15	0.19	0.09	−0.44	1									
13. Cultural similarity	−0.03	0.06	0.01	−0.24	−0.06	−0.08	−0.10	0.09	0.06	−0.08	0.33	−0.30	1								
14. Political affinity	−0.01	−0.00	−0.05	−0.43	−0.07	0.00	−0.21	0.25	−0.21	−0.20	0.25	−0.45	0.19	1							
15. Pol uncertainty-home	0.26	0.06	0.01	0.01	0.02	−0.03	0.02	0.03	0.06	−0.07	−0.01	0.08	0.02	−0.10	1						
16. Inv incentives-home	0.01	0.11	−0.01	−0.01	−0.02	−0.12	0.05	0.06	0.03	−0.04	0.03	0.08	0.02	−0.29	0.07	1					
17. Intel prop rights-home	0.03	−0.02	−0.01	0.04	−0.09	−0.05	0.00	−0.22	0.17	0.28	0.01	0.02	0.01	−0.13	−0.10	0.46	1				
18. Regime home	−0.01	−0.03	0.01	0.07	−0.05	−0.04	0.01	−0.34	−0.05	0.17	−0.01	−0.04	0.03	0.01	−0.17	−0.1	0.51	1			
19. Regime host	−0.05	0.13	−0.04	−0.41	−0.10	−0.08	−0.11	0.50	0.07	−0.07	0.13	−0.25	0.09	0.29	0.02	0.03	−0.03	−0.1	1		
20. Inv incentives-Host	−0.06	−0.07	0.06	−0.05	−0.06	−0.03	−0.05	−0.13	0.02	−0.14	−0.01	0.08	0.18	−0.12	−0.02	0.02	0.03	0.01	−0.2	1	
21. Intel prop Rights-Host	−0.11	−0.03	0.03	−0.43	−0.10	−0.08	−0.28	0.43	−0.12	−0.54	0.11	−0.12	0.25	0.23	−0.001	0.02	−0.01	−0.1	0.32	0.5	1
Mean	0.02	0.59	0.15	0.45	0.71	8.37	4.3	−1.65	0.08	545	0.09	6.98	0.19	0.27	0.017	6.4	7.68	−8.92	−6.5	6.32	6.5
St. deviation	0.016	0.49	0.36	0.49	0.45	2.94	1.12	3.93	0.14	740	0.28	4.14	0.39	0.46	0.011	0.93	1.13	3.25	5.81	1.08	1.5
Min	0	0	0	0	0	0	0	−24.1	−0.37	−2472	0	0.06	0	−1	0	2.8	1.6	−10	−10	1.69	1.2
Max	0.12	1	1	1	1	13.1	8.69	28.3	0.38	2770	1	19.3	1	1	0.12	8.98	9.2	10	10	8.98	9.2

characteristics; and v_{ct} is a vector of home and host county controls. The triple interactions show how the combined effect of KIBS(SBS) with developing versus developed countries affects the relationship between political uncertainty and the size of R&D investments.

MNE's R&D capital investment decisions are not random, but a function of firm and home–host country characteristics (Oetzel and Oh, 2014; Oh and Oetzel, 2017). We control for this self-selection bias with Heckman's two-stage selection model (Heckman, 1979; Shaver, 1998). In the first stage, we estimate the likelihood that an R&D investment could be made in any potential host country from the data, as a function of investment, home, and host country characteristics. The results of the first-stage selection model are provided in Table 4. In the second stage, we include the inverse Mills ratio from the first stage as a regressor. We also cluster the errors at the parent MNE and host country level and estimate ordinary linear regressions with heteroscedastic and autocorrelation consistent standard errors, including year, sector, and region fixed effects.

Table 4. First stage model—logit regression

Variables	(1)
Political uncertainty-host	−0.016
	(0.008)
	[0.050]
KIBS	0.343
	(0.034)
	[0.000]
Sciences sector	0.139
	(0.037)
	[0.000]
Dummy developing	−3.145
	(0.242)
	[0.000]
Project type	0.069
	(0.021)
	[0.001]
Performance	0.150
	(0.004)
	[0.000]
Skilled jobs created	−0.014
	(0.008)
	[0.092]
Diff GDP capita	−0.030
	(0.012)
	[0.010]
Diff patent granted	1.149
	(0.117)
	[0.000]
Diff R&D expend	−0.0001
	(0.000)
	[0.030]
Contiguity	0.212
	(0.042)
	[0.000]
Distance	−0.028
	(0.003)
	[0.000]
Cultural similarity	0.453
	(0.030)
	[0.000]
Political affinity	−0.006
	(0.035)
	[0.861]
Political uncertainty —home	0.005
	(0.010)
	[0.617]
Investment incentives—home	0.130
	(0.014)
	[0.000]

(Continues)

4. Results

4.1. Multivariate results

Table 5, models 1–5 present the results of testing the hypotheses. Model 1 tests for H1, with the results confirming that host country political uncertainty has a negative and significant effect on R&D capital investments (model 1: $b=-4.371$, $p=0.000$). This is graphically illustrated in Figure 1. Model 2 tests for H2. The results show that the moderating effect of investments in KIBS on the relationship between host country political uncertainty and R&D capital investments is negative and significant at a 1% significance level (model 2: $b=-2.826$, $p=0.009$). Thus, the negative impact of host country political uncertainty on R&D capital investments is stronger for investments in KIBS compared to other sectors, providing support for the hypothesis.

The moderating effect of KIBS is further illustrated in Figure 2, Panel A, which shows that the graph for KIBS lies below the graph for the other sectors, and it is steeper in slope, indicating that the negative effect of political uncertainty is stronger in KIBS versus other sectors.

In H2 we compare the effect of political uncertainty for KIBS versus other sectors. We expand this hypothesis to incorporate location differences in terms of developing versus developed host countries (H4a). Thus, in Model 3 we investigate

Table 4. (Continued)

Variables	(1)
Intel property rights-home	0.062
	(0.017)
	[0.000]
Home regime	0.023
	(0.004)
	[0.000]
Host regime	–0.012
	(0.012)
	[0.306]
Investment incentives—Host	0.145
	(0.019)
	[0.000]
Intel property rights-host	0.073
	(0.024)
	[0.003]
Bilateral investment agreement	0.099
	(0.059)
	[0.010]
Constant	–8.608
	(0.266)
	[0.000]
Observations	488,266
Sector fixed effects	Yes
Year fixed effects	Yes
Host country fixed effects	Yes

First stage logit regression of Heckman's model. Standard errors in parentheses, p-values in squared parentheses.

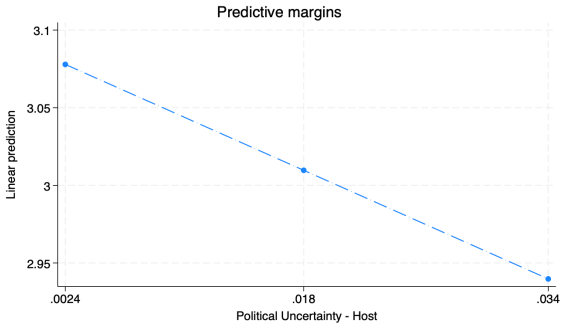

Figure 1. The baseline effect of host country political uncertainty.

the combined effect of investments in KIBS versus other sectors in developing versus developed host countries on the relationship between political uncertainty and size of R&D investments. This moderating effect is positive and significant at 1% (model 3: $b = 3.553$, $p = 0.028$). This result suggests that the negative effect of host country political uncertainty is weaker for R&D investments made in KIBS sectors in developing versus developed countries. This moderating effect is graphically displayed in Figure 2, Panel B, which shows that the graph for KIBS vs other sectors in developing countries (lies below) is flatter than the graph for KIBS versus other sectors in developed countries, suggesting that the drop in R&D capital investments, when host country political uncertainty increases, is lower for KIBS in developing countries compared to developed countries. Thus, we find support for H4a.

Model 4 tests for H3. The results show that SBS positively moderates the impact of host country political uncertainty on R&D capital investments (model 4: $b = 2.779$, $p = 0.035$), providing support for the hypothesis. As illustrated in Figure 3, Panel A, the graph for SBS lies below the graph for other sectors and it is flatter, indicating that the negative effect of political uncertainty is weaker in SBS versus other sectors. Thus, the drop in R&D capital investments due to host country political uncertainty is smaller for SBS, providing support for H3.

In Model 5 we test for the combined effect of investments in SBS versus other sectors in developing versus developed host countries on the relationship between host country political uncertainty and size of R&D capital investments (H4b). This moderating effect is positive and significant at a 1% significance level (model 5: $b = 10.591$, $p = 0.000$). This result suggests that the negative effect of host country political uncertainty on MNE's R&D capital investments is weaker for R&D investments made in SBS in developing versus developed countries.

Figure 3, Panel B illustrates this moderating effect. The graph for SBS vs other sectors in developing countries is upward sloping while the graph for SBS versus other sectors in developed countries is downward sloping. This suggests that an increase in host country political uncertainty will result in a drop in R&D capital investments in SBS versus other sectors in developed countries, but an increase in R&D capital investments in SBS versus other sectors in developing countries. Thus, we find support for H4b.

4.2. *Robustness checks*

We perform several robustness checks to account for alternative explanations regarding the moderating effect of KIBS and SBS, and their combined effect with developing versus developed host countries on the impact of host country political uncertainty on R&D investment decisions. These results are presented in Tables 6–8. Several findings are worth noting.

First, it can be argued that our findings could be affected by the host country characteristics that are fixed over time (i.e., host country fixed effects). Therefore, in Table 6, models 1–5, we re-estimate our specifications controlling for host country fixed

Table 5. Pooled OLS regressions with the logarithm of R&D capital investments as the dependent variable

Variables	(1)	(2)	(3)	(4)	(5)
Political uncertainty-host	−4.371	−2.803	−8.410	−4.750	−7.184
	(0.787)	(0.898)	(1.208)	(0.828)	(1.301)
	[0.000]	[0.002]	[0.000]	[0.000]	[0.000]
Political uncertainty-host × KIBS		−2.826			
		(1.082)			
		[0.009]			
Political uncertainty-host × KIBS × dummy developing			3.553		
			(1.614)		
			[0.028]		
Political uncertainty-host × science-based				2.779	
				(1.318)	
				[0.035]	
Political uncertainty (host) × science-based × dummy developing					10.591
					(2.105)
					[0.000]
KIBS sector	−0.201	−0.147	−0.175	−0.200	−0.199
	(0.048)	(0.051)	(0.051)	(0.047)	(0.048)
	[0.000]	[0.004]	[0.001]	[0.000]	[0.000]
Science-based sector	−0.125	−0.123	−0.120	−0.174	−0.168
	(0.042)	(0.042)	(0.042)	(0.048)	(0.048)
	[0.003]	[0.003]	[0.004]	[0.000]	[0.001]
Project type	0.122	0.121	0.115	0.122	0.120
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Performance	0.006	0.006	0.005	0.006	0.005
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
	[0.472]	[0.488]	[0.556]	[0.477]	[0.546]
Skilled jobs created	0.653	0.654	0.653	0.654	0.653
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Dummy developing	−0.227	−0.226	−0.301	−0.227	−0.325
	(0.049)	(0.049)	(0.057)	(0.049)	(0.057)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Political affinity	0.217	0.218	0.222	0.216	0.220
	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Diff GDP capita	0.027	0.027	0.026	0.027	0.027
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Diff patent granted	0.767	0.767	0.758	0.767	0.754
	(0.161)	(0.161)	(0.160)	(0.161)	(0.160)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Diff R&D expend	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[0.003]	[0.003]	[0.005]	[0.003]	[0.006]
Contiguity	−0.055	−0.054	−0.057	−0.054	−0.064
	(0.063)	(0.063)	(0.063)	(0.063)	(0.064)
	[0.379]	[0.393]	[0.369]	[0.389]	[0.314]

(Continues)

Table 5. (Continued)

Variables	(1)	(2)	(3)	(4)	(5)
Distance	−0.021	−0.021	−0.020	−0.021	−0.021
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]
Cultural similarity	−0.055	−0.056	−0.062	−0.055	−0.055
	(0.051)	(0.051)	(0.050)	(0.051)	(0.051)
	[0.278]	[0.273]	[0.222]	[0.279]	[0.283]
Political uncertainty—home	−1.550	−1.442	−1.365	−1.555	−1.515
	(1.394)	(1.403)	(1.406)	(1.394)	(1.393)
	[0.266]	[0.304]	[0.332]	[0.264]	[0.277]
Investment incentives—home	0.008	0.008	0.006	0.008	0.006
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
	[0.809]	[0.799]	[0.839]	[0.811]	[0.838]
Intel property rights—home	0.046	0.047	0.044	0.047	0.044
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
	[0.096]	[0.094]	[0.110]	[0.095]	[0.112]
Home regime	0.002	0.002	0.001	0.002	0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
	[0.798]	[0.801]	[0.868]	[0.793]	[0.821]
Host regime	−0.038	−0.038	−0.037	−0.038	−0.039
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Investment incentives—host	−0.011	−0.011	−0.012	−0.011	−0.010
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
	[0.449]	[0.440]	[0.404]	[0.460]	[0.480]
Intel property rights—host	0.075	0.076	0.084	0.075	0.081
	(0.019)	(0.019)	(0.020)	(0.019)	(0.020)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Inverse Mills ratio	−0.599	−0.599	−0.608	−0.598	−0.612
	(0.115)	(0.115)	(0.115)	(0.115)	(0.114)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Constant	1.589	1.544	1.624	1.590	1.685
	(0.444)	(0.447)	(0.448)	(0.444)	(0.444)
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Observations	11,640	11,640	11,640	11,640	11,640
Nr Firms	3260	3260	3260	3260	3260
R^2	0.538	0.541	0.540	0.539	0.540
Sector fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes
Mean VIF	4.72	4.75	4.79	4.71	4.73

Pooled OLS regressions with sector, region and year fixed effects, and with errors clustered at the parent firm and host country level. This is the second stage of the Heckman's selection model. Standard errors in parentheses, p-values in squared brackets.

effects instead of region fixed effects. The results for all our hypothesis remain consistent in both sign and significance.

Second, in our analysis, we use KIBS and SBS dummies. However, Pedota and Piscitello (2022) argue that technologies may complement worker skills. Thus, we argue that jobs created by R&D investments in these sectors are high skilled jobs that generate knowledge, which complements workers' skills. Thus, any newly created jobs will also add to these skills. Therefore, we re-run our regressions with the yearly number of skilled jobs created in KIBS and SBS sectors. The results in Table 7, models 1–5 show that our main results still stand, suggesting that skilled jobs created

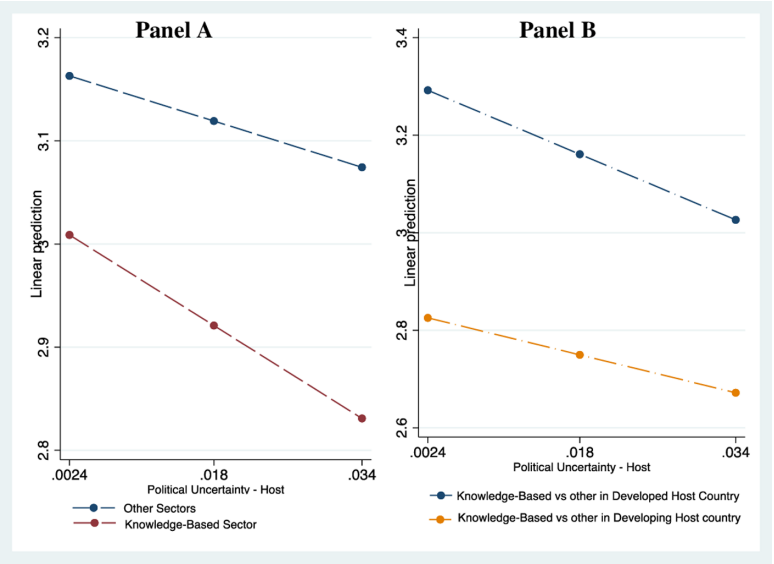

Figure 2. The moderating effect of knowledge-based sector (Panel A) and knowledge-based sector in developing host countries (Panel B) on the relationship between host country political uncertainty and MNE's R&D capital investments.

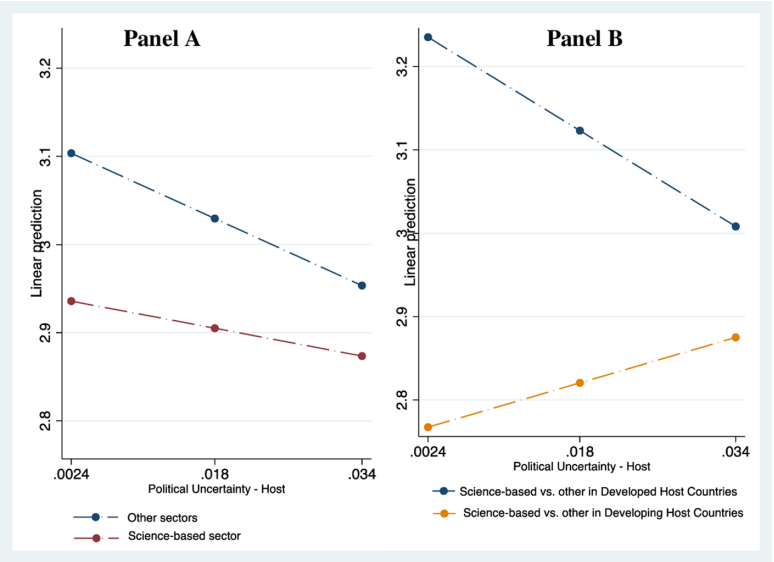

Figure 3. The moderating effect of science-based sector (Panel A) and science-based sector in developing host countries (Panel B) on the relationship between host country political uncertainty and MNE's R&D capital investments.

in these sectors are a good proxy for the knowledge generated in each respective sector.

Third, to account for the fact that the effect of political uncertainty on R&D investments for KIBS and SBS and their combined effect with developing versus developed country dummy may vary on whether the project is new or an expansion project, we test our hypotheses for each subsample. Table 8, models 1–4, show the results for the new projects while models 5–8 show the results for the expansion projects. The results show that the effect of host country political uncertainty is negative and significant for both types of projects and that our results remain consistent in both signs and significance.

5. Discussion and conclusion

In this study, we investigate the effect of political uncertainty on the size of greenfield R&D investments. We focus on the boundary conditions that affect the impact of political uncertainty on

Table 6. Robustness checks

VARIABLES	(1)	(2)	(3)	(4)	(5)
Political uncertainty-host	−4.393	−2.882	−7.096	−4.729	−5.683
	(0.766)	(0.886)	(1.149)	(0.801)	(1.211)
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Political uncertainty-host × KIBS		−2.721			
		(1.076)			
		[0.012]			
Political uncertainty (host) × KIBS × dummy developing			2.846		
			(1.401)		
			[0.042]		
Political uncertainty-host × science-based				2.443	
				(1.233)	
				[0.047]	
Political uncertainty-host × science-based × dummy developing					7.249
					(2.077)
					[0.000]
Military alliances					
KIBS sector	−0.220	−0.169	−0.195	−0.220	−0.217
	(0.050)	(0.053)	(0.053)	(0.050)	(0.050)
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Science-based sector	−0.137	−0.135	−0.132	−0.180	−0.171
	(0.043)	(0.043)	(0.043)	(0.049)	(0.049)
	[0.002]	[0.002]	[0.002]	[0.000]	[0.001]
Dummy developing	0.654	0.654	0.653	0.654	0.653
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Project type	−0.250	−0.248	−0.279	−0.249	−0.300
	(0.044)	(0.044)	(0.049)	(0.044)	(0.049)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Performance	0.124	0.123	0.118	0.124	0.123
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Skilled jobs created	0.018	0.018	0.018	0.018	0.018
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
	[0.021]	[0.022]	[0.023]	[0.021]	[0.020]
Political affinity	0.005	0.005	0.000	0.004	−0.001
	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)
	[0.929]	[0.933]	[1.000]	[0.951]	[0.990]
Diff GDP capita	0.042	0.042	0.042	0.042	0.042
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Diff patent granted	1.154	1.156	1.165	1.155	1.160
	(0.147)	(0.148)	(0.147)	(0.147)	(0.147)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Diff R&D expend	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

(Continues)

Table 6. (Continued)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Contiguity	0.081	0.082	0.086	0.082	0.078
	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)
	[0.142]	[0.135]	[0.117]	[0.138]	[0.160]
Distance	−0.012	−0.012	−0.011	−0.012	−0.012
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
	[0.008]	[0.009]	[0.015]	[0.008]	[0.010]
Cultural similarity	0.013	0.013	0.007	0.013	0.017
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
	[0.783]	[0.785]	[0.881]	[0.779]	[0.716]
Political uncertainty—home	−2.438	−2.312	−2.199	−2.432	−2.366
	(1.317)	(1.323)	(1.330)	(1.317)	(1.318)
	[0.064]	[0.081]	[0.098]	[0.065]	[0.073]
Investment incentives—home	0.001	0.002	0.004	0.001	0.002
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
	[0.960]	[0.945]	[0.887]	[0.960]	[0.958]
Intel property rights—home	0.037	0.039	0.038	0.037	0.037
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
	[0.321]	[0.288]	[0.303]	[0.319]	[0.316]
Home regime	−0.030	−0.030	−0.030	−0.029	−0.028
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
	[0.244]	[0.245]	[0.243]	[0.250]	[0.266]
Host regime	−0.040	−0.040	−0.039	−0.040	−0.040
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Investment incentives—host	−0.027	−0.027	−0.028	−0.026	−0.027
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
	[0.046]	[0.044]	[0.034]	[0.047]	[0.044]
Intel property rights—host	0.044	0.045	0.048	0.044	0.047
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Inverse Mills ratio	−0.459	−0.458	−0.455	−0.458	−0.453
	(0.061)	(0.061)	(0.060)	(0.061)	(0.060)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Constant	1.093	1.041	1.064	1.094	1.089
	(0.369)	(0.368)	(0.366)	(0.369)	(0.369)
	[0.003]	[0.005]	[0.004]	[0.003]	[0.003]
Observations	11,640	11,640	11,640	11,640	11,640
R^2	0.537	0.540	0.538	0.537	0.538
Sector fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Region fixed effects					
Host country fixed effects	Yes	Yes	Yes	Yes	Yes

Pooled OLS regressions with sector, region (or host-country) and year fixed effects, and with errors clustered at the parent firm and host country level. This is the second stage of the Heckman's selection model. Standard errors in parentheses, p-values in squared brackets.

the contextual factors that affect this relationship. the R&D investments. We argue that the impact of political uncertainty on R&D investments is affected by sector and host country location factors. As such, we contribute to the understanding of Accordingly, we show that the negative impact of political uncertainty on R&D investments is stronger in KIBS, while SBS is less affected by it. We argue that KIBS have close links with their clients

Table 7. Robustness checks for the importance of skilled R&D jobs in high-tech and sciences sectors

Variables	(1)	(2)	(3)	(4)
Political uncertainty-host	−2.765	−2.817	−4.771	−4.640
	(0.896)	(0.889)	(0.830)	(0.832)
	[0.002]	[0.002]	[0.000]	[0.000]
Political uncertainty-host × skilled jobs × KIBS	−4.445			
	(1.653)			
	[0.007]			
Political uncertainty-host × skilled jobs KIBS × dummy developing		−6.081		
		(1.848)		
		[0.001]		
Political uncertainty-host × skilled jobs SCIENCE-based			20.699	
			(9.399)	
			[0.028]	
Political uncertainty (Host) × skilled jobs science-based × dummy developing				38.294
				(10.658)
				[0.000]
Skilled jobs KIBS	−0.158	−0.173	−0.240	−0.244
	(0.079)	(0.079)	(0.074)	(0.073)
	[0.045]	[0.029]	[0.001]	[0.001]
Skilled jobs science-based	−0.440	−0.456	−0.808	−0.721
	(0.264)	(0.264)	(0.299)	(0.306)
	[0.096]	[0.084]	[0.007]	[0.019]
Dummy developing	−0.226	−0.191	−0.228	−0.243
	(0.049)	(0.053)	(0.049)	(0.050)
	[0.000]	[0.000]	[0.000]	[0.000]
Project type	0.121	0.121	0.122	0.121
	(0.026)	(0.026)	(0.026)	(0.026)
	[0.000]	[0.000]	[0.000]	[0.000]
Performance	0.007	0.007	0.007	0.007
	(0.009)	(0.009)	(0.009)	(0.009)
	[0.447]	[0.440]	[0.435]	[0.456]
Skilled jobs created	0.653	0.653	0.653	0.653
	(0.013)	(0.013)	(0.013)	(0.013)
	[0.000]	[0.000]	[0.000]	[0.000]
Political affinity	0.217	0.216	0.216	0.216
	(0.060)	(0.060)	(0.060)	(0.060)
	[0.000]	[0.000]	[0.000]	[0.000]
Diff GDP capita	0.026	0.026	0.027	0.027
	(0.005)	(0.005)	(0.005)	(0.005)
	[0.000]	[0.000]	[0.000]	[0.000]
Diff Patent granted	0.766	0.771	0.767	0.760
	(0.161)	(0.161)	(0.161)	(0.161)
	[0.000]	[0.000]	[0.000]	[0.000]
Diff R&D expend	−0.0001	−0.0001	−0.0001	−0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
	[0.003]	[0.002]	[0.003]	[0.003]
Contiguity	−0.054	−0.049	−0.054	−0.056
	(0.063)	(0.063)	(0.063)	(0.063)
	[0.394]	[0.433]	[0.390]	[0.370]

(Continues)

Table 7. (Continued)

Variables	(1)	(2)	(3)	(4)
Distance	−0.021	−0.021	−0.021	−0.021
	(0.006)	(0.006)	(0.006)	(0.006)
	[0.000]	[0.000]	[0.000]	[0.000]
Cultural similarity	−0.056	−0.058	−0.055	−0.055
	(0.051)	(0.051)	(0.051)	(0.051)
	[0.277]	[0.253]	[0.280]	[0.281]
Political uncertainty—home	−1.472	−1.473	−1.585	−1.578
	(1.403)	(1.405)	(1.394)	(1.394)
	[0.294]	[0.295]	[0.256]	[0.258]
Investment incentives—home	0.008	0.007	0.008	0.006
	(0.032)	(0.032)	(0.032)	(0.032)
	[0.798]	[0.815]	[0.808]	[0.854]
Intel property rights—home	0.047	0.048	0.047	0.048
	(0.028)	(0.028)	(0.028)	(0.028)
	[0.093]	[0.087]	[0.093]	[0.088]
Home regime	0.002	0.002	0.002	0.002
	(0.007)	(0.007)	(0.007)	(0.007)
	[0.792]	[0.812]	[0.784]	[0.810]
Host regime	−0.038	−0.037	−0.038	−0.038
	(0.003)	(0.003)	(0.003)	(0.003)
	[0.000]	[0.000]	[0.000]	[0.000]
Investment incentives—host	−0.012	−0.012	−0.011	−0.011
	(0.015)	(0.015)	(0.015)	(0.015)
	[0.431]	[0.403]	[0.453]	[0.444]
Intel property rights—host	0.077	0.076	0.076	0.077
	(0.019)	(0.019)	(0.019)	(0.019)
	[0.000]	[0.000]	[0.000]	[0.000]
Inverse Mills ratio	−0.595	−0.591	−0.594	−0.598
	(0.115)	(0.116)	(0.115)	(0.115)
	[0.000]	[0.000]	[0.000]	[0.000]
Constant	1.522	1.500	1.567	1.590
	(0.446)	(0.451)	(0.444)	(0.442)
	[0.001]	[0.001]	[0.000]	[0.000]
Observations	11,640	11,640	11,640	11,640
R^2	0.539	0.539	0.538	0.539
Sector fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes

Pooled OLS regressions with sector, region and year fixed effects, and with errors clustered at the parent firm and host country level. This is the second stage of the Heckman's selection model. Standard errors in parentheses, p-values in squared brackets.

and are affected by changes in client's demand due to increased future uncertainty caused by political uncertainty. While many SBS, such as pharmaceuticals and biotechnology, address critical societal needs and challenges (De Silva et al., 2021), for which the demand remains relatively stable, regardless of political uncertainties. This finding provides support to our argument that political uncertainty can affect the MNEs' types of international R&D activities and consequently redefine a country's technological trajectory.

Furthermore, we find that for R&D investments made in developing countries (whether in KIBS or SBS), the negative effect of political uncertainty is weaker. We argue that R&D investments in KIBS and SBS in developing countries generate cost savings and frugal innovations (Bortoluzzi et al., 2018; Shankar and Narang, 2020), making

Table 8. Robustness checks for new versus expansion projects

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Political uncertainty-host	−2.659	−7.931	−4.576	−6.237	−2.402	−8.292	−4.202	−6.467
	(1.106)	(1.533)	(1.020)	(1.585)	(1.904)	(2.483)	(1.779)	(2.738)
	[0.016]	[0.000]	[0.000]	[0.000]	[0.207]	[0.001]	[0.018]	[0.018]
Political uncertainty-host × KIBS	−2.540				−2.899			
	(1.317)				(1.498)			
	[0.054]				[0.053]			
Political uncertainty-host × KIBS × dummy developing		8.559				11.902		
		(1.658)				(2.659)		
		[0.000]				[0.000]		
Political uncertainty-host × Science-based			3.424				1.408	
			(1.600)				(0.739)	
			[0.032]				[0.056]	
Political uncertainty-host × Science-based × dummy developing				8.716				13.057
				(2.548)				(4.733)
				[0.001]				[0.006]
KIBS sector	−0.146	−0.170	−0.193	−0.192	−0.159	−0.209	−0.217	−0.210
	(0.052)	(0.052)	(0.049)	(0.049)	(0.100)	(0.101)	(0.087)	(0.088)
	[0.005]	[0.001]	[0.000]	[0.000]	[0.114]	[0.039]	[0.013]	[0.017]
Science-based sector	−0.169	−0.163	−0.231	−0.220	0.013	0.004	−0.015	−0.004
	(0.046)	(0.047)	(0.054)	(0.055)	(0.084)	(0.084)	(0.098)	(0.098)
	[0.000]	[0.001]	[0.000]	[0.000]	[0.877]	[0.965]	[0.878]	[0.971]
Dummy developing	−0.243	−0.288	−0.245	−0.312	−0.207	−0.282	−0.206	−0.316
	(0.054)	(0.062)	(0.054)	(0.062)	(0.103)	(0.114)	(0.103)	(0.114)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.044]	[0.013]	[0.045]	[0.006]
Performance	0.001	0.001	0.001	0.001	0.029	0.026	0.029	0.027
	(0.010)	(0.010)	(0.010)	(0.010)	(0.013)	(0.013)	(0.013)	(0.013)
	[0.899]	[0.937]	[0.889]	[0.940]	[0.026]	[0.042]	[0.026]	[0.033]
Skilled jobs created	0.652	0.651	0.652	0.652	0.670	0.670	0.669	0.669
	(0.014)	(0.014)	(0.014)	(0.014)	(0.023)	(0.023)	(0.023)	(0.023)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Political affinity	0.258	0.262	0.257	0.259	0.141	0.147	0.141	0.145
	(0.065)	(0.064)	(0.065)	(0.064)	(0.105)	(0.105)	(0.106)	(0.104)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.183]	[0.161]	[0.183]	[0.163]
Diff GDP capita	0.031	0.031	0.031	0.031	0.009	0.009	0.009	0.010
	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)	(0.009)	(0.009)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.339]	[0.314]	[0.327]	[0.262]
Diff Patent granted	0.799	0.794	0.798	0.791	0.936	0.898	0.942	0.917
	(0.183)	(0.181)	(0.183)	(0.182)	(0.275)	(0.276)	(0.274)	(0.274)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]
Diff R&D expend	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[0.025]	[0.030]	[0.024]	[0.035]	[0.015]	[0.021]	[0.015]	[0.019]
Contiguity	−0.087	−0.087	−0.087	−0.093	0.004	0.015	0.003	−0.006
	(0.071)	(0.071)	(0.071)	(0.072)	(0.102)	(0.102)	(0.102)	(0.102)
	[0.223]	[0.223]	[0.223]	[0.195]	[0.966]	[0.883]	[0.976]	[0.953]

(Continues)

Table 8. (Continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance	−0.021	−0.019	−0.021	−0.020	−0.025	−0.021	−0.025	−0.024
	(0.006)	(0.006)	(0.006)	(0.006)	(0.011)	(0.011)	(0.011)	(0.011)
	[0.001]	[0.002]	[0.001]	[0.001]	[0.025]	[0.063]	[0.024]	[0.031]
Cultural similarity	−0.015	−0.022	−0.015	−0.016	−0.149	−0.161	−0.147	−0.146
	(0.056)	(0.055)	(0.056)	(0.055)	(0.080)	(0.079)	(0.080)	(0.079)
	[0.784]	[0.687]	[0.785]	[0.772]	[0.061]	[0.042]	[0.064]	[0.067]
Political uncertainty—home	−1.214	−1.150	−1.318	−1.273	−2.849	−2.704	−2.958	−2.996
	(1.599)	(1.606)	(1.592)	(1.591)	(2.662)	(2.652)	(2.647)	(2.671)
	[0.448]	[0.474]	[0.408]	[0.424]	[0.285]	[0.308]	[0.264]	[0.262]
Investment incentives—home	0.012	0.010	0.012	0.011	0.014	0.014	0.014	0.012
	(0.034)	(0.034)	(0.034)	(0.034)	(0.048)	(0.048)	(0.049)	(0.048)
	[0.717]	[0.772]	[0.733]	[0.754]	[0.773]	[0.765]	[0.774]	[0.806]
Intel property rights—home	0.050	0.050	0.051	0.049	0.024	0.022	0.022	0.022
	(0.030)	(0.030)	(0.030)	(0.030)	(0.043)	(0.043)	(0.043)	(0.043)
	[0.098]	[0.101]	[0.095]	[0.106]	[0.583]	[0.601]	[0.614]	[0.601]
Home regime	0.000	−0.000	0.001	0.000	0.005	0.005	0.005	0.005
	(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.010)	(0.010)	(0.010)
	[0.949]	[0.987]	[0.941]	[0.970]	[0.584]	[0.626]	[0.590]	[0.608]
Host regime	−0.039	−0.038	−0.039	−0.039	−0.042	−0.040	−0.043	−0.044
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.005)	(0.006)	(0.005)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Investment incentives—host	−0.012	−0.013	−0.012	−0.011	−0.012	−0.012	−0.011	−0.011
	(0.016)	(0.016)	(0.016)	(0.016)	(0.027)	(0.027)	(0.027)	(0.027)
	[0.447]	[0.409]	[0.473]	[0.478]	[0.663]	[0.647]	[0.673]	[0.685]
Intel property rights—host	0.076	0.081	0.075	0.079	0.073	0.083	0.072	0.080
	(0.021)	(0.021)	(0.021)	(0.021)	(0.035)	(0.036)	(0.035)	(0.036)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.037]	[0.019]	[0.039]	[0.026]
Inverse Mills ratio	−0.652	−0.656	−0.650	−0.660	−0.436	−0.454	−0.438	−0.457
	(0.122)	(0.122)	(0.122)	(0.122)	(0.187)	(0.187)	(0.187)	(0.186)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.020]	[0.015]	[0.020]	[0.014]
Constant	1.748	1.809	1.788	1.856	1.252	1.256	1.317	1.406
	(0.473)	(0.476)	(0.469)	(0.473)	(0.753)	(0.747)	(0.754)	(0.741)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.097]	[0.093]	[0.081]	[0.058]
Observations	8341	8341	8341	8341	3299	3299	3299	3299
R^2	0.528	0.529	0.528	0.529	0.594	0.596	0.595	0.597
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Pooled OLS regressions with sector, region and year fixed effects, and with errors clustered at the parent firm and host country level. This is the second stage of the Heckman's selection model. Standard errors in parentheses, p-values in squared brackets.

these countries attractive for R&D investments, despite political uncertainty. Therefore, such investments will be less affected by political uncertainty. Finally, our results show high prediction accuracy and robustness, providing a strong credibility of the three drivers influencing R&D internationalization.

5.1. Contributions to the literature

This study broadens our understanding of the factors affecting the MNE R&D internationalization and contributes to the R&D literature in two ways. *First*, we contribute to the innovation literature on the role of political uncertainty (Pertuze et al., 2019; Cao

et al., 2022; Krammer and Kafouros, 2022). While the extant literature comes with predictions about the role of political uncertainty on innovation strategy, R&D, or product innovation, it lacks evidence or understanding on how exactly it affects different types of MNE international R&D investments. We theorize and provide new evidence that while political uncertainty lowers the size of R&D investments, this effect is not uniform across all sectors. In fact, some sectors such as science-based ones, are more resilient than others.

Second, we expand on the first contribution by bringing in the debate on the role of R&D location determinants on different types of R&D activities (Ernst et al., 2015; Bortoluzzi et al., 2018; Anand et al., 2021). As such, we investigate the role of political uncertainty on R&D investments in the two knowledge-intensive sectors, KIBS and SBS in developing versus developed countries. Against the expectations that developing countries should be more affected than developed countries by political uncertainty, the effect of political uncertainty on knowledge-intensive sectors in developing countries is attenuated by their ability to generate frugal innovations that are in demand and can be adopted in developed countries.

5.2. *Policy implications*

MNE's R&D investments can considerably increase the technological capacities and growth prospects of host countries, making our findings relevant from a policy perspective. First, our results confirm that lower political uncertainty pays off for host countries in attracting more inward R&D investments. Thus, it is crucial for policymakers to understand the mechanism of how political uncertainty affects innovation activity to design proper policies that promote R&D investments. We argued that political uncertainty leads to changes in laws and regulations governing IPRs, making it easier for IP infringement, and increasing the risk of expropriation. Thus, policymakers should prioritize efforts to support political stability by enacting and enforcing robust IPR laws to protect innovations and incentivize R&D investment and refraining from frequent changes in rules and regulations that disrupt firms' long-term plans and discourage investments. Strengthening IPR frameworks, including patents, copyrights, and trademarks, enhances the confidence of MNEs in the security of their intellectual assets and encourages long-term commitment to the sector in a particular location. Furthermore, IPR policies should not be static but evolve in line with the competitiveness and economic development of the country. This evolution should be aligned with the development path and strategic objectives of other policies aimed at enhancing the competitiveness of the location and its local economic actors.

Second, policymakers should consider that R&D investments are often long-term and characterized by inertia or "stickiness," leading to high adjustment costs, and significant uncertainty and risk. This substantiates the claim that policies should aim to provide stability and predictability in the regulatory environment to mitigate the potential negative impacts of political uncertainty on R&D activities. Specifically, policymakers should implement measures to reduce political risks and enhance the resilience of R&D investments. This may include incentives for companies to diversify their R&D activities across different geographic regions or industry clusters, thereby reducing dependence on specific locations and mitigating the risk of concentration. Additionally, policymakers could support initiatives that facilitate knowledge sharing and collaboration between companies, industries, and countries, promoting innovation and adaptability. Moreover, clear communication of policy intentions by governments is crucial. Transparency in the formulation and decision-making of policies aids in minimizing uncertainty and facilitates businesses in making well-informed decisions.

Third, our findings show that R&D investments in developing countries are less affected by political uncertainty. Thus, MNEs are tolerating a higher level of political uncertainty in these countries, other things equal. This points to the expectation of supernormal profits by MNEs from investments and/or other locational factors that outweigh the disadvantage of political uncertainty in developing countries. FDI statistics show that developing countries are an attractive alternative location for R&D activities by foreign MNEs, and governments in developed countries have to acknowledge these new entrants in the competition between R&D locations. A possible reaction is to commit to long-term policies that support innovation and invest in robust knowledge infrastructure, including research institutions, universities, and skilled labor pools. Proximity to leading universities, research institutions, and technology hubs can facilitate the recruitment of top talent and foster collaboration with academic and industry partners. In addition, priority should be given to securing consistent funding for innovative initiatives by, for instance, maintaining tax incentives for research or mobilizing both public and private funding to support technology commercialization and startups.

IRB statement
Not applicable.

Data availability statement

The data that support the findings of this study are available from fDi Markets. Restrictions apply to the availability of these data, which were used under license for this study.

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Notes

[1]https://www.prsgroup.com/explore-our-products/icrg/.

[2]OECD, "Statistics on resource flows to developing countries"; "DAC list of ODA recipients: Effective for reporting on 2022 and 2023 flows", www.oecd.org.

[3]Since these are new jobs created by R&D investments, they are expected to represent R&D related skilled jobs.

[4]http://www.cepii.fr.

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