THE IMPACT OF INSTITUTIONS ON COLLABORATIVE INNOVATIONS AND THE ROLE OF EQUITY-BASED ENTRY MODES

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ABSTRACT

This paper examines the impact of institutional variables on MNEs' choice between majority and minority acquisitions in their foreign affiliates and how this choice influences their propensity to collaborate with local firms. Using the Institutional theory and the Transaction Cost theory, we develop a number of hypotheses. In particular we suggest that majority acquisitions will be more likely than minority acquisitions and greenfields to enter collaborative R&D projects in countries that belong to the Civil Law/Eastern European legal tradition or countries where the protection of minority shareholders is poor. These hypotheses are tested using an unbalanced panel of subsidiaries controlled by British multinationals, located in 39 countries. The results confirm our theoretical predictions.

1. INTRODUCTION

The ownership level in FDI operations has been shown to be an important choice variable for MNEs investing in new countries. While early studies have identified a number of institutional factors that affect the choice of the equity ownership level, no emphasis has been placed on the implications different ownership levels have on the propensity of foreign affiliates to collaborate with local firms. This paper, based on a large dataset, provides evidence on the impact of a number of institutional variables on different equity ownership levels and on the foreign affiliates' propensity to collaborate with local firms for the development of a joint innovation.

This is an important issue both theoretically and practically. An interesting feature of the current process of R&D internationalization is that multinationals source local technical knowledge by collaborating with local companies, which may lead to the production of innovation (Cantwell and

Mudambi, 2005; Audretsch and Belitski, 2019). MNEs do so with local firms from both developed countries and countries with imperfect governance, high levels of corruption and weak protection of the intellectual property rights[1]. This trend is puzzling. There is a large academic literature which highlights the risks faced by multinationals that invest in countries with high levels of corruption and imperfect governance (Santangelo et al. 2016; Rabbiosi and Santangelo, 2019). The conventional wisdom suggests that collaborations to develop new technology in such settings can be risky pursuits for multinationals, which may be exposed to the risks of unwanted dissipation of proprietary technology and/or a failing R&D project, due to the fraudulent behaviour of the innovation partner (Anokhin and Schulze, 2009; Demirbag et al., 2021). If so, how can MNEs mitigate these risks? At the moment, there is no theoretical framework which can explain how MNEs can do so.

In this paper, we argue that MNEs investing abroad have to balance two issues: on the one hand, it has to leverage the links to the local innovation system that subsidiaries offer while on the other hand, it has to control the local subsidiary (Luo and Tung, 2007; Demirbag et al., 2010b). Our argument is that the latter issue can be solved through the ownership structure of the affiliate which is decided by taking into account the characteristics of the host country's institutional environment. A weak institutional environment implies that non-ownership-based control mechanisms (based on contractual relationships and legal enforcement) will be expensive to manage; therefore, MNEs will prefer ownership-based mechanisms (Demirbag et al., 2008). However, MNEs may still need to choose between acquisitions and greenfields. Acquisitions may be superior to greenfield as they allow MNEs not only to exercise their control rights but to join existing networks of firms which may become R&D partners. This is particularly relevant in the case of R&D-intensive FDI which happens mostly through acquisitions of existing plants (Guemin, 2010). We use the theoretical framework provided by the institutional theory (Williamson, 2000; Estrin et al., 2013) and the Transaction Cost theory to explore how the quality of institutions in the host country may explain why majority acquisitions are more likely to collaborate with external organizations than minority acquisitions. The relationship among the propensity to collaborate and innovate with external organizations, types of acquisitions and quality of institutions has never been explored before in the context of the literature on acquisitions and institutions and therefore, this is the research gap the paper is addressing.

[1] A survey conducted by the European Commission in 2016, shows that a quarter of the R&D activities of the EU-based companies in the survey sample were conducted outside the EU, with India and China receiving larger R&D investment shares than other European countries.

The empirical analysis has been conducted on a dataset of UK MNEs' subsidiaries located in Europe and belonging to manufacturing. Our theoretical analysis suggests that majority acquisitions will be more likely than minority acquisitions and greenfields to enter collaborative R&D projects in countries that belong to the Civil Law/Eastern European legal tradition that is countries where the protection of minority shareholders is poor (La Porta et al., 2008). Therefore, our data-set had to be drawn from countries belonging to a number of legal traditions such as Civil law and/or countries belonging to the Eastern European legal tradition. We decided to collect data on subsidiaries located in Europe which hosts countries belonging to each of these legal traditions. Therefore, our data-set covers a broad range of institutional settings: indeed 60% of our subsidiaries are located in a Civil law country while 30% are located in a country belonging to the East European tradition. These legal systems are very common around the world and therefore, focusing the empirical analysis on European countries allows to derive results which should apply to other continents as well.

The data set has been sourced from the Bureau Van Dijk Amadeus database and combined with the European Patents Office data and data from the Governance Matters dataset. If our hypotheses are correct, we should observe that majority acquisitions in countries with weak institutions tend to engage in collaborative R&D more often than minority acquisitions or wholly owned greenfields (in the same countries). The contribution of the paper is two-fold. First, our paper contributes to the literature on collaborative R&D projects between MNEs' subsidiaries and firms in a host country. Unlike previous studies in this area, our paper has focused on the role of institutions in shaping the propensity of MNEs to collaborate with local firms. This paper highlights how the institutional environment can shape the preference for specific types of acquisitions so that the negative impact of the institutions on firm-level choices is minimized. This is in line with existing studies such as Rabbiosi and Santangelo (2019). We make a further step in considering the implications of some corporate governance institutions for the ownership structure of the subsidiary. Second, the paper puts the host country institutions and their effectiveness in protecting investors' rights at the forefront of the discussion on risk-mitigation strategies in the context of collaborative R&D projects by explaining how ownership structure of the subsidiary and the performance of collaborative projects are the result of both firm-specific and country -level factors in the spirit of Demirbag et al. (2007, 2010b).

The paper is structured as follows. Section 2 summarizes the main literature in this area and proposes our main hypotheses. Section 3 describes the methodology used for the empirical work,

and the data used for the analysis. Section 4 presents the results while Section 5 offers some concluding remarks.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 Inter-firm collaboration and R&D

Our study draws the Transaction Costs theory and on the Institutional theory (Rodriguez et al., 2005; Uhlenbruck *et al.*, 2006) to explain why MNEs may prefer majority acquisitions when joining R&D collaborations. MNEs see the possibility to invest abroad as an opportunity to acquire external knowledge and to develop links with the local innovation system[2] (Nair et al., 2018). Research on inter-firm R&D collaboration is very well developed. This literature is made of several theoretical strands which include the Transaction Costs Economics (Williamson, 2000), the Resource-Based View, the Property Rights theory (Hart and Moore, 1990) and the Real Option theory. Research on collaborative R&D projects has mostly focused on the choice of the partner and the choice of the governance mode (Oxley and Sampson, 2004; van de Vrande et al., 2007). At the heart they all share a common goal i.e. promote knowledge sharing while minimizing the risks of the partners' opportunistic behaviour[3]. However, MNEs have to decide whether to join an R&D collaboration by establishing a new company or by acquiring an existing company which may be part of the consortium itself. Several authors suggest that MNEs may prefer an acquisition (rather than establishing a new company) (Barkema and Vermeulen, 1998; Brouthers and Brouthers, 2000; Hennart et al., 2015) to access technical knowledge and the local network[4]. We suggest that the choice between the two options (acquisition or greenfield) is driven by institutional factors as well as by the desire to internalise the costs associated to the two options. Acquisitions may be preferable in institutional settings with high institutional uncertainty as this increases the transaction costs MNEs may face (La Porta et al., 1998; Demirbag et al., 2007; 2008). If MNEs decide to acquire an existing firm in a host country, they have to decide about the size of the equity stake: the choice of majority or minority equity stake has different implications for the parent company in terms of resource commitment and level of control. While MNEs may want to internalize the transaction costs associated to each type of acquisitions, our argument is that the characteristics of the host country institutions may define the preference for the size of the equity

[2] The local innovation system or national innovation system includes a number of organizations (such as universities, research institutes and firms) that are responsible for the adoption, diffusion and development of innovations.

[3] Literature distinguishes between relational risk (i.e. risk associated to the opportunistic behaviour of partners) and performance risk (i.e. risk incurred if partners do not comply to the contractual terms).

[4] This is close to the concept of the national innovation system which may influence the ownership strategy of foreign investors.

stake by altering the costs and the benefits each option offers (Meyer et al., 2011; Mudambi and Navarra, 2004).

In our analysis, we consider the origin of the legal system (La Porta *et al.*, 1998; Beck et al., 2003) which is the key feature of the institutional environment. In addition, we consider the corporate governance framework and the extent to which it protects minority shareholders (La Porta *et al.*, 2002). Finally, we consider the Intellectual property regime and how it protects the intellectual property rights. We will now elaborate how these three dimensions of the institutional environment influence the MNEs' preference for ownership-based control mechanisms.

2.1 HYPOTHESES DEVELOPMENT

2.1.1 Legal system, Equity Stakes and R&D collaboration

Legal rights of foreign investors depend largely on the attributes of the host country's legal system; in turn this may influence (for instance) how investors can recover their financial losses in case of failed R&D projects and whether the subsidiary's management can be held responsible for such a loss (among the others). However, legal systems vary in the way foreign investors are protected (Varsakelis, 2001; Mickiewicz, 2009). Research has shown that civil law countries offer investor weak legal protection (La Porta *et al.*, 1998) mostly because the quality of law enforcement is weak compared to countries from the common law tradition[5].

Several studies have suggested that in institutional environments that are different from those of the host country, ownership-based control mechanisms tend to be relatively cheap compared to non-ownership ones that may generate additional transaction costs for the parent company (Demirbag et al., 2007, 2010b). Therefore, the only way to internalize them is to opt for ownership-based control mechanisms, according to the Transaction Costs theory. Ownership allows MNEs to exercise their control rights while simultaneously getting the necessary leverage to access technical knowledge or a local network of R&D partners[6] (Cantwell and Iammarino, 2003; Meyer et al., 2011; Mudambi and Navarra, 2004). However, acquisitions may be superior to wholly owned greenfields as the latter would not give speedy access to potential partners (Javorcik and Wei, 2009; Demirbag et al., 2007; Brouthers, 2002).

[5] In civil law countries judges cannot interfere with conduct if it is not sanctioned by legislation (La Porta et al., 2008) unlike common law courts (Coffee, 1999; Johnson et al., 2000).

[6] This is in line with the existing evidence that technologically intensive firms or firms operating in R&D industries lacking country-specific knowledge may seek to obtain that knowledge through acquisitions.

Once the MNE has decided to acquire an existing firm in a host country, it has to decide about the size of the equity stake: the choice between the majority or the minority equity stake has different implications for the parent company in terms of resource commitment and control capabilities (Demirbag et al., 2007; 2010a; Mani et al., 2007). If an MNE from a common law country invests in countries with inadequate ex post enforcement of contracts, it makes sense to opt for a majority equity ownership. The reason is that with weak institutional protection, the cost of extracting private benefits from the R&D collaboration is low for the affiliate (La Porta et al., 2008). This leads to our first two-part hypothesis:

***H1a**: Majority acquisitions are preferred to minority acquisitions when investing in countries belonging to a different legal tradition.*

***H1b:** Majority acquisitions located in countries belonging to a different legal tradition are more likely to start collaborative R&D projects with local private firms than other types of acquisitions in the same countries.*

One of the risks MNEs face in the context of collaborative R&D is expropriation from the managers of the collaborative project. Expropriation in this case may take different forms. For instance, managers may divert resources allocated to the collaborative project to a third company they have a financial interest in (La Porta et al., 1998, 2008). A much simpler form of expropriation may be related to the compensation of the project's managers (who may be overpaid) or to the perks they enjoy. In these cases, MNEs may have to find mechanisms that allow to protect themselves from these risks of expropriation. If formal corporate governance mechanisms offsetting the risk of expropriation may be expensive to implement (or are missing) (Filatotchev and Nakajima, 2010), the transaction costs associated to minority ownership may be too large and the value of ownership-based control mechanisms increases considerably. In line with the Transaction Costs theory, majority ownership allows MNEs to internalize these transaction costs. In the case of collaborative R&D, the key benefit of a majority stake is that the parent company will be able to gather information on the behaviour of the partners and on the performance of the collaboration (Sudarsanam and Mahate, 2006; Hughes et al., 2018). Majority acquisitions may give the parent company sufficient leverage to protect its investment as the parent company may be able to influence the strategic as well as the operational decision-making of the subsidiary (Gulati, 1995; Kaynak et al., 2007) and align their activities to their own interests (Driffield et al., 2013). In other words, co-alignment of incentives and the administrative monitoring properties make majority acquisitions preferable to minority acquisitions in countries with weak protection of the

minority shareholders as they allow to internalize the additional transaction costs associated to minority acquisitions. Therefore, we posit that:

H2a: *Majority acquisitions are preferred to minority acquisitions when investing in countries with poor protection of minority shareholders.*
H2b: *Majority acquisitions located in countries with poor protection of minority shareholders are more likely to start collaborative R&D projects with local private firms than other types of acquisitions in the same countries.*

2.1.2 R&D collaboration and Patents

Among the transaction costs generated by collaborative R&D, those associated to the definition of the intellectual property rights over the resulting innovation can be rather substantial. Indeed, appropriability hazards can be quite substantial in the context of collaborative R&D projects (Hagedoorn et al., 2005): collaborations for the creation of new technologies may require the parent company to share with the subsidiary (and its collaborators) strategic assets or knowledge (Hennart, 1989; Osborn and Baughn, 1990). Therefore, MNEs will be required to define ex ante a number of mechanisms that will allow to internalize the resulting transaction costs. While ownership allows to internalize such transaction costs because it gives the MNEs oversight of the subsidiary (Oxley, 1999) in line with the Transaction Cost Theory, it will limit the appropriability hazards only up to a certain point. It is important to recall that the subsidiary itself may misuse the invention or try to extract private benefits from it if the invention is not adequately protected; in particular parent companies from countries with strong protection of intellectual property rights face higher costs when they are involved in collaborative R&D in countries with poor protection of the intellectual property rights. Therefore, parent companies will have to identify additional mechanisms that address directly the appropriability risks.

Patents are one of those: first, patents protect the intellectual property embedded in the invention from misappropriation and limit the negative impact of the unavoidable knowledge spillovers among partners. Unsurprisingly, given the risks of involuntary knowledge leakage, protection of intellectual property rights generated through the R&D collaboration is more relevant here than in other types of inter-firm collaborations. In these cases, it can be very difficult to recover the losses from the theft of intellectual property in legal environments (like in Civil Law countries) where there is weak legal protection of alternative appropriability mechanisms (like trade secrecy). Second, patents allow parent companies to appropriate the benefits of the R&D investment over time in an efficient way: as the technology matures over time and the parent company has a better

understanding of its market potential, patenting may be a sensible strategy for an MNE planning to recoup the initial investment through licencing fees across several markets and over its network of subsidiaries. Finally, patenting improves the bargaining position of the MNE (and its subsidiary) in the partnership and eventually reduces the incentives of the partners to engage in opportunistic behaviour. This is particularly relevant in legal environments where the intellectual property legislation cannot protect the rights generated by alternative appropriability mechanisms.

If majority owned subsidiaries tend to collaborate with external organisations more often than wholly owned greenfields and minority acquisitions in countries with poor protection of the intellectual property rights, we would expect them to register more patents than wholly owned greenfields and minority acquisitions. This leads us to our third hypothesis:

H3: *Majority acquisitions that start collaborative R&D projects in countries from a different legal tradition or with poor protection of minority shareholders will have larger patent counts than other types of acquisitions.*

3. METHODS

To examine these hypotheses, we have combined the firm-level data of UK MNEs' subsidiaries compiled by the Bureau Van DijK's (BvD) – and commercialised under the name of Amadeus - with the European Patent Office data on their patents registered. BvD Amadeus provides annual financial accounting information for over 10 million companies across Europe[7]. The annual data include 24 balance sheet items, 25 profit and loss account items, and 26 ratios. Amadeus company level information includes international identifiers such as Eurostat NACE codes which cluster companies by industry sector. These data also provide geographic information; using the 2-digit country ISO code allowing us to match countries to listed companies. To construct our working sample, we start by identifying all UK-based manufacturing firms listed in Amadeus through their NACE codes[8]. For each firm, Amadeus records whether it owns foreign firms (i.e. firms based outside the UK) and how much it owns of the foreign firm. Importantly, Amadeus assigns a unique identifier to each of these subsidiaries allowing us to download from the database additional information about the subsidiaries such as their size, location and their accounts. Through this

[7] The dataset covers the following countries: Albania, Austria, Bosnia and Herzegovina, Belgium, Bulgaria, Belarus, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, United Kingdom, Greece, Croatia, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Latvia, Republic of Moldova, Macedonia (Fyrom), Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Russian Federation, Sweden, Slovenia, Slovakia, Turkey, Ukraine.

[8] The NACE codes for manufacturing firms range between 11 and 33.

process, we were able to identify 1845 subsidiaries located in 39 (non-UK) countries. Finally, we have created an indicator that allows us to identify whether the subsidiary is an acquisition or a greenfield. This indicator is constructed by combining information on foreign ownership, date of establishment of the company and size of the foreign stake in the company. Following the US International Trade Commission (1989) and previous research on entry modes (Demirbag et al., 2007, 2010b), a newly established company fully owned by a foreign company since its inception is classified as a greenfield while an established company bought by a foreign company is classified as a brownfield (or acquisition). Minority acquisition are then defined as those brownfields that are only partially controlled by the foreign owner (size of the foreign stake is less than 50%) while majority acquisitions are brownfields whose foreign stake is above 50%.

Patent data refer to the patents registered with the EPO and are sourced from the Worldwide Patent Statistical Database (PATSTAT). This includes patents from 81 national and international patent offices, detailed information on patents published in the EU, and citations from EPO to non-EPO patents i.e. backward and forward citations to other world patents. In addition, it includes information on the organizations to which the patent is assigned, the application and registration date, the technological sector of the invention and the inventors' names. A patent can be the result of an individual firm's R&D activity or the result of a collaborative project involving two or more firms. In the latter case, all the companies involved are included in the patent documents which allows us to trace whether the patenting company has collaborated to obtain a patent. BvD has matched the patent data from EPO to the firm-level data listed in Amadeus; as a result, it is possible to have a list of all the patents registered by both our parent companies and their subsidiaries together with the organizations they have developed the innovation with (which is co-patenting as well) and their location. A patent that is registered with the EPO by two or more assignees is considered to be a joint patent. For a patent to be in our sample, one of his assignees must be a subsidiary of our UK MNEs. The second or third assignee can be an external organization. If the patents' documents report no co-patenting organization, then we assume that the invention has not been developed as a result of inter-firm collaboration. Importantly, co-patenting organizations may include both private and public organizations (such as universities or research institutes) and therefore, we take care of splitting them into two groups: private co-patenting organizations (that include only private companies) and public co-patenting organizations (including universities and research institutes)[9]. For our analysis, we focus only on

[9] This sorting process has been done by matching the name of the organization to the list of firms included in Amadeus in the first instance. If this first step was inconclusive with respect to the nature of the collaborating organization, we have used information sourced from Internet to be able to identify the nature of the co-patenting organization.

co-patenting organizations from the private sector located in the same country as the subsidiary. Data on the host-country institutions have been collected from the World Bank 'Governance Matters' data compiled by Kaufmann *et al.* (2005, 1999) while data on the host-country Intellectual Property Rights have been sourced from the Property Rights Alliance[10].

The final sample is an unbalanced panel of manufacturing subsidiaries owned by UK MNEs covering the period 2005-2017[11]. Table 1 presents descriptive statistics for our sample. 60% of our subsidiaries are majority acquisitions while the remaining 40% is a mix of greenfields and minority acquisitions. 60% of the subsidiaries are located in a Civil Law country while 30% are located in a country belonging to the East European tradition. The mean value of the Anti-director rights index for our countries is 3.31 while the equivalent figure for the Control of Corruption index is around 3.7. The sample average number of patents per company is 4.486 but only 10% of the sample have at least a patent. Only 5.6% of the sample have co-patented with other organizations while only 2% of the sample has already collaborated with the same organization. Table 2 presents the correlation indexes among the main variables. They show that multicollinearity among the variables which will be used for our empirical analysis is not a problem[12]. The VIF confirms this result as well as the absence of heteroskedasticity[13] . The correlation coefficients are above 0.70 for the collaboration variables which will not be included simultaneously in the same regression model.

3.1 Dependent and Independent variables

Before discussing the dependent and independent variables, it is worth discussing the structure of the empirical model. The theoretical framework suggests that MNEs prefer to join collaborative R&D projects through their majority acquisitions rather than minority acquisitions or wholly owned greenfields in countries with weak institutions. If our framework is correct, we should observe that majority acquisitions are more likely to be part of joint R&D projects in countries from the Civil Law and the East European legal tradition than in common law countries. Also, they will register more patents than other types of brownfields and greenfields. The implications are that: a) the propensity of a subsidiary to join a collaborative R&D project is conditional on the

[10] These data are freely available at https://internationalpropertyrightsindex.org/.
[11] The number of subsidiaries vary by year: we have 1845 subsidiaries between 2005 and 2012. The figure increases to 1857 in 2013 while it equals 1566 between 2014 and 2017.
[12] If the correlation coefficient among two variables is above 0.70, we take care not to include them in the same regression.
[13] We want to thank a referee for observing that the VIF can be used to check for the presence of heteroskedasticity in the data.

subsidiary being a majority acquisition rather than a minority acquisition or a greenfield; b) the host country institutions influence the choice between a majority and a minority acquisition; c) collaboration with a local company has an impact on the number of patents the subsidiary registers. Given the fact that the preference for collaborative R&D projects is conditional on the subsidiary being a majority acquisition, there is a need to control for such sample bias; therefore, a selection equation is added modelling the preference for majority acquisitions rather than for minority acquisitions or wholly owned greenfields (see Demirbag et al., 2010b). As a result, we have four equations to estimate in our model. The model is summarised graphically in Figure 1.

Dependent variables. We have four dependent variables. The first equation models the MNE's preference for brownfields (as opposite to wholly owned greenfields). In this case, the dependent variable is a dummy variable taking the value of 1 if the subsidiary is a brownfield and 0 if the subsidiary is a greenfield. The second equation models the MNE's preference for majority acquisitions against minority acquisitions and so the dependent variable is a dummy variable taking the value of 1 if the subsidiary is a majority acquisition and 0 if it is a minority acquisition. The third equation models the subsidiary's propensity to join collaborative R&D projects with local firms and therefore the dependent variable is a dummy variable taking the value of 1 if the subsidiary has co-patented an invention with a firm in the host country and 0 otherwise. Finally, the last equation models the innovation outcome process; the dependent variable is the number of patents registered by the subsidiaries with the EPO. However, patents vary considerably in economic value. For this reason, we use an alternative measure of the dependent variable which is the cumulative sum of citations each patent receives (Magelssen, 2019).

Independent variables. The independent variables include the investigation variables and the control variables. The investigation variables include two institutional indicators: Anti-director rights index and the origin of the legal system. Control variables include other institutional variables (Control of Corruption and IPR index) and additional firm-level variables (previous cooperation with a partner, previous experience of inter-firm collaboration and technological distance among partners, log of employee counts, the age of the subsidiary, the number of subsidiaries in the host country controlled by the same parent company, R&D intensity, the overall R&D intensity of the subsidiaries, parent company's R&D intensity, subsidiary's leverage). Among the control variables we also include the host country GDP calculated at 1990 prices[14]. In all the specifications, we include country fixed effects as well as year and industry dummies.

[14] We have used the 1990 PPP index to deflate our GDP data.

Investigation variables. These include an indicator of the level of protection minority shareholders may have in a country and the origin of the legal system (Capron and Guillen, 2009; Globerman and Shapiro, 2003; Patnaik, 2019). We proxy the level of protection of the minority shareholders with the Anti-director rights index ranging from 0 to 6 and has been used to capture legal protection of minority shareholders. The original variable was developed by La Porta et al. (1998)[15] and it has been widely used since then (Mangena, Tauringana and Chamisa, 2012; Spamann, 2010).

The legal tradition to which the host country belongs is controlled by introducing two dummy variables that takes the value 1 if the host country's legal system belongs to the Civil Law/East European legal tradition and zero otherwise (La Porta, Lopez-de-Silanes, and Shleifer, 2008). Demirbag et al. (2017) adopt the dummy variable (common law/civil law) in their study on the the relationship between legal origin and a range of correlated indicators of social responsibility in post-socialist Central and Eastern Europe countries.

Control variables. We control also for perception of corruption in the host country as the preference for a specific type of acquisitions is influenced by the level of corruption in the host country. Our proxy for country-level corruption is the Control of Corruption Indicator (CCI), introduced by Kaufmann et al. (1999) and included in the World Bank governance indicators series. Prior studies have used this measure to account for the level of perceived corruption of a given country and to understand its impact on multinationals entry mode's choice (Mihov and Naranjo, 2019). We scale the indicator in such a way that it varies between 0 (most corrupt country) and 5 (least corrupt country). The IPR index measures the protection that countries offer to patents and copyrights. It is calculated by the Intellectual Property Rights (IPR) Alliance and made it vary between 1 (no protection) and 7 (maximum protection)[16]. For our analysis, we use the index as computed by the IPR Alliance without further manipulation. According to the Property Rights Theory (Hart and Moore, 1990) the strength of the IPR regime affects the firm-level choices of the appropriability mechanisms and hence their propensity to patent (Hagedoorn et al., 2005).

[15] As a robustness check, we use the minority shareholder protection (MSP) index (Guillén and Capron, 2016). This index measures the degree of protection of minority shareholder rights according to a list of ten basic legal provisions (e.g. prohibition on multiple voting rights, feasibility of directors' dismissal, mandatory disclosure of major share ownership). To construct this index, 52 legal scholars coded each legal provision with a score between 0 and 1, indicating its strength in each country. This led to a summed score ranging from 0 to 10.

[16] For an exhaustive explanation of how the index is computed, see IPRI (2018).

Different theoretical strands have identified a number of factors that shape the propensity of firms to enter inter-firm collaborations. We focus on the following main drivers: trust, previous cooperation with the potential partner, previous inter-firm interactions and absorptive capacity. We will now analyse each driver in detail:

Prior Cooperation. Previous interactions are important drivers of the propensity to collaborate with the same firm (Gulati, 1995). Indeed, previous collaboration allows to assess the partner's capabilities and resources and therefore helps to reduce asymmetric information among the partners. In particular, previous cooperation reduces incentives to behave opportunistically and increases trust that decreases the monitoring costs. Transaction costs scholars point out that trust helps to reduce the hold-up risk and reduces uncertainty on the behaviour of the partner (Gulati et al., 1998) Prior cooperation is particularly important to researchers in the Real Option theory as they suggest that small initial investments may help partners to understand each other's capabilities, something which is very important in an R&D collaboration (Das and Tang, 2001). To capture prior cooperation with the same firm, we construct a dummy variable taking the value of 1 if the subsidiary has already registered a patent with the same firm and 0 otherwise.

Inter-firm relationship experience. Experience in managing R&D partnerships might influence the propensity to enter a new collaboration. Indeed, experience allows to build confidence on the capabilities to manage the R&D collaboration (Billitteri et al., 2013). Importantly, this type of experience lowers the transaction costs by reducing the need for additional monitoring (Oxley and Sampson, 2004). We capture previous experience in managing inter-firm collaboration by creating a variable that takes the value of 1 if the subsidiary has already collaborated with other firms in the host country and 0 otherwise.

Absorptive capacity. If the knowledge bases of the two partners are too distant, the absorptive capacity of the two partners becomes important in ensuring a successful R&D collaboration (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998). We therefore control for the absorptive capacity of our subsidiaries. R&D intensity is our measure of absorptive capacity (Lewin, Massini, and Peeters, 2010; Rosenkopf and Nerkar, 2001; Stock, Greis, and Fischer, 2001; Veugelers, 1997).

We include the log of employee counts (to proxy for the size of the subsidiary), the age (in log) of the subsidiary as well as the number of subsidiaries in the host country controlled by the parent company. This last variable allows to control for the potential economies of scale within the

network of subsidiaries and provide a crude indicator of the resources the subsidiary can have access to through the network of subsidiaries. We also control for the subsidiary's R&D intensity and calculate the overall R&D intensity of the subsidiaries located in the host country as proxy of the possible knowledge spillovers subsidiaries can benefit from; in addition we control for the parent company's R&D intensity to proxy for the knowledge spillovers to the subsidiary. We control for subsidiary's leverage since highly leveraged companies may be less willing to bear joint R&D projects. Further, we control for the host country's market size which is captured by the host country GDP (in logs) calculated at 1990 prices[17]. In a growing market, multinationals can be expected to invest directly in the foreign market to meet their growth targets but establishing an early presence in the market may require a minority acquisition rather than a majority acquisition (Demirbag *et al.*, 2010b). In all the specifications, we include country fixed effects as well as year and industry dummies. These capture the characteristics of the sector (since the preference for a specific type of acquisitions may be driven by the main features of the industry) while country dummies control for the time-invariant characteristics of the host country which might be correlated to the MNEs' preferences in terms of types of acquisitions and control mechanisms.

3.2 Econometric Model

We have estimated our equations in a sequential fashion[18]. First, we have estimated the preference for majority acquisitions versus minority acquisitions conditional on the subsidiaries being brownfields. This first set of equations has been estimated with an Heckman-type Probit model as in Wooldridge (2002). Once this first model has been estimated, we have calculated the inverse Mill's ratio which is then included as predictor in the equation that estimates the subsidiary's propensity to collaborate with a local firm. As the dependent variable is a dichotomous variable, then this equation will be estimated with a Probit estimator. In the last step we model the innovation outcome where the number of patents is the dependent variable. The predicted value of the probability of collaborating with private companies is added to the independent variables in this equation. Since the innovation output is a count variable, ordinary least square estimates are likely to be biased and produce negative predicted values. We therefore estimate this model by using a negative binomial regression. This is a generalization of Poisson regression which loosens the restrictive assumption made by the Poisson model that the variance is equal to the mean

[17] We have used the 1990 PPP index to deflate our GDP data.

[18] We have tried to estimate the model in a simultaneous fashion using the procedure suggested by Tunali (1986) but it has produced similar results.

(Wooldridge, 2002) and therefore it is suitable for data characterized by over-dispersion or excess zeros. The Fisher test is used to check whether the econometric model is suitable for our data.

4. RESULTS

Sample selection model. Columns 1-3, Table 3 present a baseline specification of the sample selection model while Columns 4-6, Table 3 present the model enriched with the institutional variables of interest. The estimates of the first selection equation - the probability of being a brownfield - are presented in Column 1 (4) while the estimates of the second selection equation (i.e. probability of being a majority acquisition) are presented in Column 2 (5). Finally, the estimates of the outcome equation (i.e. probability of collaborating with a local company for a R&D project) are presented in Column 3 (6). The correlation coefficient between the two selection equations is significant suggesting that there are unobservable variables generating the correlation between the set of residuals. The Mills ratios are significant in both specifications suggesting that the use of the sample selection model is justified by our data.

In line with our hypotheses, we introduced the institutional variables only in the selection equation that models the MNEs' preference for majority acquisitions. We find that:

a) subsidiaries located in countries belonging to the civil law and the Eastern European legal tradition are more likely to be majority acquisitions than the baseline (i.e. subsidiaries located in Common Law countries); this result confirms the first part of H1 as we find that in countries with legal traditions different from the home country, MNEs prefer majority acquisitions to minority acquisitions.
b) The reverse holds for subsidiaries located in countries with high values for the anti-director rights index (high protection). This lends support to the first part of H2: in other words, these results suggest that parent companies prefer majority acquisitions to minority acquisitions in countries that offer poor protection of the minority shareholders' rights.

The inverse Mills' ratio calculated from this specification of the sample selection model has been added to the equation modelling the propensity to collaborate with a local firm for an R&D project. To check whether the second parts of H1 and H2 are confirmed, we need to check whether the predicted value of the inverse Mills' ratio is significant as explained above. The estimates are presented in Column 6 and show that the ratio is significant and that the coefficients do not vary significantly from those of the model estimated without the institutional variables. We

notice that the predicted value of the inverse Mills' ratio is significant confirming that the second parts of H1 and H2 hold.

As for the control variables, we consider notice that:

a) both the age of the brownfield and its size (proxied by the number of workers) are significantly and positively associated to the probability of being a majority acquisition.
b) Previous experience in collaborating with other firms in the host country is positively and significantly associated to the probability of being a majority acquisition.
c) Our measure of country-level corruption (i.e. control of corruption) is negative and significant indicating that majority acquisition investments are more likely to be located in corrupt countries.

As for the outcome equation, we notice that:

a) large and old majority acquisitions are more likely to collaborate with local firms than minority acquisitions.
b) The number of pre-existing collaborations with other organisations in the host country is positive and significant as well as the dummy variable taking the value of 1 if the subsidiary has already collaborated with the same firm in the past.
c) Our measure of absorptive capacity (i.e. the subsidiary's R&D intensity) is positive and significant lending support to the notion that technological similarity matters for a firm when deciding whether to collaborate or not with another company for an R&D project.
d) Finally, the estimates show that majority acquisitions that are more leveraged are not likely to collaborate with local firms. This is in line with our expectation that leveraged firms may not have sufficient resources to manage inter-firm R&D collaborations with potentially high sunk costs.

Innovation Equation. We next investigate Hypothesis 3 by looking at the estimates of two innovation equations where the measures of innovation outputs are: a) the number of patents registered by the majority acquisitions (Table 4, Column 1) and b) the number of their forward citations (Table 4, Column 2). The over-dispersion coefficient (α) is significant supporting the choice of the negative binomial model. In addition, the Pearson tests (reported at the bottom of Table 4) confirm the choice.

To investigate H3, we check whether the probability of collaborating with other organizations taken at its predicted values from the last specification of the sample selection model (i.e. the model with the institutional variables), is positively correlated to both dependent variables and is significant. The estimates from Table 4 confirms this is the case.

As for the control variables, we find that:

a) Firms' age has a positive effect on innovation output conditional on the probability of collaborating with an external organization, due to the generally higher propensity among established firms compared to young innovative firms.

b) The subsidiary's R&D intensity is positively associated to the number of patents it registers together with the cumulative number of patents registered in the past.

c) The IPR index has a positive and significant coefficient only in the first model suggesting that the number of patents registered by the majority acquisition is associated to the degree of protection of the intellectual property rights offered by the host country institutions. However, the variable is not significantly associated to the number of forward citations as protection of the property rights may not be sufficient to attract valuable patents to a country.

To control for the additional resources the majority acquisition may have access to by being part of a network of subsidiaries controlled by a parent company, we control for the R&D intensity of the parent company and the sum of the R&D intensity of all the subsidiaries located in the same host country. The coefficient of the former variable is positive and significant only in the first model (i.e. patents counts) suggesting that majority acquisitions tend to benefit from some internal knowledge transfer. However, the coefficient of the latter variable is negative although significant. This result may suggest that the parent company's R&D intensity and the total R&D intensity of the subsidiaries are substitute. We do not observe the same result when we control for the size of the subsidiary, proxied by its total assets. Indeed, the variable is not significant suggesting that the scale effects are already controlled by the R&D intensity variables.

5. DISCUSSION AND CONCLUSIONS

This paper has argued that when corporate governance institutions offer poor protection of the shareholders' rights, MNE may prefer ownership-based control mechanisms to mitigate some of the risks generated by the R&D collaboration. Our paper has some managerial implications. Our study is of interest to MNEs that have to consider the risks and the benefits of investing in

countries characterized by poor protection of the minority investors' rights. Our framework highlights the risks that are generated by the behaviour of the subsidiary and in this respect, it offers a novel perspective on the risks that multinationals face when investing in foreign countries. We suggest that local corporate governance institutions and ownership structure are substitute mechanisms that can mitigate this type of risk. Needless to say, ownership-based control mechanism can be costly to manage and therefore, MNEs will have to trade off the benefits that ownership offers with its costs. The paper can be extended in several directions. First, we have considered a limited number of attributes of the host country institutions but they do not cover all the institutions that may matters in the context of collaborative R&D projects. Second, the analysis can be extended by considering alternative measures of success of the collaborative R&D projects.

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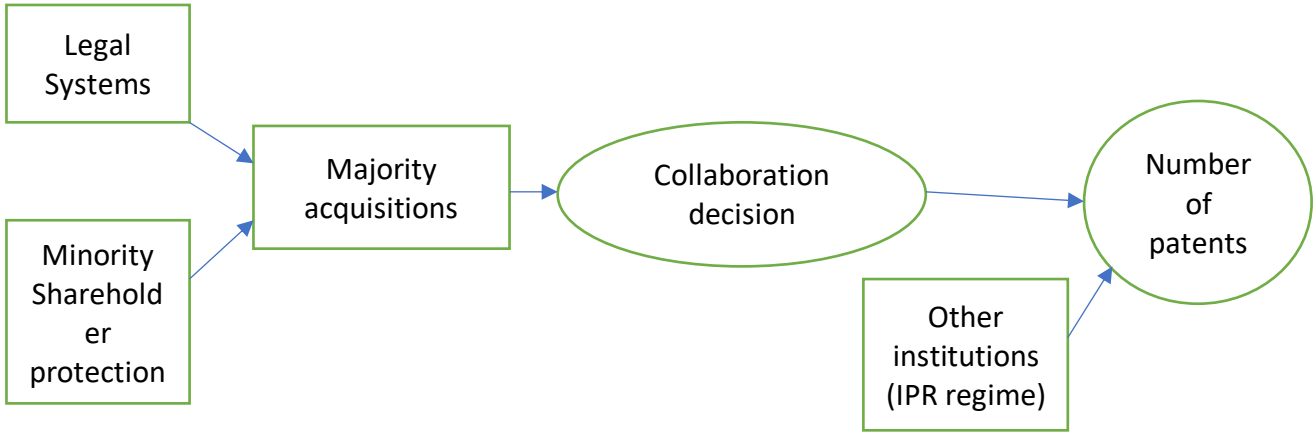

Figure 1: Conceptual Framework

Table 1. *Descriptive Statistics*

#	Variable	Label	Obs	Mean	S.D.
(1)	Majority acquisitions (1/0)	Dummy = 1 if the subsidiary is a Brownfield and the majority of its equity (>50%) is controlled by a UK MNE; =0 otherwise.	8657	.559	.497
(2)	Minority acquisitions (1/0)	Dummy = 1 if the subsidiary is a Brownfield and the minority of its equity (<50%) is controlled by a UK MNE; =0 otherwise.	8657	.42	.494
(3)	Brownfields (1/0)	Dummy = 1 if firm is a Brownfield; =0 otherwise.	8657	.979	.144
(4)	Greenfields (1/0)	Dummy = 1 if firm is a Greenfield; =0 otherwise.	8657	.015	.12
(5)	Previous collaborator (1/0)	Dummy = 1 if the firm has already collaborated with the same private company in the past; =0 otherwise.	8657	.027	.162
(6)	Age	Age of the subsidiary (in years).	8657	23.442	21.344
(7)	Employees	Number of Employees.	6393	277.37	699.81
(8)	R&D investment	R&D investment (predicted values).	6379	5.258	2.258
(9)	Number of Subsidiaries	Number of recorded subsidiaries in each host country.	8657	.823	2.236
(10)	Civil Law (1/0)	Dummy = 1 if host country belongs to the Civil law legal tradition; 0=otherwise.	8657	.601	.49
(11)	East European legal tradition (1/0)	Dummy = 1 if host country belongs the East European legal tradition; 0=otherwise.	8657	.271	.445
(12)	Anti-director index	Revised Anti-director index.	8657	3.303	.921
(13)	GDP	GDP per capita current prices in thousand US dollars.	8657	35910	18147
(14)	Control of Corruption Index	Control of Corruption Index ranging from 0 to 5.	8657	3.661	.798
(15)	Collaborating with local Organizations (1/0)	Dummy = 1 if subsidiary collaborates with a local organization (either private or public); =0 otherwise.	8657	.01	.1
(16)	Collaborating with private companies (1/0)	Dummy = 1 if subsidiary collaborates with a private firm from the host country; =0 otherwise.	8657	.054	.225
(17)	Collaborating (1/0)	Dummy = 1 if subsidiary collaborates with any kind of organization (from any country); =0 otherwise.	8657	.055	.227
(18)	Leverage	Equity / Total Assets.	7242	.157	.334
(19)	Patents	Number of patents registered by subsidiary in the financial year).	8657	4.659	84.864
(20)	Number of Citations	Cumulated sum of forward citations (by subsidiary and financial year).	8657	8.997	168.42
(21)	Total Assets	Total Assets in thousand euros.	7304	157000	1300000
(22)	IPR index	Property right index.	8657	6.849	1.259
(23)	Cumulated sum of patents (by subsidiary)	Cumulated sum of patents by subsidiary.	8657	43.554	824.64
(24)	HQ's R&D Investment	HQ's R&D investment per year.	8657	8.016	2.974
(25)	Total R&D of subsidiaries in host country	Total R&D investment of subsidiaries (pertaining to the same MNE) by each host country.	8657	103.80	134.42

Note: Authors' calculations using data sourced from the combined Amadeus and EPO database. S.D. stands for Standard Deviation.

Table 2: Pairwise correlations

#	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
(1)	1.00																								
(2)	-0.96*	1.00																							
(3)	0.17*	0.13*	1.00																						
(4)	-0.14*	-0.10*	-0.82*	1.00																					
(5)	-0.01	0.01	0.02	-0.01	1.00																				
(6)	0.07*	-0.05*	0.05*	-0.05*	0.14*	1.00																			
(7)	0.02	-0.01	0.04*	-0.03*	0.31*	0.13*	1.00																		
(8)	0.10*	-0.08*	0.09*	-0.12*	0.26*	0.29*	0.39*	1.00																	
(9)	-0.01	0.01	-0.00	-0.01	0.23*	0.23*	0.47*	0.23*	1.00																
(10)	-0.01	0.03*	0.10*	-0.15*	0.02	0.23*	-0.07*	0.30*	0.05*	1.00															
(11)	0.01	0.02	0.09*	-0.07*	-0.08*	-0.27*	0.07*	-0.31*	-0.14*	-0.75*	1.00														
(12)	0.03*	-0.08*	-0.18*	0.22*	0.00	0.01	0.03*	-0.11*	0.03*	-0.10*	-0.14*	1.00													
(13)	0.02	-0.06*	-0.15*	0.13*	0.08*	0.23*	-0.07*	0.30*	0.13*	0.44*	-0.76*	0.10*	1.00												
(14)	0.05*	-0.08*	-0.08*	0.07*	0.11*	0.22*	-0.04*	0.48*	0.09*	0.41*	-0.70*	0.13*	0.80*	1.00											
(15)	0.01	-0.01	0.01	-0.01	0.44*	0.11*	0.06*	0.14*	0.08*	0.02	-0.05*	0.02*	0.05*	0.08*	1.00										
(16)	0.10*	-0.10*	0.01	0.00	0.49*	0.16*	0.22*	0.25*	0.22*	0.04*	-0.11*	0.03*	0.14*	0.16*	0.36*	1.00									
(17)	0.10*	-0.09*	0.01	0.00	0.51*	0.16*	0.27*	0.26*	0.25*	0.04*	-0.11*	0.03*	0.14*	0.16*	0.35*	0.99*	1.00								
(18)	-0.01	0.02	0.02	-0.03*	-0.01	0.00	0.01	-0.07*	-0.00	-0.07*	0.14*	-0.09*	-0.13*	-0.12*	-0.01	-0.02	-0.01	1.00							
(19)	0.03*	-0.03*	0.01	-0.01	0.28*	0.12*	0.54*	0.25*	0.36*	-0.03*	-0.03*	0.01	0.04*	0.06*	0.02*	0.16*	0.21*	-0.01	1.00						
(20)	0.02*	-0.02*	0.01	-0.01	0.29*	0.11*	0.49*	0.23*	0.32*	-0.02*	-0.03*	0.01	0.04*	0.06*	0.03*	0.16*	0.21*	-0.01	0.84*	1.00					
(21)	0.02*	-0.02	0.01	-0.01	0.32*	0.17*	0.64*	0.28*	0.53*	-0.01	-0.05*	0.01	0.06*	0.07*	0.00	0.20*	0.26*	-0.00	0.77*	0.72*	1.00				
(22)	0.06*	-0.08*	-0.08*	0.07*	0.10*	0.22*	-0.04*	0.47*	0.08*	0.45*	-0.71*	0.12*	0.79*	0.91*	0.07*	0.15*	0.15*	-0.13*	0.05*	0.05*	0.06*	1.00			
(23)	0.04*	-0.03*	0.01	-0.01	0.27*	0.14*	0.47*	0.22*	0.38*	-0.04*	-0.03*	0.01	0.05*	0.06*	0.02	0.19*	0.21*	-0.01	0.68*	0.66*	0.89*	0.05*	1.00		
(24)	0.07*	-0.05*	0.05*	-0.04*	0.12*	0.19*	0.20*	0.30*	0.13*	0.07*	-0.12*	-0.02	0.11*	0.08*	0.07*	0.16*	0.16*	-0.03*	0.08*	0.07*	0.15*	0.09*	0.09*	1.00	
(25)	0.01	0.01	0.08*	-0.07*	0.11*	0.17*	0.13*	0.24*	0.09*	0.00	-0.01	-0.09*	0.02*	0.01	0.07*	0.08*	0.09*	-0.00	0.04*	0.04*	0.10*	0.02*	0.04*	0.66*	1.00

* shows significance at the .05 level

Note: The Pearson test has been used to test the significance of the correlation coefficients. Significant at ***1% level; **5% level; *10% level.

Table 3. *Modelling the propensity to collaborate with local firms conditional on being a majority acquisition and a brownfield. Sample Selection Model.*

		(1)			(2)	
Variables	Brownfields	Majority acquisitions (1/0)	Collaborating with private companies (1/0)	Brownfields	Majority acquisitions (1/0)	Collaborating with private companies (1/0)
IMR1			-0.549***			
			(0.742)			
IMR2						-0.548***
						(0.156)
Log AGE	0.347***	-0.100***	-0.078	0.328***	-0.110***	-0.077
	(0.052)	(0.022)	(0.061)	(0.056)	(0.023)	(0.061)
Log Employees	0.080**	0.030**	0.210***	0.100***	0.031**	0.215***
	(0.036)	(0.014)	(0.078)	(0.036)	(0.014)	(0.077)
Number of subsidiaries	-0.020	-0.008	0.065***	-0.031	-0.013	0.066***
	(0.020)	(0.008)	(0.014)	(0.022)	(0.008)	(0.014)
Civil Law (1/0)					1.340***	
					(0.222)	
East European legal tradition (1/0)					0.920***	
					(0.201)	
Anti-director index					0.387***	
					(0.081)	
Log GDP	0.083			0.102		
	(0.145)			(0.156)		
Control of Corruption	-0.961***			-1.017***		
	(0.096)			(0.098)		
R&D intensity			0.240**			0.234**
			(0.093)			(0.091)
Collaborating with local organizations (1/0)	3.698***		1.699***	3.698***		1.699***
	(0.323)		(0.408)	(0.356)		(0.408)
Previous Collaborator (1/0)			2.547***			2.548***
			(0.191)			(0.191)
Leverage			-0.309**			-0.312**
			(0.153)			(0.153)
Constant	2.762**	-0.061	-6.783***	2.759**	-2.287***	-6.775***
	(1.262)	(0.115)	(0.742)	(1.388)	(0.395)	(0.738)
Correlation coefficient	-0.753**			-1.199*		
	(0.313)			(0.670)		
Obs.	6379		5409	6379		5409
Year dummies	yes		yes	yes		Yes
Industry dummies	yes		yes	yes		Yes
Country dummies	yes		yes	yes		Yes
VIF	1.87	1.33	1.80	1.87	3.10	1.80

Note: Standard errors clustered around the host country. Significant at ***1% level; **5% level; *10% level.

Table 4. *Modelling innovation outcomes. Negative Binomial Model.*

Models	**(1)**	**(2)**
Variables	Patents	Cumulated Sum of Forward Citations
Cumulated sum of patents (by subsidiary)	1.214***	1.692***
	(0.030)	(0.063)
HQ's R&D Intensity	0.041**	0.038
	(0.020)	(0.040)
Total R&D intensity of subsidiaries in host country	-0.001***	-0.002**
	(0.000)	(0.001)
R&D intensity	0.063*	0.143*
	(0.038)	(0.075)
IPR index	0.176**	-0.152
	(0.079)	(0.136)
Log AGE	-0.229***	-0.186*
	(0.049)	(0.099)
Log Total Assets	-0.019	-0.044
	(0.033)	(0.068)
Predicted probability of Collaborating (Model 2)	1.057***	1.510***
	(0.093)	(0.222)
Constant	-5.150***	-6.454***
	(0.610)	(1.153)
Alpha	-0.021**	2.031***
	(0.0084)	(0.089)
Obs.	5409	5409
Year dummies	yes	yes
Country dummies	yes	yes
Industry dummies	yes	yes
Pearson chi2	7810.92***	69228.04***

Note: Standard errors clustered around the host country. Significant at ***1% level; **5% level; *10% level. Pearson chi squared for overdispersion Hilbe (2011).

APPENDIX A

Data-set

BvD Amadeus provides annual financial accounting information for over 10 million companies across Europe[19]. The annual data include 24 balance sheet items, 25 profit and loss account items, and 26 ratios. Amadeus company level information includes international identifiers such as Eurostat NACE codes which cluster companies by industry sector. These data also provide geographic information; using the 2-digit country ISO code allowing us to match countries to listed companies. To construct our working sample, we start by identifying all UK-based manufacturing firms listed in Amadeus through their NACE codes[20]. For each firm, Amadeus records whether it owns foreign firms (i.e. firms based outside the UK) and how much it owns of the foreign firm. Importantly, Amadeus assigns a unique identifier to each of these subsidiaries allowing us to download from the database additional information about the subsidiaries such as their size, location and their accounts. Through this process, we were able to identify 1845 subsidiaries located in 39 (non-UK) countries. Finally, we have created an indicator that allows us to identify whether the subsidiary is an acquisition or a greenfield. This indicator is constructed by combining information on foreign ownership, date of establishment of the company and size of the foreign stake in the company. Following the US International Trade Commission (1989) and previous research on entry mode (Belderbos, 2003), a newly established company fully owned by a foreign company since its inception is classified as a greenfield while an established company bought by a foreign company is classified as a brownfield (or acquisition). Minority acquisition are then defined as those brownfields that are only partially controlled by the foreign owner (size of the foreign stake is less than 50%) while majority acquisitions are brownfields whose foreign stake is above 50%.

Patent data refer to the patents registered with the EPO and are sourced from the Worldwide Patent Statistical Database (PATSTAT). This includes patents from 81 national and international patent offices, detailed information on patents published in the EU, and citations from EPO to non-EPO patents i.e. backward and forward citations to other world patents. In addition, it

[19] The dataset covers the following countries: Albania, Austria, Bosnia and Herzegovina, Belgium, Bulgaria, Belarus, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, United Kingdom, Greece, Croatia, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Latvia, Republic of Moldova, Macedonia (Fyrom), Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Russian Federation, Sweden, Slovenia, Slovakia, Turkey, Ukraine.

[20] The NACE codes for manufacturing firms range between 11 and 33.

includes information on the organizations to which the patent is assigned, the application and registration date, the technological sector of the invention and the inventors' names. A patent can be the result of an individual firm's R&D activity or the result of a collaborative project involving two or more firms. In the latter case, all the companies involved are included in the patent documents which allows us to trace whether the patenting company has collaborated to obtain a patent. BvD has matched the patent data from EPO to the firm-level data listed in Amadeus; as a result, it is possible to have a list of all the patents registered by both our parent companies and their subsidiaries together with the organizations they have developed the innovation with (which is co-patenting as well) and their location. A patent that is registered with the EPO by two or more assignees is considered to be a joint patent. For a patent to be in our sample, one of his assignees must be a subsidiary of our UK MNEs. The second or third assignee can be an external organization. If the patents' documents report no co-patenting organization, then we assume that the invention has not been developed as a result of inter-firm collaboration. Importantly, co-patenting organizations may include both private and public organizations (such as universities or research institutes) and therefore, we take care of splitting them into two groups: private co-patenting organizations (that include only private companies) and public co-patenting organizations (including universities and research institutes)[21]. For our analysis, we focus only on co-patenting organizations from the private sector located in the same country as the subsidiary. Data on the host-country institutions have been collected from the World Bank 'Governance Matters' data compiled by Kaufmann *et al.* (2005, 1999) while data on the host-country Intellectual Property Rights have been sourced from the Property Rights Alliance[22].

Dependent variables

We have four dependent variables for each of the four equations we plan to estimate. The first equation models the MNE's preference for brownfields (as opposite to greenfields). In this case, the dependent variable is a dummy variable taking the value of 1 if the subsidiary is a brownfield and 0 if the subsidiary is a greenfield. This dependent variable has been created following the procedure detailed in the previous section. The second equation models the MNE's preference for majority acquisitions against minority acquisitions and so the dependent variable is a dummy variable taking the value of 1 if the subsidiary is a majority acquisition and 0 if it is a minority

[21] This sorting process has been done by matching the name of the organization to the list of firms included in Amadeus in the first instance. If this first step was inconclusive with respect to the nature of the collaborating organization, we have used information sourced from Internet to be able to identify the nature of the co-patenting organization.

[22] These data are freely available at https://internationalpropertyrightsindex.org/.

acquisition. The third equation models the subsidiary's propensity to join collaborative R&D projects with local firms and therefore the dependent variable is a dummy variable taking the value of 1 if the subsidiary has co-patented an invention with a firm in the host country and 0 otherwise. Previous work on inter-firm R&D collaboration uses data from patent such as co-inventorship, co-assignees, or citations, as measures of cooperation (Hagedoorn, 2003; Hicks and Narin, 2001; Jaffe et al., 1993; Narin et al., 1997). Finally, the last equation models the innovation outcome process with the innovation output being the number of patents registered by the subsidiaries with the EPO. Patents represent exclusive rights to a particular invention (Hsu *et al.*, 2015; Dernis, 2007; Griliches, 1990) and therefore prior studies in International Business, corporate governance and innovation literature, have used patents counts as a proxy for the number of inventions (Almeida and Phene, 2004; Magelssen, 2019; Pavitt, 1994; Phene and Almeida, 2008). However, we are aware of the evidence suggesting that not all patents are equally important and that patents vary considerably in economic value. For this reason, we want to control for the success of the patentable inventions. To do so, we used the cumulative sum of citations each patent receives as an alternative measure of the innovation output. This is a standard approach in the literature (Jaffe, and Trajtenberg, 2002): for example, in her recent paper, Magelssen (2019) used this measure to proxy for the quality of innovation.

Independent variables

Institutional Indicators. These include an indicator of the level of protection minority shareholders may have in a country and the origin of the legal system (Capron and Guillen, 2009, Choi, Lee, and Shoham, 2014; Fang, Hasan, Leung, and Wang, 2019; Globerman and Shapiro, 2003; Patnaik, 2019). We proxy the level of protection of the minority shareholders with the Anti-director rights index which was first proposed by Djankov et al. (2008). The index ranges from 0 to 6 and has been used to capture legal protection of minority shareholders. The original variable was developed by La Porta et al. (1998)[23] and it has been widely used since then (Belev, 2003; Mangena, Tauringana and Chamisa, 2012; Spamann, 2010). For instance, Fang et al. (2019) employed the anti-director right index proposed by Djankov et al. (2008) in his study about how foreign ownership shapes bank information environments.

[23] As a robustness check, we use the minority shareholder protection (MSP) index (Guillén and Capron, 2016). This index measures the degree of protection of minority shareholder rights according to a list of ten basic legal provisions (e.g. prohibition on multiple voting rights, feasibility of directors' dismissal, mandatory disclosure of major share ownership). To construct this index, 52 legal scholars coded each legal provision with a score between 0 and 1, indicating its strength in each country. This led to a summed score ranging from 0 to 10.

The legal tradition to which the host country belongs is controlled by introducing two dummy variables that takes the value 1 if the host country's legal system belongs to the Civil Law/East European legal tradition and zero otherwise. The binary measure we used follows the logic of recent studies that have been using this to describe the legal origin of countries (La Porta, Lopez-de-Silanes, and Shleifer, 2008). The rationale for this measure relies on the assumption that the legal origin of countries imposes a certain unity on rules and practices adopted locally (Patnaik, 2019 ; Liu et al., 2019; Breuer et al., 2018; Fauver et al., 2003). Demirbag et al. (2017) adopt the dummy variable (common law/civil law) in their study on the the relationship between legal origin and a range of correlated indicators of social responsibility in post-socialist Central and Eastern Europe countries.

Other institutional variables. We control also for perception of corruption in the host country since several studies find that entry mode choice is influenced by the level of corruption in the host country. Our proxy for country-level corruption is the Control of Corruption Indicator (CCI), introduced by Kaufmann et al. (1999) and included in the World Bank governance indicators series. The CCI reflects the perception of the extent to which public power is exercised for private gain including both petty and grand forms of corruption, and also 'state capture' by elites and private interests. Prior studies have used this measure to account for the level of perceived corruption of a given country (Choi et al., 2014) and to understand its impact on multinationals entry mode's choice. For example, Mihov and Naranjo (2019) study on the effects of institutional quality on financial markets, adopts country-level indicators, including the Control of Corruption index. Similarly, Mihov and Naranjo (2019) use the World Bank database and its measures (including the Control of Corruption index) to describe the subsidiary country level institutions. We scale the indicator in such a way that it varies between 0 (most corrupt country) and 5 (least corrupt country). The IPR index measures the protection that countries offer to patents and copyrights. It varies between 1 (no protection) and 7 (maximum protection). According to the Property Rights Theory (Hart and Moore, 1990) the strength of the IPR regime affects the firm-level choices of the appropriability mechanisms and hence their propensity to patent (Hagedoorn et al., 2005).

Additional independent variables. Different theoretical strands have identified a number of factors that shape the propensity of firms to enter inter-firm collaborations. We focus on the following main

drivers: trust, previous cooperation with the potential partner, previous inter-firm interactions and technological distance among partners. We will now analyse each driver in detail:

Prior Cooperation. Previous interactions are important drivers of the propensity to collaborate with the same firm (Gulati, 1995). Indeed, previous collaboration allows to assess the partner's capabilities and resources and therefore helps to reduce asymmetric information among the partners. In particular, previous cooperation reduces incentives to behave opportunistically and increases trust that decreases the monitoring costs. Transaction costs scholars point out that trust helps to reduce the hold-up risk and reduces uncertainty on the behaviour of the partner (Dyer and Singh, 1998; Gulati et al., 2000) Prior cooperation is particularly important to researchers in the Real Option theory as they suggest that small initial investments may help partners to understand each other's capabilities, something which is very important in an R&D collaboration (Das and Tang, 2001; Huang and Cantwell, 2008). To capture prior cooperation with the same firm, we construct a dummy variable taking the value of 1 if the subsidiary has already registered a patent with the same firm and 0 otherwise.

Inter-firm relationship experience. Experience in managing R&D partnerships might influence the propensity to enter a new collaboration. Indeed, experience allows to build confidence on the capabilities to manage the R&D collaboration (Kale and Singh, 2007). Importantly, this type of experience lowers the transaction costs by reducing the need for additional monitoring (Oxley and Sampson, 2004). We capture previous experience in managing inter-firm collaboration by creating a variable that takes the value of 1 if the subsidiary has already collaborated with other firms in the host country and 0 otherwise.

Technological distance. Dissimilarities between core knowledge of potential partners may make them more likely to cooperate (Billitteri et al., 2013). However large technological distance implies they have limited ability to cooperate into a project that may require competencies which are different from the firm's core knowledge (Oxley and Sampson, 2004). This issue is typically related to the absorptive capacity of firms: indeed, if the knowledge bases of the two partners are too distant, the absorptive capacity of the two partners becomes important in ensuring a successful R&D collaboration (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998). R&D intensity is our measure of absorptive capacity. Cohen and Levinthal's (1990) concept of absorptive capacity suggests that a firm's ability to assimilate and integrate new technological knowledge is strongly associated with its past R&D activity. Scholars tend to agree with this argument and a number of relevant studies have adopted this measure to proxy for firms' absorptive capacity (Lewin, Massini,

and Peeters, 2010; Rosenkopf and Nerkar, 2001; Stock, Greis, and Fischer, 2001; Veugelers, 1997; Wenpin, 2001).

Control variables. We use a number of control variables. We include the log of employee counts (to proxy for the size of the subsidiary), the age (in log) of the subsidiary as well as the number of subsidiaries in the host country controlled by the parent company. This last variable allows to control for the potential economies of scale within the network of subsidiaries and provide a crude indicator of the resources the subsidiary can have access to through the network of subsidiaries (c.f. Belderbos, 2003). We also control for the subsidiary's R&D intensity and calculate the overall R&D intensity of the subsidiaries located in the host country as proxy of the possible knowledge spillovers subsidiaries can benefit from; in addition we control for the parent company's R&D intensity to proxy for the knowledge spillovers to the subsidiary. We control for subsidiary's leverage since highly leveraged companies may be less willing to bear joint R&D projects. Further, we control for the host country's market size which is captured by the host country GDP (in logs) calculated at 1990 prices[24]. In a growing market, multinationals can be expected to invest directly in the foreign market to meet their growth targets but establishing an early presence in the market may require a minority acquisition rather than a majority acquisition (Demirbag *et al.*, 2010a; 2010b). In all the specifications, we include country fixed effects as well as year and industry dummies. These capture the characteristics of the sector (since the preferred specific entry mode may be driven by the main features of the industry) while country dummies control for the time-invariant characteristics of the host country which might be correlated to the MNEs' preferences in terms of entry mode and control mechanisms.

[24] We have used the 1990 PPP index to deflate our GDP data.