



**FDI entry modes, development
and technological spillovers**

Isabel Álvarez

Raquel Marín

Franciso J. Santos-Arteaga

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Resumen

La literatura económica sobre inversión directa extranjera (IDE) en países en desarrollo se centra fundamentalmente en los incentivos que llevan a los productores locales a incurrir en los costes de desarrollo tecnológico requeridos para poder formar parte de la red de proveedores de las empresas multinacionales (EMN). Sin embargo, se ha prestado hasta ahora poca atención a las interacciones estratégicas que se derivan de los potenciales derrames tecnológicos (recíprocos) entre las empresas locales y las subsidiarias de las EMN, exceptuando el reciente trabajo teórico de Sanna-Randaccio y Veugelers (2007). Este vacío en la literatura se justifica mediante las diferencias tecnológicas que existen entre las empresas locales y las EMN, asumiéndose que estos dos tipos de empresas producen para mercados independientes y no compiten directamente. Si ese fuera el caso, la forma de entrada de las EMN en países en desarrollo sería independiente del nivel de desarrollo de los mismos. Este trabajo rechaza dicha simplificación e ilustra de manera empírica cómo las formas de entrada dependen del nivel de desarrollo de los países receptores de la IDE. Asimismo, este resultado empírico se justifica mediante una propuesta teórica que generaliza el modelo de Sanna-Randaccio y Veugelers (2007). Nuestra extensión tiene en cuenta todos los posibles equilibrios definidos *conjuntamente* por las estrategias de *las EMN y las empresas locales*, lo cual permite analizar los equilibrios no derivados en un análisis parcial al tiempo que proporciona una explicación de equilibrio general a la evidencia obtenida previamente.

Palabras clave: Empresas multinacionales, derrame tecnológico, países en desarrollo, formas de entrada.

Abstract

Most of the literature related to foreign direct investment in developing countries focuses on the incentives of local producers to incur in the technological development costs required to act as suppliers of multinational companies (MNC). Scarce attention has been paid to the strategic interactions derived from the potential (reciprocal) technological spillovers between local firms and MNC subsidiaries, with the recent exception of the theoretical model by Sanna-Randaccio and Veugelers (2007). Such a void in the literature is justified on the technological differences between MNC and local firms, assuming that both of them produce for totally independent markets under no direct competition conditions. If this were the case, MNC entry modes in underdeveloped countries should be independent of their level of development. We reject such a simplification illustrating empirically how entry modes depend on the development level of a given host country. Besides, this finding is justified with a theoretical proposal that generalizes the Sanna-Randaccio and Veugelers (2007) model. Our extension accounts for all the possible equilibrium scenarios *jointly* defined by the strategies of *both the MNC and the local firms*, which allows us to consider the equilibria ignored in a partial analysis and to provide a general equilibrium explanation for the evidence presented.

Key words: Multinacional companies, technological spillovers, developing countries, entry modes.

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Isabel Álvarez

Grupo de Investigación en Economía y Política de la Innovación. Instituto Complutense de Estudios Internacionales y Departamento de Economía Aplicada II

Raquel Marín

Profesora del Departamento de Economía de la Empresa.

Facultad de Económicas.

Universidad Europea de Madrid.

Franciso J. Santos-Arteaga

Universidad Complutense de Madrid

Campus de Somosaguas, 28223-Pozuelo

e-mail: FSantosArteaga@unibz.it

Instituto Complutense de Estudios Internacionales, Universidad Complutense de Madrid. Campus de Somosaguas, Finca Mas Ferre. 28223, Pozuelo de Alarcón, Madrid, Spain.

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1 Introduction

The *so-called* globalisation phenomenon has not substantially modified the behaviour of foreign direct investment (FDI) worldwide. The main observable changes are related to the greater variety of FDI entry modes, the benefits that FDI may generate in locations and the more diverse forms of interaction with local economies. One of the key propositions of this paper is to consider the absorptive capacities of firms as a crucial aspect for understanding the evolution of FDI flows in developing countries, underlying the diversity of MNC entry modes and the consequences that R&D decentralization decisions may have in the generation of reciprocal technological flows with local units.

The motives for FDI can differ according to the development level of countries, as is also the case with local factors for the attraction of foreign capital flows. In fact, international inequalities persist and despite the raise of FDI flows, the activities of MNC are still regionally concentrated in the most developed countries (Rugman and Doh, 2008). However, there has been recently a certain shift in the direction of investments, confirming that developing countries are also entering the global scene. Besides, cross-border mergers and acquisitions (M&A) have experienced a notable increase during the last decades and, although these operations are also mainly concentrated in developed countries, developing countries are gaining some ground in this general trend too (UNCTAD, 2005; 2007).

Then, taking into account the geographical reorientation of FDI flows as well as the level of interaction with local economies of the different entry modes, our empirical target is to explore the conditioning factors of FDI behavior in a multi-country analysis. The question is to what extent the shift in the types of FDI operation responds to a set of determinants, already agreed in the economic literature and development studies, as well as to other more qualitative aspects; in particular, we include the effects of the institutional framework and the absorptive capacities of firms as factors affecting FDI attraction in countries with dissimilar levels of development. Previous evidence in the literature has confirmed, first, that FDI may contribute to the local upgrading of host economies; second, that the kind of technological strategies of MNC may determine the existence and size of spillover effects; and third, that, regarding FDI entry modes, M&A show a higher level of interaction with local productive systems.

The available empirical evidence also tells us that some driving forces are common to both *greenfield* FDI and M&As, whereas different effects in host economies may derive from the two modes of entry. It is generally assumed that local conditions in terms of factor costs, market structure, human skills and regulatory frameworks are determinant factors for the attraction of foreign investments. However, we will justify that the explanatory capacity of these local assets as determinants of inward investments could differ between developed and developing countries. Moreover, technological upgrading is one of the positive effects

that both *greenfield* and M&A operations may generate in host economies. Our hypothesis relates to the fact that their impact depends on the countries' level of development and the decisions of both foreign firms and local units.

Data from a broad sample of both developed and developing countries, over a time span of seven years, enable us to carry out panel data estimation for the two entry modes. The results of this empirical model are justified with a theoretical proposal based on the model of Sanna-Randaccio and Veuglers (2007). We extend the set of entry games developed by these authors in order to account for all the possible equilibrium decentralization scenarios jointly defined by the strategies of *both* the MNC *and* the local firms. In particular, the extended set of entry games defines a general equilibrium framework illustrating the strategic optimality of the empirical evidence presented in the current paper regarding MNC entry modes. The corresponding set of equilibria derives from the intensity of the information flows and knowledge spillovers taking place among the local, subsidiary and multinational firms.

The next section is devoted to the literature background. Section three includes the empirical analysis, containing some data, descriptive statistics as well as the econometric model and the results from the estimations. Section four introduces our theoretical proposal, while Section five fixes the required notations and basic assumptions. The set of games and our main theoretical results are developed through Section six. Section seven concludes the paper and suggests future lines of research.

2 Literature Background

The activities of multinational companies abroad may play a fundamental role in the relationship between the international generation and diffusion of knowledge, and welfare improvements. Following the spillover literature that explores the effects that FDI is able to generate in local productive systems, it is agreed that technological change may be manifested in host locations by different means: the increase of competition due to the presence of foreign-owned firms, the corresponding demonstrative effects as well as the mobility of a highly skilled labour force. Nonetheless, there is no strong support for the positive external effects that MNC subsidiaries should generate and, to the contrary, the empirical evidence is mixed and differences among countries are found (Kokko, 1992; Blomström & Kokko, 1998; Perez, 1998; Aitken & Harrison, 1999; Álvarez & Molero, 2005). Moreover, an important part of the extended body of empirical research confirmed that the effects are smaller in LDC due to the existence of a threshold level for the generation of externalities; this would imply that countries need a certain level of education, technology, infrastructures and health to benefit from investment flows (OECD, 2002). In particular, the literature has remarked that

FDI enhancing growth requires a minimum threshold of domestic capabilities (Borensztein et al., 1998); i.e. although the relevance of human capital differs according to industries, it constitutes a basic condition for the upgrading of domestic capabilities from FDI. Technology transfer from MNCs may generate positive impacts in host economies in several ways and the size of the gap between domestic and foreign units may become an important element when assessing them.

Furthermore, according to recent trends, some middle-income and low-income countries are revealing an important growth potential in the world economy, becoming more attractive for foreign investors and active players as investors as well (Meyer, 2004; Wright et al., 2005). In this sense, a clear distinction is to be made between the more backward countries -mainly located in Africa- and those with a large potential that are actively gaining ground in the international context; such as China, India, Malaysia or Indonesia among others. In fact, a study in a multi-country model of the effects of technological transfers from USA MNC confirms the existence of some conditional local factors. Positive and significant effects were detected for developed countries but not for LDC, and human capital levels played a crucial role (Xu, 2000). Moreover, an analysis based on Latin American countries by Mortimore and Vegara (2004) shows that the nature of FDI and its effects depend on technological capacities, human capital thresholds and supplier capabilities in the host country, defining a minimum level of capability threshold to benefit from technology diffusion from the MNC.

It is also known that positive effects in terms of knowledge spillovers are dependent on the types of activities carried out by MNC subsidiaries; for instance, whether they are oriented to production or to R&D activities in the host location. In this sense, MNC are increasingly becoming multi-centric firms and it is important to distinguish between competence creating and competence exploiting mandates of subsidiaries (Cantwell & Mudambi, 2005). A special case of this framework has been the conception of *home base exploiting* strategies, which implies the exploitation of technological advantages a firm has in its domestic activity, and *home base augmenting*, in which the bulk of the activity is oriented to increasing the technological basis through the incorporation of other created assets available in advanced foreign countries (Kuemmerle, 1999). Nonetheless, the subsidiaries are increasingly exploiting competencies from all over the firms network and often try to create entirely new competencies. In addition, differences could arise if time and geographical dimensions are taken into consideration. In fact, the evolution of firms strategies in foreign countries changes over time, becoming more integrated with local firms and institutions (Pearce, 1999). On the other hand, they also change due to the cumulative character that the presence of FDI generates in the local economies and how it provides incentives for new inward FDI (Mudambi, 1995). Firms often prefer to invest in countries in which they are already active because the experience in locations increases the likelihood of their foreign investment activities (Davidson, 1980).

Regarding different entry modes in cross-border M&As, firms consider various local conditions in the host economy, including those related to domestic firms and factors at both industry and country levels: Factors such as capital, labour, natural resource endowment as well as institutional variables – legal, political and cultural environments – are all significant (Shimizu et al, 2004; Globerman & Shapiro, 2002). Indeed, a major focus of research in this line of the literature is related to market growth in host countries, cultural idiosyncrasies between home and host countries and the specific culture of acquiring firms. Empirical findings confirm that market growth, cultural proximity and low uncertainty are factors that increase the likelihood of entry via M&A (Kogut & Singh, 1988; Brouthers & Brouthers, 2000; 2003; Chang & Rosenweig, 2001). When country differences are substantial, multinational companies tend to set up new ventures rather than acquiring existing firms (Xu & Shenkar, 2002). Empirical evidence also provides support to the idea that MNC are more likely to choose acquisitions when the geographic scope of the subsidiarys mandate is broad and when the MNC has a greater multinational experience (Mudambi & Mudambi, 2002). The chosen entry mode is also likely to have an impact on vertical linkages in the host economy and acquired affiliates are likely to have a higher local content, given their pre-acquisition *embeddedness* in the host economy as locally owned firms (Belderbos et al., 2001). Moreover, entry modes could also affect the extent of knowledge transfer since the investment size and the subsidiarys role vary with it. In this sense, Yang et al. (2008) explore the determinants of conventional and reverse knowledge transfer in three transition economies in Central and Eastern Europe (CEE) and find the existence of some significant country effects.

Finally, MNC are able to provide new production facilities, managerial practices and also technology transfers to host locations; however, there can be reverse flows to foreign subsidiaries since firms strategies aim at tapping into new knowledge in host locations as well (Cantwell, 1989; 1995; Barkema & Vermeulen, 1998; Frost, 2001; Piscitello, 2004; McCann & Mudambi, 2005; Singh, 2007; Mudambi, 2008). The corresponding micro foundations relate to the firms decision on whether to centralise or decentralise key activities such as R&D through its subsidiaries (Sanna-Randaccio, 2002). When the latter choice prevails, it is plausible to wonder about the existence of international technological flows in both directions, from the parent to the subsidiary and vice versa, as well as the main determinant factors of such a process. Indeed, there are exceptionally few formal essays that underline some organisational implications for companies benefiting from interaction with host productive systems when choosing to decentralise (Sanna-Randaccio & Veugelers, 2007). Besides, the choice of location depends on the changing strategies of MNC, whether subsidiaries are assigned as a particular competence mandate or whether they behave according to the new geography of value chain activities (Cantwell & Mudambi, 2005; Mudambi, 2008). In this sense, new contributions to the comparative analysis of performance between *greenfield* and acquisitions include both internal and external integration levels of subsidiaries (Slangen &

Hennart, 2008).

In short, FDI constitutes a crucial factor for international technology diffusion. It may be a channel of access to international markets through the dynamics of trade and it may also permit the extension of productive systems in which MNC operate. These literature findings provide us with a basic framework to support our integrative approach of differentiated local determinant factors for the attraction of FDI and cross-border M&A, and to illustrate how the observed MNC entry modes are the optimal consequence of an strategic environment in which *both* the MNC and local firms interact.

3 Empirical Analysis

3.1 Data Description

We have assisted to a notable raise of FDI flows since the 1980s that together with trade flows have remarkably contributed to the internationalization process of the world economy. This has affected both the behaviour and growth of international production and markets if we take into account that foreign capital stock has achieved nowadays around 20 per cent of world GDP. The strength of direct investment flows is greater for cross-border M&As than for *greenfield* operations since an overwhelming percentage of FDI currently takes place through the former type of investments (UNCTAD, 2003; 2007). As recent data from UNCTAD reveal, there has been a rebound in FDI after three years of declining. Although the evolution of the different entry modes of FDI followed similar trends during the 1990s, there was a spectacular rise in the value of M&As in the second half of the decade (refer to Graph 1).

The world distribution of FDI is not uniform and, on the contrary, this is a field in which inequalities still persist. Nonetheless, flows to developing countries and the transition economies attained their highest levels ever while the rise of FDI from developing and transition economies and the growth of South-South FDI are important recent trends (UNCTAD; 2007). The rationale is that to maximise their competitive advantages TNC are trying to combine the comparative advantages of geographic location with their own resources and competencies. For this reason, firms are leveraging knowledge from dispersed foreign subsidiaries at a global scale (Piscitello, 2004; McCann & Mudambi, 2005). Appealing to their high value-added activities, firms from advanced countries relocate the more standardised activities of the value chain in emerging economies, defining the potential for the generation of spillovers. On the other hand, in response to different incentives, firms from emerging market economies such as Mexico, India, China and Brazil are trying to catch-up locating their R&D and marketing operations in advanced market economies (Mudambi, 2008). The direction of international M&A appears to be predetermined, firstly, by industrial and busi-

ness features of the recipient economy and this makes it sufficiently viable to think that the existence of local firms worth buying by foreigner investors is a key determinant for cross-border M&A. There must exist valuable acquisition targets in the host economy for successful cross-border M&A to occur and this reason would explain that this FDI entry mode is less frequent in the poorest developing countries. Secondly, changes in the institutional and regulatory environment, such as the development of capital markets and the power of law in host economies, can be seen as another powerful determinant of the evolution of M&A. Finally, the potential for economic growth, the dynamism of the domestic markets and the regional integration processes are also considered factors fostering M&A.

The existence of worldwide differences in the behaviour of FDI can be observed through the level of development across countries. We use World Bank criteria for the classification of countries according to GDP per capita income variable in three different groups. We make calculations of some basic statistics for both developed countries integrated in the high income level group and developing countries, which are divided into two different groups: upper-middle and lower-middle economies¹ in Table I. The determinants of both *greenfield* and cross-border M&A as types of FDI entry modes differ according to the features of host economies. Thus, we address the relationship between FDI and national systems of innovation through the combination of two different components. One refers to FDI flows, that is to say, it does not differentiate how long foreign capital remains in the host economies, or the qualitative nature of the investment flows. The second is more related to the involvement of foreign capital as measured by the annual volume of cross-border M&A, integrating a point of view based on the higher degree of interaction that investments through M&A generate in host economies (Xu, 2000). The impact on the host economies can vary with the different FDI entry modes, since acquired affiliates have a higher local content.

Looking at the descriptive side, developing countries are not an homogeneous group of economies and the diversity among them is clearly observable; the heterogeneity between groups is more noticeable in some variables than in others and also intra-group differences arise for some countries with similar income levels. It can be noted that developing countries (lower and upper middle income) present similar mean values in inward FDI flows whereas the other group shows a notable higher value Table I. The highest dispersion in this indicator corresponds to the group of least developed economies. On the other hand, regarding the profile describing the variable M&A, it is remarkable that the most developed countries are less heterogeneous whereas the highest value of the coefficient of variation in cross-border M&A corresponds to lower-middle income countries, demonstrating the notable diversity in

¹We have added India to the lower-middle group because of its economic magnitude while we discarded a group of low income countries due to several reasons of data availability and the low dynamic impact of FDI in these economies. The list of countries as well as the country groups can be found in the Appendix -Table 1A-.

the behaviour of these operations within the least developed economies considered.

The descriptive statistics also show that the accumulation of foreign capital, measured by the FDI stock in host economies, shows large inter-group differences. Likewise, there exists still a significant difference in the level of salaries in developed economies when compared to the developing world – notably higher in the former group when we consider the relative internal market size of the different groups of countries. Developed economies present a higher mean value than middle-income economies and the dispersion is also higher in the highest income group. The opposite is derived from the dynamism of the market, revealing largest mean values for the countries with the least level of development, although the dispersion of the variable distribution is also larger for them.

The differences between developed and developing countries are even more marked when qualitative local factors of FDI attraction are considered, such as the educational level and R&D intensity Table I. Two important factors defining the existing gap between high-income countries and the others are the indicators of human capital and absorptive capacities (Álvarez & Magaa, 2007). However, in aspects such as the openness level of both high and upper-middle income countries, the averages for these two groups are very similar, even larger for the latter group, with a greater dispersion in the former. With respect to institutional stability, it is not surprising that the statistics obtained reveal the existence of a large gap between developed and developing worlds. The mean values for the countries integrated in the lower-middle income group define the lowest stability and regulatory framework, and even become negative. In short, these statistics illustrate the extreme heterogeneity of the developing world, here represented by 43 countries, as well as the potential and the weaknesses that countries belonging to the middle-income group have for catching-up in the economic globalisation process (Durlauf & Johnson, 1995; Álvarez & Magaa, 2007; Castellaci, 2008).

3.2 Empirical Model

In this paper, the empirical analysis aims at examining whether cross-border M&As as a mode of entry may denote a higher interest in the productive system of host economies, assuming first, that there must exist valuable acquisition targets in the host economy, and second, that this FDI type will imply a greater interaction with domestic capabilities than *greenfield* investments. Therefore, the aim is to relate the level of development of countries to the type of FDI they receive. Our hypothesis is that there exists a threshold effect on the level of development achieved by countries allowing them to participate in the shift of FDI entry modes, out of which M&As are gaining more ground. Thus, we expect entry modes to be dependent on the set of factors mentioned in the previous section and the development levels achieved by countries. Cross-border M&A account for a modest share of the overall FDI activity in developing countries, although firms from these countries are increasingly

involved in this type of deals (UNCTAD, 2005).

There are several elements revealing the type of FDI undertaken in host countries. Some of them can be considered as more conventional determinants of FDI, such as productive costs (i.e. wages), the openness level of countries and the size and growth of the internal market (i.e. GDP). Others are more related to features of the national systems of innovation, such as, first, the path of foreign capital presence; second, the human capital level, which provides a plausible argument to explain the evolution of foreign capital entries in countries and, particularly, in least developed economies, that could be measured through the level of school enrolment in secondary education; and third, the absorptive capacities. The latter, adopted from the micro concept formulated by Cohen and Levinthal (1990), is understood as the possibility to benefit from innovation carried out externally to the firms and defining a second phase of learning. At an aggregate level (Narula et al., 2002), absorptive capacities can be measured through national R&D expenditures. In addition, aspects regarding the institutional and regulatory features of host economies can also be considered. The idea is that institutional stability can be seen as a determinant factor of attractiveness. Although imperfect, the institutional framework can be measured by the *Government Matters Indicator* that has been built under the auspices of the World Bank.²

The current empirical model tries to explain *greenfield* investment flows and cross-border M&A as a function of the following determinants: cumulative nature of foreign capital (FDIstock), size and growth of the internal market (GDP and Δ GDP), level of openness (OP), labour costs (W) as well as human capital level (HK), R&D intensity (RD) and the institutional framework (GMI).³ All these variables are introduced into the estimations taking logarithm transformations, except for the last one.⁴ In a first model estimation, our dependent variable is greenfield investment (FDI) while in the second it will be cross-border M&A (MA). Each will be regressed against the set of determinants previously mentioned.

Equation (1) is adopted for the estimation of both FDI and M&A, separately. Moreover, time and country dummies are also included to account for those macro impacts not explicitly controlled in the model. The variables and their definitions are listed in Table II.

$$\log y_{it} = \alpha_1 \log FDIstock_{it} + \alpha_2 \log GDP_{it} + \alpha_3 \log \Delta GDP_{it} + \alpha_4 \log OP_{it} + \alpha_5 \log W_{it} + \alpha_6 \log HK_{it} + \alpha_7 \log RD_{it} + \alpha_8 \log GMI_{it} + \eta_{dt} + \nu_{dt} + \epsilon_{it} \quad (1)$$

²The “Governance Matters Indicator, developed by Kaufmann et al (2007), is the average of six different indicators: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption. For each one and for each country, 352 indicators were collected from different sources: international organisms, rating agencies and others.

³Correlations among variables can be found in Table 2A of the Appendix.

⁴The *Government Indicator* is the average of a set of indicators on voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption.

In order to understand the relative importance that local determinants have in each FDI mode of entry from a dynamic perspective, the estimation method and the availability of panel data are crucial. Indeed, the time dimension is an element to be observed from the estimations of both FDI and M&A variables. The model will be estimated following a dynamic approach where its inherent endogenous structure is taken into account: the dependent variable, present and lagged, may be correlated with the independent variables (determinants); that is, past results may determine the FDI type of entry now. A common way of dealing with the problem is to test to what extent the determinants affect FDI results, as well as to eliminate non-observable effects. The generalised method of moments (GMM) uses the first differencing transformation to wipe out non-observable individual effects and all possible lags of regressors as instruments to eliminate possible correlations with the individual effect (Arellano & Bond, 1991). An extension of the GMM estimator considers both the original instruments in levels for equations in first differences and instruments in first differences for equations in levels (Arellano & Bover, 1995; Blundell & Bond, 1998). In this estimation procedure, which is called system-GMM, predetermined variables in levels are instrumented with lags of their own first differences. The system-GMM estimation procedure is the one adopted in estimating our equations, because of its superior performance and its inherent advantages over the first differenced GMM estimator since it exploits all moment conditions available.

The results of the estimations allow us to confirm that *greenfield* FDI presents a positive relationship with the previous presence of foreign capital in the economy, the size and dynamism of the internal market and the institutional features of host countries, whereas labour costs act in a negative direction column 1 of Table III. By contrast, the openness degree and factors revealing the qualification of national systems, such as human capital and R&D intensity, do not seem to have a powerful explanatory capacity. Nonetheless, the results presented in the second column of Table III manifest the persistence of world inequalities and differentiated results arise when controlling for the national level of income per capita. Absorptive capacities become even more significant for those countries with a lower level of development; the interacted variable (R&D*lower-middle income) behaves differently from and better than it does for the higher income group. These findings would satisfactorily confirm our hypothesis and indicate the existence of a combination of traditional determinants and institutional factors for host economies in the explanation of the worldwide foreign investment flows.

The institutional framework is also a significant factor positively related to cross-border M&A in host productive systems. On the one hand, absorptive capacities gain ground in the explanation of this entry mode while the costs variable loses importance (third column of Table III). Nevertheless, when the development level of countries is considered (last column of Table III), our findings reveal that R&D intensity allows us to approach the absorptive

capacity of national systems of innovation and that there exists also a coincidence between institutional factors, such as political stability and the regulatory quality of host countries. On the other hand, M&As seem to be related negatively with the degree of openness of host economies. Although we have not explicitly measured this aspect as a determinant of FDI entry in host economies, previous evidence built by Belderbos et al., (2001) shows that the tariff jumping motivation for Japanese manufacturing investment appears to be the most likely explanation for the difference on vertical linkages in comparison with European and US multinationals. This reason seems to be behind the strong reliance on *greenfield* investments to expand the Japanese manufacturing operations abroad while the EU and US multinational firms show a greater preference for acquisitions. Leaving aside the possible effect the home-country of the investing company has, our cross-country analysis confirms that a more protective foreign trade regulation in host economies would become also a determinant factor for the behaviour of cross-border M&A flows.

There exist significant elements of differentiation in understanding the main FDI entry modes during the last decade. Internal market size, labour costs and the level of human capital in host systems do not seem to play a significant role as determinants of cross-border M&A. Meanwhile, the government indicator is a significant determinant for the two forms of entry while absorptive capacity is a feature more related to the attraction capacity of company investments looking for acquiring, getting a more permanent establishment and positioning in productive systems. In addition, the exploration of the differences that are observable in the behaviour of cross-border M&A according to the income level of countries confirms the evidence of world heterogeneity. This aspect is noticeable even after leaving aside the least developed countries, integrated by low income economies, and considering the intra group differences within the segment of developing economies, integrated by the two sets of middle-income countries.

The results of our analysis confirm the importance that the different levels of commitment have for the two choices of FDI entry. Cross-border M&A seems to be an option for companies investing abroad that are more closely determined by the regulatory and institutional framework of the host countries. This aspect is also related to the higher importance of qualitative aspects, such as the R&D-intensity of the recipient economies. This is true for developed and the richest countries but specially revealing for developing economies. In fact, the significance of R&D intensities was obtained in the estimation of the general model and it is reinforced when controlling for the level of development in countries, being especially significant in the case of upper-middle income ones. This group is integrated by some Asian countries, many European economies in transition (Central and Eastern Europe) as well as most of the Latin American countries.

Finally, the group of emerging market economies has successfully upgraded its national capabilities becoming more attractive for foreign investors (Hobday, 1995). Moreover, com-

panies from emerging economies are changing their international strategies and becoming more integrated in international flows as well (Brouthers et al., 2005; Singh, 2007). The combination of all these aspects allows us to argue that an evolutionary path may be described by the behaviour of foreign investments, the development level of countries and the increasing trends of cross-border M&A. The potential for positive effects in host economies would enrich their options for catching up and integrating the more advanced and dynamic international markets. Therefore, institutional stability and the importance of the innovative environment should be noticeable to policy makers in charge of FDI attraction, while some new and further research regarding the differences found in the developing world, which could provide new insights for the managers of international companies, is required.

4 Game Theoretic Environment

The theoretical basis defining our game derives from the one of Sanna-Randaccio and Veugelers (2007). These authors build a strategic setting based on internal MNC information flows and external knowledge spillovers between the MNC subsidiary and a local firm located in the chosen country of entrance. They do so in a noiseless environment where the information flows and knowledge spillovers parameters determine the final equilibrium of the corresponding MNC R&D decentralization (entry) game. The intensity of both, flows and spillovers, is used to provide sufficient conditions for the dominant strategy of the MNC to consist of decentralizing its R&D activities. Providing sufficient decentralization conditions within a unique entry game allows for a unique decision process, game and equilibrium defining the strategy set of the multinational firm.

We maintain the information structure defined by Sanna-Randaccio and Veugelers unchanged in the current paper. However, we do extend the set of entry games in order to account for all the possible equilibrium decentralization strategies defined by *both* the multinational *and the local firm*. Sufficient conditions are provided for complete decentralization, both on the multinational and local sides, to define the equilibrium of a given entry game. At the same time, the extended set of entry games defines a theoretical framework illustrating the strategic optimality of the empirical evidence presented in the first part of the current paper. The corresponding set of equilibria derives directly from the intensity of the information flows and knowledge spillovers taking place among the local, subsidiary and multinational firms.

The following assumptions will be implicitly made through the rest of the paper, and will become explicit whenever necessary to illustrate the results obtained. First, the ability of the multinational to source local knowledge through its subsidiary depends on the level of

development of the country where local firms are located.⁵ Similarly, the ability of local firms to benefit from MNC R&D knowledge spillovers depends on the development level of their country.⁶ Therefore, developing countries have no incentive to allow for knowledge transfers with the subsidiary if the level of development of local firms prevents them from benefiting from such interaction. That is, we should observe no interaction between foreign subsidiaries and local firms in countries with low development levels, leading to greenfield investment entry modes. On the other hand, as the level of development of a given country increases, its local firms may start benefiting from knowledge exchanges with foreign subsidiaries and cooperation would occur, leading to M&A entry modes.

The conclusions derived from the implicit assumptions above highlight the role played by local firms in determining the observed MNC entry mode in a given country. In other words, to fully understand the type of entry modes observed we must allow for a general equilibrium setting defined by both multinational and local firms, where the latter are able to prevent knowledge flows from taking place with the subsidiary.⁷ The ability of local developing firms (and countries) to block the flow of knowledge and technology with MNC (and their subsidiaries) has been described and analyzed in the international macroeconomic literature by Parente and Prescott (1994) and (2000). In this regard, our extended set of games and equilibria does allow for a general equilibrium explanation of the entry barriers to foreign knowledge and technology imposed by some developing countries and observed by Parente and Prescott.⁸

Finally, multinational firms do only enter a country if the benefits from doing so are higher than those derived from centralization. It will be shown that knowledge does not need to be exchanged between the subsidiary and local firms for decentralization to be optimal for the multinational. However, if local firms are also able to block internal information transfers

⁵Singh (2007) provides empirical evidence supporting this assumption, illustrating how knowledge outflows from the local firm to the subsidiary are larger (lower) in technologically advanced (laggard) countries.

⁶This assumption is directly related to the literature on absorptive capacities developed by Cohen and Levinthal (1989) and its corresponding empirical counterparts, i.e. Cantwell (1989). That is, countries and firms that lag far behind the technological frontier may not even have the minimum amount of knowledge required to absorb further knowledge. Additional support for this assumption is provided by the empirical literature on national systems of innovation, see, for example, Furman, Porter and Stern (2002), that describes the complex infrastructure requirements (at country and cluster levels, as well as between them) for technological innovation and assimilation to take place. In addition, these authors illustrate empirically how no country fits a perfect innovation model even among the more technologically developed ones.

⁷That is, the decentralization of R&D activities by the multinational does not guarantee per se the exchange of knowledge with local firms.

⁸It should be noted that the imposition of entry barriers by local firms is an *optimal* equilibrium consequence of the strategic structure defining our model, while it constitutes an inefficient *ex ante* restriction in the models of Parente and Prescott.

between the multinational parent and the subsidiary, then the resulting equilibrium leads to the reluctance of MNC to decentralize their R&D activities in the corresponding country.

We introduce the basic notation and assumptions describing the strategic game theoretical environment in the following section. The remaining section presents the extended set of games and equilibria that illustrate the optimality underlying the observed differences in multinational entry modes between (technologically) developed and developing countries.

5 Basic Notation and Assumptions

We follow Sanna-Randaccio and Veugelers (2007) to define optimal equilibrium strategies *for both* the multinational and local firms based on the state of the local economy regarding information and knowledge flows. This section follows directly from their paper and maintains their original notation.

There are two countries and three different agents interacting in the system, a MNC, its subsidiary and a local firm to one of the countries. The MNC is a monopolist in the other country and controls the subsidiary in the host country where the local firm operates.

Knowledge spillovers are geographically bound, with R&D proximity required for knowledge to flow between firms. Both the MNC and the local firm compete in product innovation in differentiated substitutes. A short run environment is considered, with the level of R&D resources fixed by each firm. The multinational allocates \bar{x}_m own resources to R&D activities while the local firm allocates \bar{x}_l .

The MNC decides whether or not to decentralize its R&D activities to the subsidiary, given a fixed level of R&D resources in the system

$$\begin{aligned}\hat{x}_m^c &= \hat{x}_m^d = \bar{x}_m \\ \hat{x}_l^c &= \hat{x}_l^d = \bar{x}_l\end{aligned}$$

where the superscripts c and d stand for R&D centralization and decentralization respectively.

If R&D is centralized, the MNC allocates all its R&D resources in its base country, leading to a resource distribution between parent and subsidiary equal to

$$\begin{aligned}\hat{x}_p^c &= \bar{x}_m \\ \hat{x}_s^c &= 0\end{aligned}$$

On the other hand, if decentralization takes place, the distribution of resources between parent and subsidiary is given by

$$\hat{x}_p^d = (1 - \alpha)\bar{x}_m$$

$$\hat{x}_s^d = \alpha\bar{x}_m$$

where α represents the share of R&D resources that the MNC allocates to its subsidiary.

Information and knowledge flow both internally between the parent and its subsidiary, and externally between the subsidiary and the local firm. The internal proportion of information transmitted is represented by the variable $\beta^I \leq 1$, revealing the imperfections that exist in the transmission of information within the MNC setting. The variable β^{Ip} represents the case where information is transferred from the parent to the subsidiary. The reciprocal case, where information is transferred from the subsidiary to the parent, is denoted by β^{Is} . Larger similarities between the local and foreign markets lead to higher values of the β^I variables.

A similar structure can be used to model knowledge spillovers between the subsidiary and the local firm resulting from R&D decentralization. In this case, the variable β^X represents all knowledge spillovers transferred externally. The amount of knowledge transferred from the local firm to the subsidiary is denoted by β^{Xl} , while that from the subsidiary to the local firm is given by β^{Xs} .⁹ Both these variables are larger than zero if and only if *all* R&D activities (those of the MNC *and* the local firm) are decentralized.

The ability of firms to source external knowledge, their absorptive capacity, is considered next. The absorptive capacity of a firm is directly determined by its own R&D capacity. Therefore, the effective external spillovers received from the local firm by the subsidiary are based on its absorptive capacity, and given by $(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l$. Similarly, the external spillovers received from the subsidiary by the local firm are also based on their absorptive capacity, and are given by $(\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m$.

The effective know-how base of each firm is defined next. This variable represents the amount of R&D resources needed by firms in the absence of information flows and knowledge spillovers to obtain the same research output as in the case where flows and spillovers take place. The effective know-how bases with R&D centralization for the multinational parent, the subsidiary and the local firm are

$$X_p^c = \bar{x}_m$$

$$X_s^c = \beta^{Ip}\bar{x}_m$$

$$X_l^c = \bar{x}_l$$

⁹Sanna-Randaccio and Veugelers assume $\beta^{Xs}\bar{x}_l \leq 1$. Though such restriction will prove useful in simplifying some particular cases when calculating the subsidiary decentralization profits, it does not affect the main results obtained.

while with R&D decentralization are given by

$$\begin{aligned} X_p^d &= (1 - \alpha)\bar{x}_m + \beta^{Is}\alpha\bar{x}_m + \beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l \\ X_s^d &= \alpha\bar{x}_m + \beta^{Ip}(1 - \alpha)\bar{x}_m + (\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l \\ X_l^d &= \bar{x}_l + (\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m \end{aligned}$$

Market competition is introduced through perfectly segmented markets with linear demand functions. The multinational parent firm is a monopolist in its country, while its subsidiary competes à la Cournot with the local firm. Linear demand curves are implicitly defined in terms of the effective know-how bases of firms through the effect that R&D activities have on product innovation and demand

$$\begin{aligned} p_I &= A_I + X_p^k - b_I q_p^k \\ p_{II,s} &= A_{II} + X_s^k - b_{II}(q_s^k + \varphi q_l^k) \\ p_{II,l} &= A_{II} + X_l^k - b_{II}(q_l^k + \varphi q_s^k) \end{aligned}$$

with $k = c, d$. Market size parameters, denoted by A and b , are defined for each country, their subindexes representing the respective country (i.e. subscript II corresponds to the host market where the local firm and the MNC subsidiary operate). Parameters b_I and b_{II} are inversely related to the market size of countries I and II, respectively. The φ parameter stands for the degree of differentiation existing between local market products with higher values corresponding to less differentiated products and higher competition between the subsidiary and the local firm.

The basic model is completed defining the profits of firms, given that the MNC must add the profits obtained in both markets, its local one and the foreign one reached through its subsidiary. Thus, the profits obtained from R&D centralization are

$$\begin{aligned} \Pi_m^c &= \pi_p^c + \pi_s^c \\ \Pi_l^c &= \pi_l^c \\ \pi_p^c &= [A_I + \bar{x}_m - b_I q_p^c - c_p] q_p^c \\ \pi_s^c &= [A_{II} + \beta^{Ip}\bar{x}_m - b_{II}(q_s^c + \varphi q_l^c) - c_s] q_s^c \\ \pi_l^c &= [A_{II} + \bar{x}_l - b_{II}(q_l^c + \varphi q_s^c) - c_l] q_l^c \end{aligned}$$

with the c_p , c_s , and c_l variables representing the corresponding unit production costs associated to each firm. If R&D is decentralized, profits are given by

$$\begin{aligned}
\Pi_m^d &= \pi_p^d + \pi_s^d - T \\
\Pi_l^d &= \pi_l^d \\
\pi_p^d &= [A_I + (1 - \alpha)\bar{x}_m + \beta^{Is}\alpha\bar{x}_m + \beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l - b_I q_p^d - c_p]q_p^d \\
\pi_s^d &= [A_{II} + \alpha\bar{x}_m + \beta^{Ip}(1 - \alpha)\bar{x}_m + (\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l - b_{II}(q_s^d + \varphi q_l^d) - c_s]q_s^d \\
\pi_l^d &= [A_{II} + \bar{x}_l + (\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m - b_{II}(q_l^d + \varphi q_s^d) - c_l]q_l^d
\end{aligned}$$

where $T > 0$ is a positive cost derived from the existence of centripetal location factors, such as the loss of scale economies in R&D, and is strictly increasing in α , i.e. $T = f(\alpha\bar{x}_m)$, with $T'_\alpha > 0$.

We conclude this section presenting the *equilibrium* expressions for output, which, at the same time, determine the corresponding optimal profit values.¹⁰ It can be easily shown that all optimal profit functions are increasing in \hat{q} , $\forall \hat{q} \geq 0$. The equilibrium outputs resulting from R&D centralization are

$$\begin{aligned}
\frac{A_I - c_p}{2b_I} + \frac{\bar{x}_m}{2b_I} &= \hat{q}_p^c \\
\frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} - \frac{\varphi\bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{2\beta^{Ip}\bar{x}_m}{(4 - \varphi^2)b_{II}} &= \hat{q}_s^c \\
\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}} &= \hat{q}_l^c
\end{aligned}$$

However, if R&D decentralization takes place, we obtain the following equilibrium outputs

$$\begin{aligned}
\frac{A_I - c_p}{2b_I} + \frac{(1 - \alpha)\bar{x}_m}{2b_I} + \frac{\beta^{Is}\alpha\bar{x}_m}{2b_I} + \frac{\beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{2b_I} &= \hat{q}_p^d \\
\frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} + \frac{2\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xl}\alpha\bar{x}_m - \varphi)\bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} &= \hat{q}_s^d \\
\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xs}\bar{x}_l - \varphi)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{(4 - \varphi^2)b_{II}} &= \hat{q}_l^d
\end{aligned}$$

¹⁰These equilibrium results as well as the respective profit expressions are explicitly derived in the mathematical appendix.

6 The R&D Decentralization Game

The setting defined in the previous section leads to a strategic entry environment where *both* the multinational and the local firm must interact. The MNC must decide whether or not to decentralize its R&D activities, while the local firm either allows for knowledge transferences with the foreign subsidiary or remains closed to all flows.

The international business and economic literatures have not yet considered the strategic incentives faced by *both* the MNC and the local firm when *jointly* determining the equilibrium of the corresponding entry game. The main set of equilibrium scenarios analyzed in the literature is summarized in Figure 1. In all frameworks, attention is focused on the MNC incentives to decentralize its R&D activities, while assuming that the local firm has already decided *ex ante* to either block knowledge flows or interact with the subsidiary.

The “absorptive capacities” branch of the literature emphasizes the role played by knowledge spillovers and location factors in determining the MNC decentralization decision, while the local firm remains a mere observer to this process, allowing for knowledge interactions with the subsidiary. On the other hand, the international macroeconomic branch, i.e. Parente and Prescott (1994) and (2000), concentrates on the MNC optimization process when barriers to technology spillovers preventing the diffusion of knowledge are *ex ante* imposed by the local firm or the host country. In this case, the creation of barriers to technology spillovers is inefficient and due to the existence of monopoly rights preserved within the less technologically developed countries, see, Prescott (1998).

At the same time, even though the behaviour of the local firm is described and modelled in Sanna-Randaccio and Veugelers (2007), the strategic incentives defining their R&D decentralization equilibrium refer only to the MNC. Thus, by explicitly recognizing the strategic role of local firms in the determination of the R&D decentralization equilibrium, and following our empirical results, we will be able to explain why R&D expenditures is not a relevant variable among high income countries while it remains highly relevant among lower middle income ones, or why the observed MNC entry modes should shift from greenfield FDI to interactive M&A *among developing countries* as their level of (technological) development increases. Indeed, if local firms do play a strategic role when deciding the entry mode chosen by the MNC, the latter tendency should somehow be equivalent to a removal of entry barriers to MNC knowledge and technology.

The corresponding technology decentralization game is defined as follows

R&D Decentralization Game

	c	d
c	Π_m^c, Π_l^c	$\Pi_m^c, \Pi_l^d(\alpha = 0) = \Pi_l^c$
d	$\Pi_m^d(\beta^{X^s} = \beta^{X^l} = 0), \Pi_l^d(\beta^{X^s} = \beta^{X^l} = 0)$	Π_m^d, Π_l^d

where the multinational firm is modelled as the left player, while the local firm remains as the upper one. The entrances defining the matrix payoffs follow from the profits obtained by each firm depending on their mutual strategies and the relative values of the knowledge spillovers and information flows variables in the system. At the same time, the profit expressions follow directly from the optimal equilibrium quantities derived for each firm.¹¹

$$\begin{aligned}\Pi_m^c &= \frac{A_I - c_p}{2b_I} + \frac{\bar{x}_m}{2b_I} + \frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} - \frac{\varphi \bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{2\beta^{Ip}\bar{x}_m}{(4 - \varphi^2)b_{II}} \\ \Pi_l^c &= \frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}} \\ \Pi_m^d &= \frac{A_I - c_p}{2b_I} + \frac{(1 - \alpha)\bar{x}_m}{2b_I} + \frac{\beta^{Is}\alpha\bar{x}_m}{2b_I} + \frac{\beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{2b_I} + \frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} + \\ &\quad \frac{2\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xl}\alpha\bar{x}_m - \varphi)\bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} - T\end{aligned}$$

¹¹The profit functions of all firms are derived in the mathematical appendix. The MNC profit function consists of the sum of both the parent and the subsidiary profit functions, and is given by

$$\hat{\pi}_p^c + \hat{\pi}_s^c = b_I(\hat{q}_p^c)^2 + b_{II}(\hat{q}_s^c)^2$$

with the T variable subtracted if decentralization is chosen.

On the other hand, the local firm profits are

$$\hat{\pi}_l^c = b_{II}(\hat{q}_l^c)^2$$

Clearly, the matrix entrances defining the strategic decentralization environment correspond to a largely simplified version of the respective profit functions. Indeed, this simplification is valid when considering the local firm profit expressions Π_l^c , Π_l^d and $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$. Local firms would choose to decentralize their technology and allow for knowledge flows if $\Pi_l^d > \Pi_l^c(\beta^{Xs} = \beta^{Xl} = 0)$.

However, the profit expressions defined for the MNC are not mathematically correct, since each one of them consists of two additive effects that cannot initially be simplified in the way presented. That is, the simplification introduced allows for $\Pi_m^d > \Pi_m^c$ (i.e. $\hat{q}_p^d + \hat{q}_s^d > \hat{q}_p^c + \hat{q}_s^c$) while leading to $(\hat{\pi}_p^c + \hat{\pi}_s^c) > (\hat{\pi}_p^d + \hat{\pi}_s^d)$. Nevertheless, it can be easily shown that the sufficient conditions for MNC technological decentralization consist of the following expressions being strictly positive

$$\begin{aligned}& [\hat{q}_p^d - \hat{q}_p^c] \quad \text{and} \quad [\hat{q}_s^d - \hat{q}_s^c] \quad \text{if the local firm decentralizes.} \\ & [\hat{q}_p^d(\beta^{Xs} = \beta^{Xl} = 0) - \hat{q}_p^c] \quad \text{and} \quad [\hat{q}_s^d(\beta^{Xs} = \beta^{Xl} = 0) - \hat{q}_s^c] \quad \text{if the local firm centralizes.}\end{aligned}$$

The first part of each expression corresponds to the b_I denominator terms defining Π_m^c , Π_m^d , and $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$, while the second one relates to the b_{II} terms. It must be noted that the results obtained in the paper satisfy the sufficient conditions defined above and do not depend on the expositional simplification introduced to allow for a more intuitive presentation.

$$\begin{aligned}
\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) &= \frac{A_I - c_p}{2b_I} + \frac{(1 - \alpha)\bar{x}_m}{2b_I} + \frac{\beta^{Is}\alpha\bar{x}_m}{2b_I} + \frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} + \\
&\quad \frac{2\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} - \frac{\varphi\bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{2\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} - T \\
\Pi_l^d &= \frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xs}\bar{x}_l - \varphi)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{(4 - \varphi^2)b_{II}} \\
\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) &= \frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(\beta^{Ip} - 1)\varphi\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}}
\end{aligned}$$

The economic interpretation of the terms defining each profit function is presented in Sanna-Randaccio and Veugelers (2007). Since the results obtained in the current paper depend on the existing relationships among the knowledge and information transmission variables, we omit repeating the economic intuition developed by these authors and refer the interested reader to their paper. We will nevertheless provide the required economic interpretation of the corresponding relationships obtained when illustrating our main results.

Note that, given $\beta^{Ip} \leq 1$, we have $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_l^c$ except for the case of perfect internal information flows, $\beta^{Ip} = 1$, where $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) = \Pi_l^c$. That is, when $\beta^{Ip} = 1$ the parent is able to transfer information perfectly to the subsidiary. Thus, the local firm choosing to centralize would face the same increase in competition via φ independently of the decentralization decision taken by the MNC. That is, when $\beta^{Ip} = 1$ the MNC does not face any adaptation cost to the local market and it can exert its competition via φ over the local firm without decentralizing its R&D activities.

On the other hand, if $\beta^{Ip} \leq 1$, information would be imperfectly transmitted from the parent to the subsidiary. In this case, the local firm choosing to centralize would face higher competition and a lower profit if the MNC decentralizes its R&D activities. Note that this is the case despite the local firm being able to prevent any knowledge from spilling to the subsidiary via β^{Xl} .

The existing relationships among the remaining profit expressions are analyzed in the following subsection.

6.1 Equilibrium Scenarios

We start by analyzing the incentives of the local firm to decentralize its knowledge and allow for information flows through trade with the subsidiary located in the host country. In order to do so, we must compare the profits obtained when knowledge flows and trade with the subsidiary are cancelled

$$\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) = \frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} - \frac{\varphi\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}}$$

with the profits derived from allowing trade and knowledge spillovers between the local firm and the subsidiary

$$\Pi_l^d = \frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xs}\bar{x}_l - \varphi)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{(4 - \varphi^2)b_{II}}$$

In order for the local firm to decentralize technology and allow for knowledge spillovers with the subsidiary we must have that

$$2\beta^{Xs}\bar{x}_l\alpha\bar{x}_m - \varphi\beta^{Xl}\alpha\bar{x}_m\bar{x}_l > 0$$

which simplifies to

$$\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$$

Sanna-Randaccio and Veugelers (2007) assume that $\varphi < 2$ and we will restrict their assumption to $\varphi \in (0, 2)$ in order to simplify the presentation of our results.¹² Note that, in accordance with the empirical evidence presented by Singh (2007), the restriction imposed on φ implies that the knowledge spillovers received by the local firm are not necessarily larger than those transferred when interacting with the subsidiary.

We concentrate now on the behaviour of the parent multinational firm. Note that $\hat{\pi}_p^d + \hat{\pi}_s^d = b_I(\hat{q}_p^d)^2 + b_{II}(\hat{q}_s^d)^2 - T$ and $\hat{\pi}_p^c + \hat{\pi}_s^c = b_I(\hat{q}_p^c)^2 + b_{II}(\hat{q}_s^c)^2$. Thus, for $\Pi_m^d > \Pi_m^c$ we must have

$$b_I[(\hat{q}_p^d)^2 - (\hat{q}_p^c)^2] + b_{II}[(\hat{q}_s^d)^2 - (\hat{q}_s^c)^2] - T > 0$$

implying that for decentralization to be viable for the multinational firm it suffices to have $\hat{q}_p^d > \hat{q}_p^c$, $\hat{q}_s^d > \hat{q}_s^c$, and a large enough sum of their differences weighted by the b market size parameters so as to compensate for the value of the centripetal parameter T such that the entire expression is larger than zero.

¹²Otherwise, we should consider the following parameter inequality through several parts of our analysis $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{2}{\varphi}$, with the right hand side equating ∞ when $\varphi = 0$. Though we could rely on standard set-theoretic results to justify the required parametric behaviour, i.e. Theorem 7.8 in Munkres (2000), the incurred mathematical complexities would not add any economic intuition to the results obtained.

There exist different theoretical scenarios defined by the value of the knowledge diffusion variables, leading to several possible sets of games and their corresponding equilibria. Consider first the condition for $\hat{q}_p^d > \hat{q}_p^c$

$$\frac{-\alpha\bar{x}_m}{2b_I} + \frac{\beta^{Is}\alpha\bar{x}_m}{2b_I} + \frac{\beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{2b_I} > 0$$

which simplifies to

$$\Pi^p = \beta^{Is} + \beta^{Is}\beta^{Xl}\bar{x}_l - 1 > 0$$

Clearly, an increase in either β^{Is} , β^{Xl} or both increases the benefits from decentralization for the multinational parent firm.¹³ Note that the incentives of the parent to decentralize move in the opposite direction to those of the local firm when the variable β^{Xl} is considered. This result makes intuitive sense, as larger knowledge outflows from the local firm to the subsidiary decrease the local incentives to decentralize technology. At the same time, better internal information flows between the parent and the subsidiary increase the R&D decentralization incentives of the MNC. Therefore, the best decentralization scenario the parent firm can aim to within the current framework is given by $\beta^{Is} = \beta^{Xl} = 1$, leading to a positive amount of profit over the centralization case

$$\Pi^p = \left[\frac{\alpha\bar{x}_m}{2b_I} \right] \bar{x}_l > 0$$

Similarly, the worst possible decentralization scenario for the parent firm is given by $\beta^{Is} = \beta^{Xl} = 0$, leading to a negative amount of profit with respect to the centralization case

$$\Pi^p = \frac{-\alpha\bar{x}_m}{2b_I} < 0$$

¹³The following possible cases arise

- (i) If $\beta^{Is} = 0$, $\Pi^p < 0 \forall \beta^{Xl}$.
- (ii) If $\beta^{Is} = 1$, $\Pi^p > 0 \forall \beta^{Xl} \neq 0$.
- (iii) For some $\beta^{Is} < 1$, $\exists \beta^{Xl} > 0$ such that $\Pi^p = 0$.
- (iv) If $\beta^{Xl} = 0$, then $\Pi^p < 0 \forall \beta^{Is} \neq 1$.
- (v) If $\beta^{Xl} = 1$, then $\Pi^p > 0$ if $\beta^{Is} = 1$, and $\exists \beta^{Is} > 0$ such that $\Pi^p = 0$.
- (vi) If $\beta^{Xl} < 1$, then $\exists \beta^{Is} > 0$ such that $\Pi^p = 0$.

Sanna-Randaccio and Veugelers (2007) assume $\beta^{Xl}\alpha\bar{x}_m \leq 1$. In order to further simplify the presentation we assume $\beta^{Xl} \leq 1$. The results obtained and the sets of possible cases and games analyzed remain unaffected by our additional simplification.

Consider now the knowledge parameters conditions for $\hat{q}_s^d > \hat{q}_s^c$, implying that the profits obtained by the subsidiary from R&D decentralization, Π^s , must be positive

$$\Pi^s = \frac{-2\beta^{Ip}\alpha\bar{x}_m}{(4-\varphi^2)b_{II}} + \frac{2\beta^{Xl}\alpha\bar{x}_m\bar{x}_l}{(4-\varphi^2)b_{II}} + \frac{(2-\varphi\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m}{(4-\varphi^2)b_{II}} > 0$$

which simplifies to

$$\Pi^s = 1 + \beta^{Xl}\bar{x}_l - \beta^{Ip} - \frac{\varphi\beta^{Xs}\bar{x}_l}{2} > 0$$

The subsidiary profits from decentralization are strictly increasing in β^{Xl} , but strictly decreasing in β^{Ip} and β^{Xs} .¹⁴ Thus, the best decentralization scenario the subsidiary firm can aspire to is given by $\beta^{Xl} = 1$ and $\beta^{Ip} = \beta^{Xs} = 0$, leading to a positive profit over the centralization case¹⁵

¹⁴We must consider the following possibilities

- (i) If $\beta^{Xl} = \beta^{Ip} = \beta^{Xs} = 0$, then $\Pi^s > 0$.
- (ii) If $\beta^{Xl} = \beta^{Ip} = \beta^{Xs} = 1$, then $\Pi^s > 0$ since $\Pi^s = \frac{(2-\varphi)\bar{x}_l}{2}$ and $\varphi < 2$.
- (iii) If $\beta^{Xs} = 0$, then $\Pi^s \geq 0, \forall \beta^{Xl}, \beta^{Ip} \geq 0$.
- (iv) If $\beta^{Xs} = 1$, then $\Pi^s = 2(1 - \beta^{Ip}) + (2\beta^{Xl} - \varphi)\bar{x}_l$.
Thus, If $\beta^{Xl} = 1, \beta^{Ip} = 0$ then $\Pi^s > 0$ and if $\beta^{Xl} = 0, \beta^{Ip} = 1$ then $\Pi^s < 0$.
Besides, $\exists(\beta^{Xl}, \beta^{Ip},)$ such that $\Pi^s = 0$.
- (v) If $\beta^{Ip} = 0$, then $\Pi^s = 2 + (2\beta^{Xl} - \varphi\beta^{Xs})\bar{x}_l > 0, \forall \beta^{Xl}, \beta^{Xs}$, since $\varphi < 2$ and $\beta^{Xs}\bar{x}_l \leq 1$.
- (vi) If $\beta^{Ip} = 1$, then $\Pi^s = (2\beta^{Xl} - \varphi\beta^{Xs})\bar{x}_l$.
Thus, If $\beta^{Xl} = 1, \beta^{Xs} = 0$ then $\Pi^s > 0$ and if $\beta^{Xl} = 0, \beta^{Xs} = 1$ then $\Pi^s < 0$.
Besides, $\exists(\beta^{Xl}, \beta^{Xs},)$ such that $\Pi^s = 0$.
- (vii) If $\beta^{Xl} = 0$, then $\Pi^s = 2 - 2\beta^{Ip} - \varphi\beta^{Xs}\bar{x}_l$.
Thus, if $\beta^{Ip} = 0$, then $\Pi^s > 0, \forall \beta^{Xs}$, and if $\beta^{Ip} = \beta^{Xs} = 1$, then $\Pi^s < 0$.
Besides, $\exists(\beta^{Ip}, \beta^{Xs})$ such that $\Pi^s = 0$.
- (viii) If $\beta^{Xl} = 1$, then $\Pi^s > 0, \forall \beta^{Ip}$ and $\forall \beta^{Xs} \leq 1$.
- (ix) If β^{Xl} [respectively β^{Ip}, β^{Xs}] < 1 , then, by continuity
 $\exists(\beta^{Ip}, \beta^{Xs})$ [respectively $(\beta^{Xl}, \beta^{Xs}), (\beta^{Xl}, \beta^{Ip})$] such that $\Pi^s > 0, \Pi^s = 0$ and $\Pi^s < 0$.

¹⁵Note that the optimal behaviour of β^{Xl} and β^{Xs} from the subsidiary profit perspective eliminates all decentralization incentives for the local firm.

$$\Pi^s = \frac{2\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}}[1 + \bar{x}_l] > 0$$

At the same time, the worst possible decentralization scenario for the subsidiary firm is given by $\beta^{Xl} = 0$ and $\beta^{Ip} = \beta^{Xs} = 1$, leading to a negative profit with respect to the centralization case

$$\Pi^s = -\frac{\varphi\bar{x}_l\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} < 0$$

As in the parent case, the decentralization incentives faced by the subsidiary oppose that of the local firm, with larger knowledge inflows from and lower outflows to the local firm increasing the decentralization incentives of the subsidiary. In addition, better internal information flows from the parent, i.e. higher β^{Ip} values, reduce the decentralization incentives of the MNC. That is, as the value of β^{Ip} increases, the cost of adaptation to the local market faced by the subsidiary decreases, reducing the MNC decentralization incentives due to this demand competition motive.

We present below a summary of the best and worst possible values that the information flows and knowledge spillovers variables may take from a parent and subsidiary decentralization perspective.

Multinational Profit Matrix

	Best	Worst
Parent	$\beta^{Is} = \beta^{Xl} = 1, \Pi^p > 0$	$\beta^{Is} = \beta^{Xl} = 0, \Pi^p < 0$
Subsidiary	$\beta^{Xl} = 1, \beta^{Ip} = \beta^{Xs} = 0, \Pi^s > 0$	$\beta^{Xl} = 0, \beta^{Ip} = \beta^{Xs} = 1, \Pi^s < 0$

Note, once again, that the knowledge spillover incentives for the multinational firm to decentralize its R&D activities, high β^{Xl} and low β^{Xs} values, decrease the incentives of the local firm to allow for knowledge flows with the subsidiary operating in the local economy. However, the interaction of the β^{Xl} and β^{Xs} variables with the remaining ones defining the set of information and knowledge flows in the entire system, β^{Is} and β^{Ip} , allows for a wide variety of possible equilibria.

Consider the previously defined R&D decentralization game again

R&D Decentralization Game

	c	d
c	Π_m^c, Π_l^c	$\Pi_m^c, \Pi_l^d(\alpha = 0) = \Pi_l^c$
d	$\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0), \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$	Π_m^d, Π_l^d

We have already analyzed the conditions for $\Pi_m^d > \Pi_m^c$ and $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$, which lead to the (d, d) equilibrium, and observed their opposite dependence on the knowledge spillover variables. In order to complete the extended set of games based on the information flows and knowledge spillovers variables we must compare the multinational profits under the remaining information transmission structures.

When comparing $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ and Π_m^c , i.e. when calculating $\hat{q}_p^d(\beta^{Xs} = \beta^{Xl} = 0) - \hat{q}_p^c$, we obtain

$$\Pi^p(\beta^{Xs} = \beta^{Xl} = 0) = \beta^{Is} - 1 < 0, \forall \beta^{Is} \neq 1$$

while $\hat{q}_s^d(\beta^{Xs} = \beta^{Xl} = 0) - \hat{q}_s^c$ leads to

$$\Pi^s(\beta^{Xs} = \beta^{Xl} = 0) = 1 - \beta^{Ip} > 0, \forall \beta^{Ip} \neq 1$$

The economic intuition behind these results is identical to the one presented in the $\Pi_m^d > \Pi_m^c$ case.¹⁶ Similarly, when comparing $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ and Π_m^d a reinforcement of the $\Pi_m^d > \Pi_m^c$ results is obtained. That is, for $\Pi_m^d > \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ we must have

$$\Pi_m^d - \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) = \frac{\beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{2b_I} + \frac{(2\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Xs}\bar{x}_l\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} > 0$$

which simplifies to the following expression¹⁷

$$\Pi_m^d - \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) = 2\beta^{Xl} - \varphi\beta^{Xs} > 0$$

Thus, for $\Pi_m^d > \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ we must have $\frac{\beta^{Xs}}{\beta^{Xl}} < \frac{2}{\varphi}$. This condition inverts the local decentralization condition $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$ as $\varphi \rightarrow 2$. Therefore, as the degree of market competition in the local economy increases so does the interval of β^{Xs} and β^{Xl} values that lead to opposing decentralization incentives between the local firm and the MNC. Note, however, that even if $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{2}{\varphi}$, there may exist a set of values such that $\Pi_m^d > \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$. At the same time, even if such set of β^{Is} values is empty, there exist pairs of both β^{Is} and β^{Ip} values such that the multinational firm profits from technology decentralization, i.e. if

¹⁶Note that, if $\beta^{Is} = 1$ and $\beta^{Ip} = 0$ then $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^c$, while $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^c$ if $\beta^{Is} = 0$ and $\beta^{Ip} = 1$. Thus, by continuity, $\exists \beta^{Is}, \beta^{Ip}$ such that $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) = \Pi_m^c$. Finally, if R&D decentralization is profitable for the multinational when $\beta^{Is} = 1$ and $\beta^{Ip} = 0$, there must exist a cut-off point such that the decentralization profits (over the centralization case) equal T .

¹⁷Clearly, for the $\Pi_m^d - \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ expression to be positive it suffices that $2\beta^{Xl} - \varphi\beta^{Xs} > 0$, since $\beta^{Is}\beta^{Xl} \geq 0, \forall \beta^{Is}, \beta^{Xl}$.

$\beta^{Is} = 1$ and $\beta^{Ip} = 0$, then both $\Pi_m^d > \Pi_m^c$ and $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^c$ independently of the values taken by β^{Xs} and β^{Xl} .¹⁸

We introduce the set of possible game theoretical scenarios based on the information flows and knowledge spillovers variables in the following section. A deterministic environment is considered where the value assigned to all variables is assumed to be known by all firms in the system. However, probability distributions corresponding to each variable and game could be assumed, and the corresponding set of signalling Bayesian games studied.

6.2 The Set of Information Games

The previous section has illustrated the existence of several strategic scenarios based on the payoffs derived from the different values taken by the knowledge spillovers and information flows variables. Through this section, we introduce the set of all games that follow from the previous strategic scenarios and calculate their corresponding equilibria. That is, we analyze the common strategic decision setting faced by the MNC and the local firm, and define all possible equilibria for each and every game within the set of information games, denoted by Ω . In so doing, we will be able provide a theoretical justification for the observed behaviour of both the R&D absorptive capacities variables described in Table III as well as the observed entry modes of MNC in developing countries, shifting from greenfield investment to M&A as the level of development of the host country increases.

It should be already clear that the observed modes of entry are *jointly* determined by the multinational and the local firm as an equilibrium consequence of the host country information transmission structure. In this regard, whenever the MNC centralizes its R&D activities, knowledge would not spill via β^X independently of the behaviour of the local firm. Such centralizing strategy results in identical matrix entrances, given by (c, c) and (c, d) , uniquely determined by the behaviour of the MNC.

On the other hand, whenever the MNC decentralizes its R&D activities, the local firm may decide either to block all knowledge transmissions with the subsidiary or to allow for knowledge spillovers via the β^X variables. The former scenario, defined by the (d, c) matrix entrance, corresponds to the greenfield FDI case, where the MNC enters a country and decentralizes R&D activities, but no interaction with the local firm takes place. The latter scenario, described by the (d, d) matrix entrance, does allow for knowledge spillovers to occur between the subsidiary and the local firm, leading to the M&A observed in the respective

¹⁸We are assuming that in both cases the profit differential suffices to account for the T parameter value. Though this does not need to be necessarily true for all the values taken by β^{Xs} and β^{Xl} , we can nonetheless assume that it is true for a subset of them such that $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{2}{\varphi}$, i.e. we can find a functional form for T satisfying these requirements.

host economies.¹⁹

We will consider only pure equilibria defined by (weakly) dominant strategies. However, mixed equilibria can be easily introduced within the current framework if the variables defining the information transmission structure in Ω are assumed to be stochastic.

Finally, numbers have been included in the entrances of the game matrices to simplify the presentation and allow for an easier comparison among different information transmission scenarios. The results presented are independent of the chosen numerical values.

The Ω set of information games is divided in three main subsets depending on the type of R&D decentralization strategies induced on the MNC and the local firm by the knowledge spillovers and information flows variables. The first subset of games corresponds to the case studied by Sanna-Randaccio and Veugelers (2007), where a pure R&D decentralization effect is induced on the parent firm constituting its strictly dominant strategy. That is

$$\begin{aligned} \Pi_m^d > \Pi_m^c \text{ and } \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^c \\ \text{i.e. } \beta^{Is} = \beta^{Xl} = 1 \text{ and } \beta^{Ip} = \beta^{Xs} = 0 \end{aligned}$$

Two possible game types and equilibria in pure strategies exist, depending on the incentives of the local firm to allow for knowledge spillovers with the subsidiary located in the host country

Complete Decentralization

	c	d
c	1, 1	1, 1
d	$> 1, \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$	$> 1, \Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$

Only Parent Firm Decentralizes

	c	d
c	1, 1	1, 1
d	$> 1, \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$	$> 1, \Pi_l^d < \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$

However, these game types are not analyzed by Sanna-Randaccio and Veugelers (2007) as the behaviour of the local firm is not studied explicitly in their paper. Note also that the knowledge spillovers parameters should be modified to allow for the complete decentralization

¹⁹Clearly, knowledge may spill between the local firm and the subsidiary without any M&A taking place. However, knowledge interactions and spillovers between the subsidiary and the local firm do occur whenever M&A are observed (due, among other reasons, to a pure proximity effect), while this is not necessarily the case with greenfield FDI.

equilibrium to arise, i.e. $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$. This requirement and the intuition behind it, i.e. the explicit modelization of the local firm R&D decentralization incentives, takes us to the next subset of games.

The second subset of games allows for more complex strategic interactions to take place between the multinational and the local firm. Indeed, the MNC must consider the equilibrium strategies of the local firm when designing its own R&D decentralization strategy. There exist two different scenarios, each one divided in two subcases with their corresponding equilibria.

The first scenario derives from the following multinational payoff entrances²⁰

$$\Pi_m^d > \Pi_m^c \text{ and } \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^c$$

$$\text{i.e. low } \beta^{Is}, \text{ high } \beta^{Ip}, \frac{\beta^{Xs}}{\beta^{Xl}} < \frac{2}{\varphi}$$

Two possible subcases arise within this scenario. The first subcase corresponds to the payoff structure $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_l^d$, i.e. $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$, and its (pure strategy Nash) equilibrium is given by the (d, d) entrance of the following payoff matrix

Undefined Decentralization 1a

	c	d
c	1, 1	1, 1
d	$< 1, \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_l^d$	$> 1, \Pi_l^d$

The second subcase is defined by the payoff structure $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_l^d$, i.e. $\frac{\beta^{Xs}}{\beta^{Xl}} < \frac{\varphi}{2}$, whose equilibrium is given by the (c, c) entrance of the following payoff matrix

Undefined Decentralization 1b

	c	d
c	1, 1	1, 1
d	$< 1, \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_l^d$	$> 1, \Pi_l^d$

²⁰The existence of parameter values guaranteeing, at the same time, the existence of each equilibrium scenario is implicitly assumed, except when indicated explicitly due to an algebraic impossibility. Otherwise, we should proceed numerically and find exact values for the information and knowledge parameters leading to each particular equilibrium. Note, however, that the inclusion of the assumed parameter values in the corresponding profit functions allows for an intuitive verification of the required equilibrium constraints. If these constraints were not initially satisfied, the values of either b_I , b_{II} or T can be easily modified to accommodate the respective equilibrium requirements.

Similarly, the second scenario derives from the following multinational payoff entrances

$$\begin{aligned} \Pi_m^d < \Pi_m^c \text{ and } \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^c \\ \text{i.e. high } \beta^{Is}, \text{ low } \beta^{Ip}, \frac{\beta^{Xs}}{\beta^{Xl}} > \frac{2}{\varphi} \end{aligned}$$

As in the previous setting, two possible subcases take place within this scenario. The first subcase is given by the payoff structure $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_l^d$, i.e. $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$, whose equilibrium corresponds to the (c, d) entrance of the following payoff matrix

Undefined Decentralization 2a

	c	d
c	1, 1	1, 1
d	$> 1, \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_l^d$	$< 1, \Pi_l^d$

The second subcase follows from the payoff structure $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_l^d$, i.e. $\frac{\beta^{Xs}}{\beta^{Xl}} < \frac{\varphi}{2}$, and its equilibrium corresponds to the (d, c) entrance of the following payoff matrix

Undefined Decentralization 2b

	c	d
c	1, 1	1, 1
d	$> 1, \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_l^d$	$< 1, \Pi_l^d$

This subcase provides a direct theoretical justification for the behaviour of the RD*LowerMiddle variable described in Table III. That is, greenfield FDI is viable in developing countries iff they have reached a sufficient technological development level so as to allow the MNC to benefit from information flows and knowledge spillovers if M&A would take place. In other words

Theorem 6.1 $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_l^d$ iff $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^d$.

Proof If $\Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_l^d$ then $\frac{\beta^{Xs}}{\beta^{Xl}} < \frac{\varphi}{2}$. However, for $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^d$ it is necessary that $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$. There exist no $\varphi \in (0, 2)$ such that both requirements are satisfied. ■

Note that Theorem 6.1 does not impose any incentive on the MNC to decentralize its R&D, as the $\Pi_m^d < \Pi_m^c$ and $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^c$ scenario is not ruled out by its assumptions. In fact, such a case defines the third subset of game types, where the MNC has a strictly dominant incentive to centralize its R&D activities. Theorem 6.1 does however imply that if the MNC has an incentive to decentralize its R&D activities but the local firm does not, then the MNC would rather do so via M&A than through greenfield FDI.

The third subset of games derives from the following payoff structure

$$\begin{aligned} \Pi_m^d < \Pi_m^c \text{ and } \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^c \\ \text{i.e. } \beta^{Is} = \beta^{Xl} = 0 \text{ and } \beta^{Ip} = \beta^{Xs} = 1 \end{aligned}$$

The resulting game type has two possible equilibria, (c, c) and (c, d) , both defined by the R&D centralization strategy of the multinational firm

No Decentralization

	c	d
c	1, 1	1, 1
d	$< 1, \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$	$< 1, \Pi_l^d$

The previous subsets together with their respective subcases define all possible (pure) equilibrium scenarios that may be reached depending on the values taken by the information flows and knowledge spillovers variables. In this regard, the current model extends that of Sanna-Randaccio and Veugelers, whose strategic structure corresponds to the first subset of games presented, in order to allow for the equilibrium to be jointly determined by the strategies of both the MNC and the local firm. Thus, the type of entry mode observed constitutes an optimal equilibrium phenomenon while explicitly acknowledging the active role played by the local firm in its determination.

Consider now the behaviour of the RD*UpperMiddle variable displayed in Table III. The absorptive capacities of the local economy determine the entry of MNC via M&A but are not significant when greenfield FDI is considered. We know from the above analysis that the local firm would only follow a decentralization strategy and allow for a M&A entry mode if such strategy leads to a more beneficial equilibrium than greenfield FDI, i.e. $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$. If this were the case, the value taken by $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ should have no influence whatsoever in determining the MNC R&D decentralization strategy. The following theorem illustrates this point.

Theorem 6.2 *If $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$, then the MNC decentralization strategy is independent of the value taken by $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ with respect to Π_m^c .*

Proof If $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$ then $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$. At the same time,

- (i) For $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^d$ it is necessary that $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{2}{\varphi}$, while
- (ii) For $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^d$ it suffices that $\frac{\beta^{Xs}}{\beta^{Xl}} < \frac{2}{\varphi}$.

Clearly, we can always find values of β^{Xs} and β^{Xl} for any $\varphi \in (0, 2)$ such that $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$ and either (i) or (ii) are satisfied. Thus, no constraint is imposed on the relative values of $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ and Π_m^d by $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$.

We illustrate now the existence of equilibria such that the MNC decentralization strategy prevails for both $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^c$ and $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^c$ in either (i) or (ii).

- (a) If, for example, $\beta^{Is} = 1$ and $\beta^{Ip} = 0$ then $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^c$, and, by continuity, there exists $T > 0$ such that (d, d) defines the game equilibrium (with larger MNC decentralization profits, after accounting for T , than in the centralization case), whenever (i) or (ii) occur.
- (b) If, for example, $\beta^{Is} = 1$ and $\beta^{Ip} = 1$ then $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) < \Pi_m^c$, and, by continuity, there exist $T > 0$, and a large enough b_I , small enough b_{II} , or both, such that (d, d) defines the game equilibrium (with larger MNC decentralization profits, after accounting for T , than in the centralization case), whenever (i) or (ii) occur.

In the same way, the continuity property of the equilibrium profit functions guarantees the existence of infinitely many parameter values leading to any of the previous, i.e. either (a) or (b), equilibrium scenarios. Thus, the *Complete Decentralization* and the *Undefined Decentralization 1a* games have the same R&D decentralization equilibrium, which is, therefore, independent of the value taken by $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0)$ with respect to Π_m^c . ■

It should be emphasized that the (d, d) equilibrium can be achieved in the (i) – (b) scenario despite its counterintuitive requirements, given by

$$\begin{aligned} \Pi_l^d &> \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0), \\ \Pi_m^c &> \Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^d \end{aligned}$$

In this case, market size parameters and centripetal factors play an active role in the determination of the equilibrium. In order for the (d, d) equilibrium to be achieved, we require a large enough b_I , small enough b_{II} , or both, together with a relatively low T value.

That is, a relatively small market of origin for the MNC and a potentially large local market together with a low enough centripetal cost would suffice to reach the (d, d) equilibrium.²¹

Similarly, market size parameters and centripetal factors become essential when modelling the behaviour of the RD*High variable. Table III illustrates the lack of significance of local absorptive capacities when determining MNC entry strategies of any type in high income countries. Indeed, if the MNC internal structure allows for the subsidiary to receive relatively low quantities of information while sending large amounts to the parent, then the MNC decentralization strategy may easily become independent of the values taken by the local knowledge spillovers variables.

Once again, the continuity property of the equilibrium profit functions guarantees the existence of infinitely many parameter values leading to the results derived below.

Assume that $\beta^{Is} = 1$ and $\beta^{Ip} = 0$. That is, the subsidiary firm receives no information from the parent but sends back information perfectly. It immediately follows that $\Pi_m^d(\beta^{Xs} = \beta^{Xl} = 0) > \Pi_m^c$. It remains to show that $\Pi_m^d > \Pi_m^c$ for both possible cases $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$, with $\frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$, and $\Pi_l^d < \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$, with $\frac{\beta^{Xs}}{\beta^{Xl}} < \frac{\varphi}{2}$.

In order for $\Pi_m^d > \Pi_m^c$ it is sufficient, but not necessary, to have both

$$\Pi^p = \beta^{Is} + \beta^{Is}\beta^{Xl}\bar{x}_l - 1 > 0, \text{ and}$$

$$\Pi^s = 1 + \beta^{Xl}\bar{x}_l - \beta^{Ip} - \frac{\varphi\beta^{Xs}\bar{x}_l}{2} > 0$$

given that b_I , b_{II} and T values exist such that total decentralization profits are positive after accounting for the centripetal variable T . If $\beta^{Is} = 1$ and $\beta^{Ip} = 0$ the above constraints simplify to

$$(a) \quad \Pi^p = \beta^{Xl}\bar{x}_l > 0$$

$$(b) \quad \Pi^s = 1 + \beta^{Xl}\bar{x}_l - \frac{\varphi\beta^{Xs}\bar{x}_l}{2} > 0$$

Consider now conditions (a) and (b) above together with the respective local decentralization constraints

$$(i) \quad \Pi_l^d < \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) \text{ with } \frac{\beta^{Xs}}{\beta^{Xl}} < \frac{\varphi}{2}$$

$$(ii) \quad \Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0) \text{ with } \frac{\beta^{Xs}}{\beta^{Xl}} > \frac{\varphi}{2}$$

²¹Remember that b_I and b_{II} are inversely related to the market size of countries I and II , respectively, with the II subindex referring to the local economy.

If case (i) takes place, then $(b) > 0$ for any β^{Xl} , since $\Pi^s > 1 + (1 - \frac{\varphi^2}{4})\beta^{Xl}\bar{x}_l > 0$, with $\varphi \in (0, 2)$. Thus, there exist b_I , b_{II} and T values such that total decentralization profits are positive for all possible values taken by β^{Xl} and β^{Xs} . Note that, if $\beta^{Xl} = 0$, then $\beta^{Xs} = 0$, since $\beta^{Xs} \not\leq 0$ by definition, resulting in $\Pi_l^d = \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$. In this case, $\Pi^p = 0$ and $\Pi^s = 1 > 0$. Thus, b_I , b_{II} and T values exist such that total decentralization profits are positive when $\beta^{Xl} = 0$ and $\beta^{Xs} = 0$.

Assume now that case (ii) occurs. Then, $\Pi^s < 1 + (1 - \frac{\varphi^2}{4})\beta^{Xl}\bar{x}_l$, with $(b) \geq 0$. Thus, if $\beta^{Xl} = 0$ ($\beta^{Xl} > 0$), there exist values of b_I , b_{II} and T such that, *for a given subset of finite β^{Xs} (for any finite β^{Xs})*,²² total decentralization profits are positive after accounting for the centripetal factors variable T .

Therefore, when analyzing the behaviour of the RD*High income variable, we observe that knowledge interactions with the local firm do not constitute a decentralization incentive for the MNC, which must focus on the ability of the subsidiary to source back information instead. Besides, relative market sizes and centripetal costs become important when defining the strategic behaviour of the MNC. For example, a relatively large b_I , indicating a potentially small market of origin, together with a relatively low b_{II} , indicating a potentially large host local market, would foster the MNC R&D decentralization strategy. Thus, if knowledge spillovers lose importance in determining the MNC entry strategy, it must be in favour of market size parameters, centripetal costs, and internal MNC information flows.

In order for the above analysis to reflect the observed behaviour of the RD*High variable, we must rely on the existence of demand pull technological factors when determining the potential size of a given market. Such an assumption implies that both b_I and b_{II} should be decreasing functions of the level of technological development of a country. That is, as a country becomes more advanced technologically, its market demand for technologically advanced products should also increase. This pure demand motive ignores knowledge spillovers considerations, leaving the MNC R&D decentralization requirements to be mainly determined by market size variables and internal MNC information flows.

The lack of significance of the local absorptive capacities, defined by the knowledge spillovers variables, together with the importance gained by market size and centripetal costs variables relate the RD*High scenario above directly to the evidence presented by Singh (2007) regarding the main mandates followed by MNC subsidiaries, which consist of the following

- (1) “Incremental adaptation of their parent firm’s products for the local market”. Clearly, this role corresponds to a pure demand related motive for R&D decentralization. The

²²It has been assumed that $\beta^{Xs}\bar{x}_l \leq 1$, which prevents β^{Xs} from taking a value of ∞ . That is, however large is the value taken by β^{Xs} , it must be such that this constraint is satisfied.

MNC tries to expand the market for its product from a potentially small market of origin, defined by a relatively large b_I value, to a potentially large local market, defined by a relatively small b_{II} value.²³

- (2) “Listening posts to monitor technological developments in the host country”. Besides, “foreign subsidiaries of even technologically advanced firms typically focus on peripheral technologies where these firms lag behind other countries, rather than cutting-edge R&D in core technologies of the firm”. Thus, the centripetal factors affecting the R&D decentralization decision of the MNC are strategically minimized, resulting in a relatively small T value. In addition, the share of information transferred internally from the parent to the subsidiary, β^{Ip} , should be relatively lower than the flow expected to be received back from the subsidiary, β^{Is} , in its role as listening post.
- (3) “MNC often restrict leakage of their core technologies by leveraging their global innovation network and complementary capabilities, which ensures that access to knowledge from just their local subsidiary would not be very valuable for the a potential competitor in the host country”. Therefore, as illustrated when defining Ω , the fact that the local firm decentralizes knowledge spillovers, i.e. $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$, does not necessarily imply that the knowledge inflows it receives via β^{Xs} are larger (or more valuable) than the outflows it sends via β^{Xl} to the subsidiary, since $\beta^{Xs} > \frac{\varphi}{2}\beta^{Xl}$, with $\varphi \in (0, 2)$.

We conclude this section illustrating how, as the income level of the host local economy increases from Lower Middle to Upper Middle, M&A should *optimally* prevail over greenfield FDI as the empirically observed MNC entry mode. In order to do so, we rely on the absorptive capacities literature developed by Cohen and Levinthal (1989) together with the findings reported by Singh (2007). The former authors state that, if local firms lag far behind the MNC in technological development, they may not have the minimum amount of knowledge required to absorb further knowledge. In addition, Singh shows how knowledge outflows from the local firm to the subsidiary exceed inflows in technologically developed countries, while this tendency is reversed for technological laggards.

Denote the relative (to the technological frontier) level of technological development of a country by ψ . Thus, if the local firm requires a minimum ψ to benefit from a decentralization strategy, i.e. for $\Pi_l^d > \Pi_l^d(\beta^{Xs} = \beta^{Xl} = 0)$, then $\frac{\beta^{Xs}}{\beta^{Xl}}$ must be a function of ψ , such that

²³That is, after covering its market of origin demand, the MNC must search for relatively large foreign markets to expand the demand for its products. Note that we are not considering further strategic scenarios within the current paper, that may derive, for example, from the existence of contestable markets or the tying of complementary products.

$\frac{\beta^{Xs}}{\beta^{Xl}}(\psi) < \frac{\varphi}{2}$, for $\psi < \psi_m$, where ψ_m is the minimum level of technological development required to benefit from R&D decentralization. Together with the evidence presented by Singh (2007), the minimum absorptive capacity requirement implies that²⁴

$$\frac{\partial \left(\frac{\beta^{Xs}}{\beta^{Xl}} \right)}{\partial \psi} > 0, \text{ for } \psi < \psi^*; \quad \frac{\partial \left(\frac{\beta^{Xs}}{\beta^{Xl}} \right)}{\partial \psi} = 0, \text{ at } \psi = \psi^*; \quad \frac{\partial \left(\frac{\beta^{Xs}}{\beta^{Xl}} \right)}{\partial \psi} < 0, \text{ for } \psi > \psi^*.$$

These results are summarized in the following theorem, that concludes the paper and provides an optimal general equilibrium justification for the empirical evidence on local absorptive capacities and MNC entry modes presented in Table III.

Theorem 6.3 *If $\frac{\partial \left(\frac{\beta^{Xs}}{\beta^{Xl}} \right)}{\partial \psi} > 0$, whenever $\psi < \psi^*$, then, for any given φ , greenfield FDI entry strategies will be **optimally** observed for relatively low ψ values, while M&A would only start taking place after a minimum ψ value has been achieved by the local firm.*

7 Conclusion and Extensions

This paper has illustrated both empirically and theoretically the dependence of MNC entry modes on the level of (technological) development of the host country. These results extend the partial analysis considered in the international business and macroeconomic literatures, and verify the strategic optimality of the empirical evidence presented. That is, the observed entry modes are strategically chosen by the MNC after analyzing the host country information structure and the decentralization strategies of the corresponding local firm.

Our general formulation is not only important when explaining the evidence presented but also allows for natural Bayesian extensions of the set Ω . Note that mixed equilibria can be easily introduced within the strategic structure of Ω if the values of the information flows and knowledge spillovers variables are assumed to be unknown by either the multinational, the local firm, or both. In this case, a set of Bayesian signalling games would be generated and could be analyzed as one of the immediate extensions of the current theoretical environment. For example, the local firm could be assumed to have private information regarding restrictions imposed by the host country on knowledge transmission that are unknown to the multinational. On the other hand, we could assume that the local firm does not know the exact value of β^{Xs} and must assign a given probability to its possible realizations based

²⁴We have assumed, without loss of generality, that the function $\frac{\beta^{Xs}}{\beta^{Xl}}(\psi)$ is continuously differentiable. Otherwise, the results should be given in terms of a step function but would remain unaltered.

on its beliefs about the MNC information transmission structure. That is, a sequential signalling game could be designed where the local firm signals its will to decentralize based on its private information regarding host country restrictions or, if β^{X^s} is unknown, on its information and beliefs about the value of β^{X^s} . A similar strategic structure could be easily defined from the perspective of the multinational firm and its subsidiary. In both these cases, however, the theoretical analysis would precede the empirical time series verification.

Mathematical Appendix

The first order conditions leading to the optimal output level and corresponding profits for all firms in the case of R&D centralization are given by

$$\begin{aligned}\frac{\partial \pi_p^c}{\partial q_p^c} &= A_I + \bar{x}_m - 2b_I q_p^c - c_p = 0 \\ \frac{\partial \pi_s^c}{\partial q_s^c} &= A_{II} + \beta^{Ip} \bar{x}_m - 2b_{II} q_s^c - b_{II} \varphi q_l^c - c_s = 0 \\ \frac{\partial \pi_l^c}{\partial q_l^c} &= A_{II} + \bar{x}_l - 2b_{II} q_l^c - b_{II} \varphi q_s^c - c_l = 0\end{aligned}$$

The optimal choice of output for all firms derives from solving the above system of equations for the corresponding quantity variables

$$\begin{aligned}\frac{A_I - c_p}{2b_I} + \frac{\bar{x}_m}{2b_I} &= \hat{q}_p^c \\ \frac{A_{II} + \beta^{Ip} \bar{x}_m - b_{II} \varphi q_l^c - c_s}{2b_{II}} &= q_s^c \\ A_{II} + \bar{x}_l - 2b_{II} q_l^c - b_{II} \varphi \left[\frac{A_{II} + \beta^{Ip} \bar{x}_m - b_{II} \varphi q_l^c - c_s}{2b_{II}} \right] - c_l &= 0\end{aligned}$$

which leads to the following expressions

$$\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi \beta^{Ip} \bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}} = \hat{q}_l^c$$

and

$$\frac{A_{II} + \beta^{Ip} \bar{x}_m - b_{II} \varphi \left[\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi \beta^{Ip} \bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}} \right] - c_s}{2b_{II}} = \hat{q}_s^c$$

such that

$$\frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} - \frac{\varphi \bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{2\beta^{Ip} \bar{x}_m}{(4 - \varphi^2)b_{II}} = \hat{q}_s^c$$

A similar process takes place when calculating the optimal choice of output if R&D decentralization is assumed. The first order conditions are

$$\frac{\partial \pi_p^d}{\partial q_p^d} = A_I + (1 - \alpha)\bar{x}_m + \beta^{Is}\alpha\bar{x}_m + \beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l - 2b_I q_p^d - c_p = 0$$

$$\frac{\partial \pi_s^d}{\partial q_s^d} = A_{II} + \alpha\bar{x}_m + \beta^{Ip}(1 - \alpha)\bar{x}_m + (\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l - 2b_{II}q_s^d - b_{II}\varphi q_l^d - c_s = 0$$

$$\frac{\partial \pi_l^d}{\partial q_l^d} = A_{II} + \bar{x}_l + (\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m - 2b_{II}q_l^d - b_{II}\varphi q_s^d - c_l = 0$$

The optimal choice of output for each firm results from solving the above system of equations for the respective quantity variables

$$\begin{aligned} \frac{A_I - c_p}{2b_I} + \frac{(1 - \alpha)\bar{x}_m}{2b_I} + \frac{\beta^{Is}\alpha\bar{x}_m}{2b_I} + \frac{\beta^{Is}(\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{2b_I} &= \hat{q}_p^d \\ \frac{A_{II} + \alpha\bar{x}_m + \beta^{Ip}(1 - \alpha)\bar{x}_m + (\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l - b_{II}\varphi q_l^d - c_s}{2b_{II}} &= q_s^d \\ A_{II} + \bar{x}_l + (\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m - 2b_{II}q_l^d - & \\ b_{II}\varphi \left[\frac{A_{II} + \alpha\bar{x}_m + \beta^{Ip}(1 - \alpha)\bar{x}_m + (\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l - b_{II}\varphi q_l^d - c_s}{2b_{II}} \right] - c_l &= 0 \end{aligned}$$

leading to

$$\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xs}\bar{x}_l - \varphi)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{(4 - \varphi^2)b_{II}} = \hat{q}_l^d$$

and

$$\begin{aligned} \frac{A_{II} + \alpha\bar{x}_m + \beta^{Ip}(1 - \alpha)\bar{x}_m + (\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{2b_{II}} - & \\ \frac{b_{II}\varphi \left[\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xs}\bar{x}_l - \varphi)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xl}\alpha\bar{x}_m)\bar{x}_l}{(4 - \varphi^2)b_{II}} \right]}{2b_{II}} - \frac{c_s}{2b_{II}} &= \hat{q}_s^d \end{aligned}$$

such that

$$\frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} + \frac{2\beta^{Ip}(1 - \alpha)\bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{(2\beta^{Xl}\alpha\bar{x}_m - \varphi)\bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{(2 - \varphi\beta^{Xs}\bar{x}_l)\alpha\bar{x}_m}{(4 - \varphi^2)b_{II}} = \hat{q}_s^d$$

It follows directly from the above equations that the optimal profits obtained by firms depend positively on the quantity of goods sold. Consider first the profits obtained by the parent firm under R&D centralization

$$\pi_p^c = \left[A_I + \bar{x}_m - b_I \left(\frac{A_I - c_p}{2b_I} + \frac{\bar{x}_m}{2b_I} \right) - c_p \right] q_p^c$$

Solving the expression inside the bracket we obtain

$$\hat{\pi}_p^c = \left[\frac{A_I - c_p}{2} + \frac{\bar{x}_m}{2} \right] \hat{q}_p^c$$

which simplifies to

$$\hat{\pi}_p^c = [b_I \hat{q}_p^c] \hat{q}_p^c = b_I (\hat{q}_p^c)^2$$

Similarly, the profits obtained by the subsidiary under R&D centralization are given by the following expression

$$\begin{aligned} \pi_s^c = & \left[A_{II} + \beta^{Ip} \bar{x}_m - b_{II} \left(\frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} - \frac{\varphi \bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{2\beta^{Ip} \bar{x}_m}{(4 - \varphi^2)b_{II}} + \right. \right. \\ & \left. \left. \varphi \left[\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi \beta^{Ip} \bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}} \right] \right) - c_s \right] q_s^c \end{aligned}$$

which simplifies to

$$\hat{\pi}_s^c = \left[\frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)} - \frac{\varphi \bar{x}_l}{(4 - \varphi^2)} + \frac{2\beta^{Ip} \bar{x}_m}{(4 - \varphi^2)} \right] \hat{q}_s^c$$

That is, as in the case of the parent firm, we obtain a quadratic profit expression in quantities sold

$$\hat{\pi}_s^c = [b_{II} \hat{q}_s^c] \hat{q}_s^c = b_{II} (\hat{q}_s^c)^2$$

Finally, the profits obtained by the local firm under R&D centralization are given by

$$\begin{aligned} \pi_l^c = & \left[A_{II} + \bar{x}_l - b_{II} \left(\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)b_{II}} - \frac{\varphi \beta^{Ip} \bar{x}_m}{(4 - \varphi^2)b_{II}} + \frac{2\bar{x}_l}{(4 - \varphi^2)b_{II}} + \right. \right. \\ & \left. \left. \varphi \left[\frac{(2 - \varphi)A_{II} - 2c_s + \varphi c_l}{(4 - \varphi^2)b_{II}} - \frac{\varphi \bar{x}_l}{(4 - \varphi^2)b_{II}} + \frac{2\beta^{Ip} \bar{x}_m}{(4 - \varphi^2)b_{II}} \right] \right) - c_l \right] q_l^c \end{aligned}$$

which simplifies to

$$\hat{\pi}_l^c = \left[\frac{(2 - \varphi)A_{II} - 2c_l + \varphi c_s}{(4 - \varphi^2)} - \frac{\varphi \beta^{Ip} \bar{x}_m}{(4 - \varphi^2)} + \frac{2\bar{x}_l}{(4 - \varphi^2)} \right] \hat{q}_l^c$$

delivering a quadratic profit expression in quantities sold identical to the one obtained for the subsidiary operating in the local country economy

$$\hat{\pi}_l^c = [b_{II} \hat{q}_l^c] \hat{q}_l^c = b_{II} (\hat{q}_l^c)^2$$

Therefore, profits are (strictly) increasing in q for (strictly) positive quantities sold

$$\frac{\partial \hat{\pi}_p^c}{\partial \hat{q}_p^c} = 2b_I \hat{q}_p^c \geq 0$$

$$\frac{\partial \hat{\pi}_i^c}{\partial \hat{q}_i^c} = 2b_{II} \hat{q}_i^c \geq 0, \quad i = s, l$$

We omit developing the equilibrium profit expressions for the R&D decentralization case due to their analytical resemblance with the centralization one. In both scenarios, profits remain (strictly) increasing in q for (strictly) positive quantities produced.

References

- [1] Aitken, B.J., Harrisson, A.E. (1999) “Do domestic firms benefit from FDI? Evidence from Venezuela, *American Economic Review* 89 (3), 605-618.
- [2] Álvarez, I., Magaa, G. (2007) “Technological development in middle-income countries, in J.A. Alonso (ed.), *Cooperation with Middle-income Countries*, Ed. Complutense, Madrid, pp. 339-369.
- [3] Álvarez, I., Molero, J. (2005) “Technology and the generation of international spillovers: an application to Spanish manufacturing firms, *Research Policy*, 34, 1440-1452.
- [4] Arellano, M., Bond, S.R. (1991) “Some tests of specification for panel data, *Journal of Econometrics*, 59, 87-97.
- [5] Arellano, M., Bover, O. (1995) “Another look at the instrumental variables estimation of error components models, *Journal of Econometrics* 68, 29-51.
- [6] Barkema, H.G., Vermeulen, F. (1998) “International Expansion through Start-up or Acquisition: A learning perspective, *Academy of Management Journal*, Vol. 4, No 1, 7-26.
- [7] Belderbos, R. E., Capannelli, G., Fukao, K. (2001) “Backward Vertical Linkages of Foreign Manufacturing Affiliates: Evidence from Japanese Multinationals, *World Development*, 29(1), 189-208.
- [8] Bertrand, O. Hakkala, K., Norbck, P.J. (2007) Cross-Border Acquisition or Greenfield Entry: Does it Matter for Affiliate R&D?, *Research Institute of Industrial Economics*, Working Paper Series, 693, Stockholm,
- [9] Blomstrm, M., Kokko, A. (1998) “Multinational corporations and spillovers, *Journal of Economics Surveys*, 12(2), 1-31.
- [10] Blundell, R.W., Bond, S.R. (1998) “Initial conditions and moment restrictions in dynamic panel models, *Journal of Econometrics*, 87, 115-143.
- [11] Borensztein, E., De Gregrio, J., Lee, J.W. (1998) “How does FDI affect economic growth?, *Journal of International Economics*, 4 (1), 115-135.
- [12] Brouthers, K.D., Brouthers, L.E. (2000) “Acquisition or greenfield start-up? Institutional, cultural and transaction cost influences, *Strategic Management Journal*, 21, 89-97.

- [13] Brouthers, K.D., Brouthers, L.E. (2003) "Why service and manufacturing entry mode choices differ: the influence of transaction cost factors, risk, and trust, *Journal of Management Studies*, 40, 1179-204.
- [14] Brouthers, L. E., O'Donnell, E., Hadjimarcou, J. (2005) "Generic Product Strategies for Emerging Market Exports into Triad Nation Markets: A Mimetic Isomorphism Approach, *Journal of Management Studies*, 42, 207-225.
- [15] Cantwell, J. (1989) *Technological Innovation and Multinational Corporations*, Basil Blackwell, Oxford.
- [16] Cantwell, J. (1995) "The globalization of technology: What remains of the product cycle model?, *Cambridge Journal of Economics*, 19:1, 155-174.
- [17] Cantwell, J., Mudambi, R. (2005) "MNE competence-creating subsidiary mandates, *Strategic Management Journal*, 26 (12), 1109-1128.
- [18] Castellacci, F. (2008) "Technology clubs, technology gaps and growth trajectories, *Structural Change and Economic Dynamics*, 19(4), 301-314.
- [19] Chang, S. J., Rosenweig, P. M. (2001) "The choice of entry mode in sequential foreign direct investment, *Strategic Management Journal*, 22(8), 747-776.
- [20] Cohen, W.M., Levinthal, D.A. (1989) "Innovation and learning: the two faces of R&D, *Economic Journal*, 99 (397), 569-596.
- [21] Cohen, W.M., Levinthal, D.A. (1990) "Absorptive capacity: a new perspective on learning and innovation, *Administrative Science Quarterly*, 35, 128-152.
- [22] Davidson, W.H. (1980) "The Location of Foreign Direct Investment Activity: Country Characteristics and Experience Effects, *Journal of International Business Studies*, 11(2), 9-22.
- [23] Durlauf, S.N. y Jonson, P.A. (1995) "Multiple regimes and cross-country growth behaviour, *Journal of Applied Econometrics*, 10, 365-384.
- [24] Freeman, C. (1987) *Technology Policy and Economic Performance: Lessons from Japan*, Pinter, London.
- [25] Frost, T. (2001) "The geographic sources of Foreign Subsidiaries Innovations, *Strategic Management Journal*, 22, 101-123.

- [26] Furman, J., Porter, M., Stern S. (2002) "The determinants of national innovative capacity, *Research Policy* 31, 899-933.
- [27] Globerman, S., Shapiro, D. (2002) "Global foreign direct investment flows: the role of governance infrastructure, *World Development*, 30(11), 1899-1919.
- [28] Hobday, M. (1995) *Innovation in East Asia*, Edward Elgar, Aldershot.
- [29] Kaufmann, D., Kraay, A., Mastruzzi, M. (2007) "Governance Matters VI: Governance Indicators for 1996-2006, *World Bank Policy Research Working Paper No. 4280*, World Bank, Washington. <http://ssrn.com/abstract=999979>
- [30] Kogut, B., Singh, H. (1988) "The effect of national culture on the choice of entry mode, *Journal of International Business Studies*, 19(3), 411-432.
- [31] Kokko, A. (1992) *FDI, host country characteristics and spillovers*, The Economic Research Institute, Stockholm School of Economics.
- [32] Kuemmerle, W. (1999) "Foreign direct investment in industrial research in the pharmaceutical and electronics industries: results from a survey of multinational firms, *Research Policy*, 28(2-3), 179-193.
- [33] McCann, P., Mudambi, R. (2005) "Analytical differences in the economics of geography: the case of the multinational firm, *Environment and Planning A*, 37, 1857- 1876.
- [34] Meyer, K.E. (2004) "Perspectives on Multinational Enterprises in Emerging Economies, *Journal of International Business Studies*, 35(4), 259-276.
- [35] Mortimore, M., Vergara, S. (2004) "Targeting winners: can foreign direct investment policy help developing countries industrialise?, *The European Journal of Development Research*, 16(3), 499-530.
- [36] Mudambi, R. (1995) "The MNE investment location decision: some empirical evidence, *Managerial and Decision Economics*, 16, 249-257.
- [37] Mudambi, R. (2008) "Location, control and innovation in knowledge-intensive industries, *Journal of Economic Geography*, 8, 699-725.
- [38] Mudambi, R., Mudambi, S.M. (2002) "Diversification and market entry choices in the context of foreign direct investment, *International Business Review*, 11, 355-370.
- [39] Munkres, J. R. (2000) *Topology*, Prentice Hall, Inc.

- [40] Narula, R., Criscuolo, P., Verspagen, B. (2002) "The relative importance of home and host innovation systems in the internationalisation of MNE R&D: a patent citation analysis, *Merit Memorandum* MERIT RM 2002-26.
- [41] OECD (2002) *Foreign Direct Investment for Development*, OECD, Paris.
- [42] Parente, S. L., Prescott E. C. (1994) "Barriers to technology adoption and development, *Journal of Political Economy*, 102, 298-321.
- [43] Parente, S. L., Prescott E. C. (2000) *Barriers to Riches*, Cambridge: MIT press.
- [44] Pearce, R. (1999) "Decentralised R&D and strategic competitiveness: globalised approaches to generation and use of technology in multinational enterprises (MNEs), *Research Policy*, 28, 157-178.
- [45] Perez, T (1998) *Multinational enterprises and technological spillovers*, Harwood Pub., Amsterdam.
- [46] Piscitello, L. (2004), "Corporate diversification, coherence and economic performance. *Industrial and Corporate Change*, 13 (5), 757-787.
- [47] Prescott, E. (1998) "Needed: A Theory of Total Factor Productivity, *International Economic Review* 39, 525-551.
- [48] Rugman, A.M., Doh, J.P. (2008) *Multinationals and development*, Yale University Press, New Haven and London.
- [49] Sanna-Randaccio, F. (2002) "The impact of foreign direct investment on home and host countries with endogenous R&D, *Review of International Economics*, 10 (2), 278-298.
- [50] Sanna-Randaccio, F., Veugelers, R. (2007) "Multinational knowledge spillovers with decentralised R&D: a game-theoretic approach, *Journal of International Business Studies*, 38(1), 47-63.
- [51] Shimizu, K.; Hitt, M.A.; Vaidyanath, D.; Pisano, V. (2004) "Theoretical foundations of cross-border mergers and acquisitions: A review of current research and recommendations for the future, *Journal of International Management*, 10, 307-355.
- [52] Singh, J. (2007) "Asymmetry of knowledge spillovers between MNCs and host country firms, *Journal of International Business Studies*, 38, 764-786.

- [53] Slangen, A., Hennart, J.F. (2008) “Do Foreign Greenfields Outperform Foreign Acquisitions or Vice Versa? An Institutional Perspective, *Journal of Management Studies*, 45(7), 1301-1328.
- [54] UNCTAD (2005) *World Investment Report Transnational Corporations and the Internationalization of R&D*, United Nations, New York and Geneva.
- [55] UNCTAD (2007) *World Investment Report Transnational Corporations, Extractive Industries and development*, United Nations, New York and Geneva.
- [56] Wright, M., Filatotchev, I., Hoskisson, R. E., Peng, M. W. (2005) “Guest Editors’ Introduction. Strategy Research in Emerging Economies: Challenging the Conventional Wisdom, *Journal of Management Studies*, 42, 1-34.
- [57] Xu, B. (2000) “Multinational enterprises, technology diffusion, and host country productivity growth, *Journal of Development Economics*, 62, 477-493.
- [58] Xu, F. Shenkar, O. (2002) “Institutional distance and the Multinational Enterprise, *Academy of Management Review*, 27(4), 60-618.
- [59] Yang, Q., Mudambi, R., Meyer, K.E. (2008) “Conventional and Reverse Knowledge Flows in Multinational Corporations, *Journal of Management* forthcoming 2008.

APPENDIX

TABLES AND FIGURES

Graph 1. World FDI inflows and M&As sales (value and share of GDP) — 1990-2006

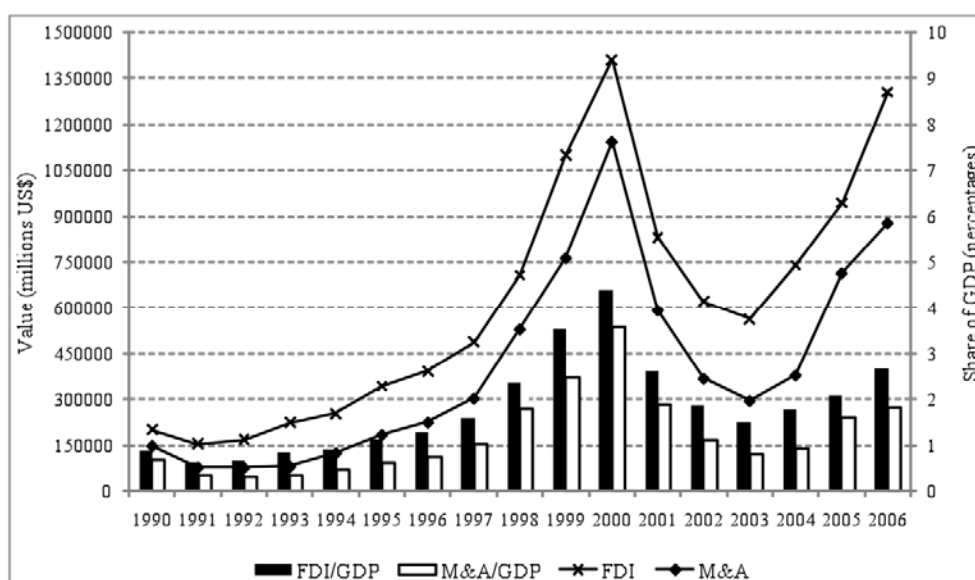


Table I. Descriptive Statistics^(*), 1998-2004

	High Income		Upper-Middle Income		Lower-Middle Income	
	Mean	Std. Dev/Mean	Mean	Std. Dev/Mean	Mean	Std. Dev/Mean
FDI (millions US\$)	19,345.62	2.05	3,285.51	1.42	4,219.01	2.55
M&A (millions US\$)	17,967.12	2.43	1,517.28	1.90	1,269.65	2.78
FDI Stock (millions US\$ PPP)	159,698.07	1.58	27,238.53	1.26	22,384.70	2.07
GDP (millions US\$ constant 2000)	828,853.96	2.32	100,736.53	1.38	132,592.05	2.27
GDP Growth (%)	3.01	0.84	3.67	1.19	4.38	0.87
Openness (%)	94.54	0.68	98.21	0.47	72.95	0.42
Wages (US\$ PPP)	33,084.67	1.72	7,326.82	1.40	8,412.25	1.50
Human Capital (school enrolment in secondary education, %)	109.82	0.19	84.39	0.15	76.91	0.21
R&D/GDP (%)	1.92	0.55	0.59	0.53	0.44	0.75
Governance Matters	1.32	0.33	0.35	1.49	-0.39	0.37

(*) The list of countries as well as the country groups can be found in Table IA. The definition of variables can be found in Table II.

Table II. Summary of variables

<i>Variable</i>	<i>Definition</i>	<i>Source</i>
FDI	Foreign Direct Investment (net inflows, \$US) measured in natural logarithms	UNCTAD, FDI database
MA	Mergers and Acquisitions (inflows, \$US) measured in natural logarithms	UNCTAD, FDI database
FDIStock	Stock of FDI (\$US, PPP) measured in natural logarithms	World Bank, WDI 2005
GDP	Gross Domestic Product (US\$ constant 2000) measured in natural logarithms	World Bank, WDI 2005
ΔGDP	Annual growth rate of GDP measured in natural logarithms	World Bank, WDI 2005
OP	Openness: Exports and imports of goods and services (%GDP) measured in natural logarithms	World Bank, WDI 2005
W	Compensation of employees (\$US, PPP) measured in natural logarithms	World Bank, WDI 2005
HK	Human Capital: School enrolment in secondary education (%Total) measured in natural logarithms	World Bank, WDI 2005
RD	Research and Development expenditures (%GDP) measured in natural logarithms	World Bank, WDI 2005
GMI	Governance matters indicator	World Bank

Table IA. Countries included in the analysis grouped by their level of GDP per capita

HIGH	UPPER-MIDDLE	LOWER-MIDDLE
Australia	Argentina	Armenia
Austria	Chile	Azerbaijan
Belgium	Costa Rica	Belarus
Canada	Croatia	Bolivia
Cyprus	Czech Republic	Brazil
Denmark	Estonia	Bulgaria
Finland	Hungary	China
France	Latvia	Colombia
Germany	Lithuania	Ecuador
Greece	Malaysia	Egypt
Hong Kong	Mauritius	El Salvador
Iceland	Mexico	Georgia
Ireland	Panama	Honduras
Israel	Poland	Kazakhstan
Italy	Russia	Macedonia
Japan	Slovak Republic	Morocco
Korea, South	Trinidad and Tobago	Paraguay
Kuwait	Turkey	Peru
Luxembourg	Uruguay	Romania
Malta	Venezuela	Thailand
New Zealand		Tunisia
Norway		Ukraine
Portugal		India (Low income)
Singapore		
Slovenia		
Spain		
Sweden		
Switzerland		
United Kingdom		
United States		

Table IIA. Rank correlations: FDI, M&A and national factors (1998-2004)

	Total Sample		High Income		Upper-Middle Income		Lower-Middle Income	
	FDI	MA	FDI	MA	FDI	MA	FDI	MA
FDI	1	0.754**	1	0.706**	1	0.740**	1	0.637**
MA	0.754**	1	0.706**	1	0.740**	1	0.637**	1
FDIStock	0.887**	0.695**	0.877**	0.670**	0.805**	0.593**	0.871**	0.547**
GDP	0.783**	0.642**	0.723**	0.690**	0.790**	0.609**	0.822**	0.525**
ΔGDP	-0.048	-0.095*	0.015	0.009	-0.088	-0.095	0.127	0.007
OP	-0.231**	-0.229**	-0.193**	-0.396**	-0.281**	-0.233**	-0.439**	-0.344**
W	0.728**	0.626**	0.664**	0.580**	0.777**	0.564**	0.599**	0.419**
HK	0.364**	0.388**	0.272**	0.260**	0.029	0.102	0.081	0.068
RD	0.563**	0.533**	0.434**	0.455**	0.370**	0.303**	0.429**	0.237**
GMI	0.439**	0.450**	0.355**	0.250**	-0.237**	-0.142	0.350**	0.352**

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

Table III. GMM estimations

	FDI		MA	
	(1)	(2)	(1)	(2)
FDIStock	0.800*** (0.068)	0.814*** (0.073)	0.833*** (0.143)	0.851*** (0.165)
GDP	0.296** (0.117)	0.304** (0.121)	0.249 (0.242)	0.341 (0.252)
ΔGDP	0.042** (0.018)	0.041** (0.018)	0.076* (0.043)	0.064* (0.037)
OP	-0.240 (0.169)	-0.255 (0.175)	-1.294*** (0.342)	-1.333*** (0.378)
W	-0.252** (0.127)	-0.278** (0.134)	-0.186 (0.259)	-0.328 (0.241)
HK	-0.264 (0.272)	-0.184 (0.307)	0.237 (0.523)	0.516 (0.398)
RD	0.171 (0.118)		0.601*** (0.220)	
GMI	0.214* (0.122)	0.192 (0.124)	0.664** (0.277)	0.617** (0.275)
RD*High		0.108 (0.245)		-0.031 (0.356)
RD*UpperMiddle		0.178 (0.208)		1.088*** (0.400)
RD*LowerMiddle		0.243* (0.139)		1.080** (0.459)
Hansen test Chi ²	48.21**	48.38**	53.80**	53.92**
Arellano-Bond test for AR(1)	-2.79***	-2.80***	-1.94**	-1.95**
Arellano-Bond test for AR(2)	0.35	0.34	-0.81	-0.87
Number of observations	404	404	364	364
Number of individuals	72	72	71	71

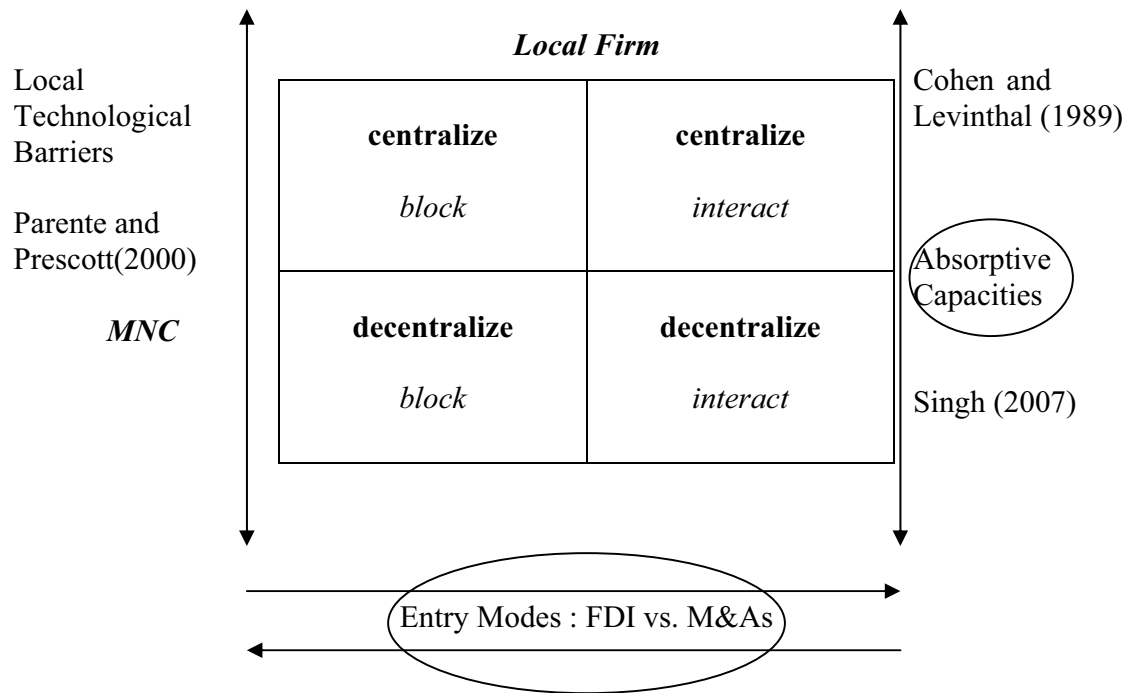
* significant at 10% level; ** significant at 5% level; ***significant at 1% level

Robust standard errors in parentheses.

All variables are in logarithms except the Governance Matters Indicator.

Figure 1

R&D Decentralization (Entry) Games



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