Department of Business Administration
Faculty of Economy and Business Administration

ESSAYS ON LOCATION AND DEVELOPMENT OF SUBSIDIARY'S R&D STRATEGIC ROLES: A MATTER OF DUAL NETWORK EMBEDDEDNESS

Ph.D. thesis presented by
Fariza Achcaoucaou Iallouchen

Supervised by
Paloma Miravitlles Matamoros, Ph.D.

Tutored by
José M. Castán Farrero, Ph.D.

Doctoral thesis submitted to the Doctorate Program in
Business of the Universitat de Barcelona

Barcelona, May of 2013

Als meus pares
i a Sebastià

-Digues, foll, has diners?-. Respòs: -He amat-. -Has viles, ni castells, ni ciutats, comdats ni ducats?-. Respòs: -He amors, pensaments, plors, desirers, treballs, llanguiments, qui són mellors que emperis ni regnats.

Ramon Llull, Llibre d'Amic e Amat, 1283.

AGRAÏMENTS

Al llarg del camí que m'ha portat fins aquí he tingut els millors companys de viatge que podria haver desitjat. És ara el moment d'agrair els coneixements, suport i afecte rebuts.

A Paloma Miravitlles, la meva directora de tesi, no tinc paraules per agrair tota la paciència, dedicació i confiança que ha dipositat en mi. L'autonomia amb la qual m'ha deixat treballar, junt amb la seva agudesa, domini i compromís amb la investigació ben feta, han estat una font de motivació i un model a seguir en aquesta tesi. La seva implicació, orientació i suport incondicionals han fet que me'n pugui sortir. Gràcies, Paloma, per creure en mi i donar-me ànims i seguretat per seguir endavant. Espero algun dia poder correspondre d'alguna manera tot el que m'emporto.

També m'agradaria agrair al Departament d'Economia i Organització d'Empreses de la UB, encapçalat pel seu director Jaume Valls, tots aquests anys que m'ha acollit. Sobretot vull donar les gràcies a l'Esther Hormiga, la Laura Guitart, l'Ana Núñez, en José M. Castán i el Claudio Cruz, per donar-me la confiança de transmetre-us les meves inquietuds (sobre el que és recerca i el que no). La vostra comprensió, ànims i consells em retornaven la il·lusió cada cop que defallia.

De la mateixa manera, m'agradaria expressar el meu sincer agraïment al departament de Direcció d'Empreses 'Joan José Renau Piqueras' de la UV, i, molt especialment a Fidel León. Durant la meva estada de recerca em van fer partícip d'un ambient molt generós i estimulant per fer recerca en internacionalització, el qual em va donar l'empenta final que necessitava per encarar l'última etapa d'aquesta tesi.

In this sense, I am also indebted to Iain Robinson for helping me to polish my written English, sometimes at record-breaking speed. Many thanks to Carmen Garcia too, who always makes efforts for helping us beyond her duties.

Així mateix, també voldria donar les gràcies als meus amics, que tot i les meves intermitents i a vegades llargues absències, sempre m'han recompensat amb comprensió, complicitat i recolzament, sovint amb més del que mereixia. Gràcies a la colla dels Pinfly's per recordar-me cada estiu qui era jo abans d'iniciar aquesta insòlita aventura, sobretot, a la Sheila García. Tant de bo hagués acabat fa un mes. Al Jordi Asensi, el meu company incansable de tren i excel·lent conversador, per escoltar-me atentament i tenir sempre les paraules adients d'alè i optimisme. I al grupet dels divendres, en especial a la Marta Ventura i el Josep Julià, per la seva amistat i per retornar-me a la realitat de les coses essencials de la vida.

Deixo per al final a aquells que sempre heu estat i estareu al meu costat: A la meva família. Als meus germans i germanes per la seva comprensió, estoïcisme i suport en tot moment, tot fent sacrificis per a què jo pugues dedicar-me a fer recerca. Als meus pares per l'amor, els principis i els valors que ens han inculcat a tots cinc germans. El meu pare per educar-nos en la cultura de l'esforç sense descans i contagiar-me la passió pel treball. I la meva mare per omplir la llar familiar d'amor, comprensió i afecte. Per últim, als darrers a arribar, els meus nebots, que sense entendre ben bé perquè "*la tieta sempre està fent deures*", procuraven no fer soroll mentre jugaven. Gràcies per ser la millor distracció de la tesi que es pugui tenir.

Finalment, un agraïment molt especial a Sebastià, per esperar-me pacientment i, sobretot, estar sempre al meu costat i fer-me feliç. Afortunadament, el destí va preferir que ens coneguéssim molt abans que m'embranques en aquesta bogeria.

A tots vosaltres, gràcies per acompanyar-me en els "*amors, pensaments, plors, desirers, treballs, llanguiments, qui són mellors que emperis ni regnats*".

ABSTRACT

The integration of subsidiaries into international networks is altering the scholarly conception of the Multinational Corporation (MNC), forcing us to see subsidiaries as differentiated nodes of the internal corporate network embedded at the same time in the external host-local networks. This double-network paradigm highlights the potential of the subsidiary to tap into specific bodies of local knowledge and to make it available to the rest of the MNC, enabling the subsidiary to become an important source of technological competencies and to contribute to the MNC's overall competitive advantage. This view has revived interest in the configuration of subsidiary R&D roles, especially in those with a particularly contributive disposition that is conducive to long-term success. Nevertheless, the literature examining subsidiary R&D roles has tended to focus mainly on just one side of the dual phenomenon, either its embeddedness in the internal or in the external network. To fill this void, this dissertation seeks to advance our understanding of the location and development of subsidiary R&D roles at the interface of internal and external knowledge networks.

This dissertation is made up of three essays that together form a unique line of argument, where each essay delves more deeply into the findings of the preceding essay. The first essay revisits the commonly cited location advantages for R&D and explores the extent to which they influence the R&D-contributing roles of subsidiaries. Adopting a case study methodology and examining eight subsidiaries with centres of research excellence in Spain, it is shown that supply-side factors impacting technology have a greater power of attraction than demand-side market factors on the R&D-contributing role. However, the Spanish environment appears to be characterised by a greater prevalence of demand-side factors than it is by supply-side factors, which accounts for Spain's ranking as an 'intermediate' country when it comes to attracting foreign direct investment in R&D and innovation. Nevertheless, the high R&D-contributing subsidiaries studied demonstrate that the moderate innovative context of the host country does not hinder their technological potential, provided they maintain relatively stable relations with local agents in the environment. As a result, the degree of embeddedness of affiliates in

the local networks emerges as a catalyst for foreign direct investment (FDI) in R&D. This finding prompted us to focus on the network effects of interacting with multiple agents on the evolution in R&D roles and guided the subsequent research.

The second essay focuses on changes in subsidiary capabilities and on the dynamic mechanisms by which their R&D role might evolve, especially, as a consequence of their interaction with a variety of knowledge networks. This issue is examined through four longitudinal case studies of subsidiaries operating in Spain. Using an inductive approach to theory building, we develop a general theoretical framework considering the subsidiary's embeddedness in knowledge networks within the MNC (internal) and within the host country (external). We find that the evolution towards a competence-creating mandate is characterised by the simultaneous growth of embeddedness in both internal and external networks; otherwise, a subsidiary may actually gravitate away from upgrading its R&D role.

The results of the first and second essays revealed the confounding effects of country factors, corporate factors and dual-embeddedness on subsidiary R&D roles and redirected the focus of the third essay toward this issue. Adopting a partial least square approach to structural equation modelling, the third essay provides empirical evidence for the interaction of these elements based on a survey of 111 foreign-owned subsidiaries located in Spain. This chapter finds that favourable internal and external context conditions do not necessarily lead to the enhancement of a subsidiary's R&D-contributing role unless dual embeddedness is well established, since internal embeddedness acts as a full mediator for corporate effects, external embeddedness acts as a partial mediator for country effects and, in turn, dual embeddedness (with external embeddedness preceding internal embeddedness) acts as a partial mediator of country effects.

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CHAPTER 1. INTRODUCTION

1.1. INTRODUCTION, MOTIVATION AND RESEARCH OBJECTIVES

Received wisdom conceptualizes the Multinational Corporation (MNC) as an international organization whose core advantages derive from its ability to develop and diffuse knowledge across geographically dispersed foreign subsidiaries. In fact, MNCs are considered to be superior to alternative organizational configurations in terms of their ability to transfer knowledge across borders (Foss & Pedersen, 2002; Michailova & Mustaffa, 2012). Yet, this 'universal conceptualization' has been differently understood over time in parallel with the evolution and changes experienced by theories of foreign direct investment (FDI).

Initial theorizing conceived the MNC as a centralized hierarchical organization (e.g. Caves, 1971) that exploited overseas ownership advantages through the transfer of knowledge generated by the parent firm in the home country. This left subsidiaries as simply market-access providers (Dunning, 1993) or passive technology recipients from the headquarters (Vernon, 1966). However, at the beginning of the 1990s, changes in the worldwide economy, together with an apparent trend toward the internationalization of more value-adding activities by MNCs, led researchers to take more seriously the possibility that foreign subsidiaries might in fact play an important role as sources of new knowledge and capabilities (Frost, 2001). This meant that the parent office relinquished its dominant position in the hierarchy to create and hoard all sources of competitive advantage, in favour of a network formed by differentiated subsidiaries. From this juncture on, the attention of researchers has become increasingly focused on the idea that what makes an MNC unique is not so much the traditional process of 'forward' knowledge transfer, but rather the less conventional process of 'reverse' and 'lateral' transfer of knowledge from the subsidiary to the headquarters and among the subsidiaries (Ambos, Ambos, & Schlegelmilch, 2006). Correspondingly, later theorizing perceived MNCs as being less hierarchical and more loosely coupled organisations evolving towards a heterarchically (Hedlund, 1986), transnationally (Bartlett &

Ghoshal, 1989) or even metanationally (Doz, Santos, & Williamson, 2001) differentiated network corporate model. Thus, the focus of investigation shifted from the parent company to the subsidiary unit.

According to these new models, MNCs assign diverse missions and mandates to subsidiaries in order to secure a widened range of objectives subject to their reasons for operating in each host country (Manolopoulos, 2010). Thus, some subsidiaries that began as local market-oriented (import-substituting) units have been gradually transformed into effective knowledge-seeking units. With this has also come the realization that different subsidiaries might play different roles within the MNC network (Harzing & Noorderhaven, 2006). Concurrently, ownership-advantages are no longer solely developed at corporate headquarters, since the subsidiaries may themselves become important sources of competitive advantage for the entire MNC (Hogenbirk & van Kranenburg, 2006), often adopting the role of strategic leaders (Bartlett & Ghoshal, 1986), acquiring world mandates (Birkinshaw & Morrison, 1995) or establishing themselves as centres of excellence (Holm & Pedersen, 2000). This research effort to provide different role typologies for subsidiaries reflects this shift in the locus of firm-specific advantage creation in the frame of the MNC (see Birkinshaw & Morrison, 1995; Birkinshaw & Hood, 1998, Birkinshaw et al., 1998).

As the R&D function is in large part responsible for the creation and transference of the MNC's proprietary knowledge, the importance of effectively managing internationally dispersed R&D subsidiaries becomes 'the *raison d'être* of the MNC' (Nobel & Birkinshaw, 1998). As such, the study of knowledge transfers is better undertaken by narrowing down the unit of analysis from the subsidiary to the R&D value chain. The above arguments regarding subsidiaries' roles are even more applicable to the specific case of the R&D function. Traditionally, for the sake of sustaining the MNC's competitive advantage, the core of the R&D process was undertaken within the home country. Thus, MNCs used to locate their R&D units close to the parent office so as to protect and maintain control

over them (De Meyer, 1993) and so avoid the risk of unwanted leakage of proprietary knowledge (Ambos & Schlegelmilch, 2007). The only situation in which a foreign subsidiary might undertake 'marginal' creative activities would be when there was a need to adapt the MNC's centrally derived capacities to local conditions (Bartlett & Ghoshal, 1989; Manolopoulos, 2010; Prahalad & Doz, 1987). However, in recent years, linked to the closer integration of subsidiaries into international networks within the MNC, some subsidiaries have gained a more creative role involving the generation of new technology in accordance with their host country's comparative advantage in innovation (Cantwell, 1995; Cantwell & Janne, 1999; Cantwell & Mudambi, 2005; Pearce, 1999; Zander, 1999). This shift has led to an increase in the quality and number of R&D activities being undertaken in foreign subsidiaries and, in turn, in the variety of R&D roles being performed; some of a particularly contributive disposition, such as global innovator (Gupta & Govindarajan, 1991), home-base augmenting (Kuemmerle, 1997) or competence-creating roles (Cantwell & Mudambi, 2005).

Indeed, *'a potentially important source of competitive advantage for multinational firms is the capacity of their foreign subsidiaries to generate innovations based on the stimuli and resources resident in the heterogeneous host country environments in which they operate'* (Frost, 2001). In this respect, one element which has received increasing research attention is the MNC's participation in its surrounding networks through its interorganizational relationships (Gulati, Nohria, & Zaheer, 2000), in particular its subsidiaries' relationships with the local context, that is, their external embeddedness (Nell & Andersson, 2012). This line of literature argues that the interaction of a subsidiary with its local counterparts (that is, its customers, suppliers, universities, science centres or regulators and other policy-makers) constitutes an important source of knowledge for contributing to the development of capabilities in the MNC as a whole (Andersson, Forsgren, & Holm, 2001; 2002; 2007; Andersson, Björkman, & Forsgren, 2005; Forsgren, Holm, & Johanson,

2005; Holm, Holmström, & Sharma, 2005; Nell & Andersson, 2012; Rabbiosi, 2011; Schmid & Schurig, 2003; Wang & Suh, 2009).

These relationships can be of various kinds and, as such, represent different possibilities for learning and development, ranging from arm's-length relationships, where there is no element of capability building, to long-lasting relationships, involving the exchange of information and knowledge of increasing complexity (Figueiredo, 2011). Consequently, the R&D roles of subsidiaries may vary because of the existence of differences in their external network embeddedness, given that subsidiaries will be differentially exposed to new knowledge, ideas and opportunities. The shift towards 'supply-side' motivations to perform R&D operations overseas (Criscuolo, Narula, & Verspagen, 2005) along with the strategic significance of interorganizational ties (Wang & Suh, 2009) has led headquarters to allocate different R&D mandates to specific subsidiaries so that they might tap knowledge linked to the host environments of these subsidiaries, especially capability augmenting mandates (Ambos & Schlegelmilch, 2007). These subsidiaries that control vital resources that other parts of the MNC depend upon have received multiple labels, including *global innovators*, *home-base augmenting*, *competence-creating* or *capability-augmenting*, as well as *centres of excellence*.

While all these terms have been used in referring to subsidiaries that contribute substantially to firm-specific advantage (Birkinshaw, Hood, & Jonsson, 1998), they are not exactly interchangeable, their meaning varying with the nature of the subsidiary's contribution to MNC competitiveness (Blomkvist, Kappen, & Zander, 2010). However, they all have one thing in common, namely their explicit recognition of the relative superiority of the technological competences held by the subsidiary in question. For this reason, here we adopt the generic term 'R&D-contributing role' in order to bundle together these different types of more technologically advanced foreign subsidiaries and to refer to subsidiaries that have been assigned a competence-creating mandate.

At the heart of this 'contributory role' (Birkinshaw et al., 1998) lies the ability of subsidiaries to create unique value by linking the resources and capabilities located at different places in the external environments in which they are embedded (Forsgren, Johanson, & Sharma, 2000). However, this ability is also dependent on the level of integration they enjoy within the MNC network, i.e. their degree of internal embeddedness. The stronger the linkages that a subsidiary builds with its headquarters and sister subsidiaries within the corporate network, the greater will be its predisposition to share and transfer knowledge (Michailova & Minbaeva, 2012). Thus, the ability to manage dispersed capabilities effectively within this 'double network' – comprising internal and external networks (Zanfei, 2000) – is seen as a key aspect to an MNC's competitive advantage (Frost, Birkinshaw, & Ensign, 2002). Nevertheless, very little is known about the simultaneous impact of the internal and external contexts on the different R&D roles adopted by subsidiaries, especially those of a high-contributing nature.

Although in the framework of this double-network organization (Zanfei, 2000), dispersed R&D units are subject to isomorphic co-evolution pressures at the interface of the contexts of the local environment and the MNC organization (Heidenreich, 2012), the literature examining subsidiary R&D roles focuses mainly on just one side of the dual phenomenon, either the internal or the external network. While some authors have reported that the level and direction of intra-corporate knowledge flows are important factors in predicting R&D-contributing roles (Ambos & Reitsperger, 2004; Birkinshaw & Morrison, 1995; Ciabuschi, Dellestrand, & Martin, 2011; Gupta & Govindarajan, 1991; Harzing & Noorderhaven, 2006; Nobel & Birkinshaw, 1998), others have examined the impact of local embeddedness (Andersson & Forsgren, 2000; Andersson, Forsgren, & Pedersen, 2001; Andersson et al., 2002; 2007; Frost et al., 2002; Holm & Pedersen, 2000), while just a few recent studies have explicitly considered their simultaneous impact on subsidiary innovation, albeit not specifically on their R&D roles. For instance, Figueiredo (2011) explores the effect of corporate and local

embeddedness on the innovative performance of subsidiaries over time, but omit their influence on roles; Yamin & Andersson (2011) investigate how internal embeddedness acts as a moderating factor of the external embeddedness effect, but focus on a subsidiary's 'distinctiveness'. More closely related to the analysis of the interface between internal and external embeddedness and subsidiary roles, Birkinshaw, Hood, & Young (2005) developed a four category typology (externally-focused, internally-focused, benign environment, dual-focused) emphasizing the interplay between subsidiary entrepreneurship and the subsidiary's competitive environment, but for the whole subsidiary as a unit, with a unique, homogeneous role; and Gammelgaard, McDonald, Stephan, Tüselmann, & Dörrenbächer (2012) developed this work further by adopting a dynamic approach and testing the model in a large sample. However, this second study does not provide any evidence of the factors that determine these complex interactions in terms of subsidiary roles. Only two recent contributions analyse the role of subsidiaries within both contexts, although they both suffer substantial limitations: first, Wang, Liu, & Li (2009) assess the role of subsidiaries according to their relative positions in the internal and external networks, but do so independently and do not examine the simultaneous influence of both competing forces; second, Helble & Chong (2004) analyse and classify R&D subsidiaries in four groups according to their degree of embeddedness (fully linked, externally semi-linked, internally semi-linked, loosely linked), but neglect the point at which such links influence innovation. In sum, despite increasing interest in the double-network approach to MNCs, it has not yet been fully applied to subsidiary R&D typology.

Consequently, as the literature on subsidiary R&D roles is either fully concerned with relational embeddedness or with organizational issues, it is our contention that these two perspectives serve as complementary, partial explanations of the same phenomena. To fill this gap in the literature, the objective of this thesis is to develop a model that considers the interaction effects of all elements. We posit that the differential role of subsidiaries as contributors to the MNC's competitive advantage can best

be understood by simultaneously analysing the characteristics of the corporate- and country-level factors and the dual embeddedness of the subsidiaries within these contexts. Hence, this thesis seeks to provide fresh answers to the following traditional questions:

(1) Why do the subsidiaries of the same firm sited in different locations develop different R&D roles?
(2) Why do the subsidiaries of different firms sited in the same location develop different R&D roles?

To answer these research questions, this dissertation subscribes to the view of the firm as a network of differentiated roles and responsibilities in which access to internal and external knowledge networks enables it to continuously create and renew its competitive advantage (Ambos et al., 2006; Nohria & Ghoshal, 1997). There are several reasons why an in-depth investigation of subsidiaries' R&D roles, such as the one reported in this thesis, may be of interest to both academics and practitioners. First, certain schemes may be uniformly adopted across the whole universe of subsidiaries, but if we accept that distinct types can be identified, the appropriate starting point from a theoretical and practical perspective is to believe that modes of governance, strategizing and competing will also tend to vary. Second, such studies should be able to simplify the complexity of the reality of networked firms, the subsidiaries of which act as nodes embedded in a variety of local contexts. By reducing the number of related characteristics into a manageable number of features clustered in distinct typologies, it should be easier to understand and explain how multinational companies function (Harzing & Noorderhaven, 2006). Third, investigations of this type can be used to predict the drivers of the attaining of competence-creating mandates in contrast with those that lead to the adoption of alternative R&D roles (e.g. competence-exploiting or isolated subsidiaries or even mandate depletion). This is particularly important if the underlying goal is to establish the guidelines for firms' best practices.

1.2. STRUCTURE OF THE THESIS

The general questions announced are addressed from several empirical angles embodied in three essays. These essays can be integrated to form a unique line of argument, where each essay delves more deeply into the findings of the former; or, seen from another perspective, each essay paves the way for undertaking the subsequent analysis. Table 1.1 provides an overview of the three essays that constitute this dissertation.

The initial essay[1], after first contextualizing the research field and revisiting the commonly cited location advantages for R&D, serves to accommodate our understanding of the drivers of subsidiary R&D roles to the growing integration of subsidiaries into international networks, both within and outside the MNC. Given that MNCs increasingly seek to optimise their global innovative capabilities by incorporating subsidiary-specific advantages in different countries (Davis & Meyer, 2004), this essay addresses the specific question: 'How important are the different location advantages for a subsidiary's R&D-contributing role?'. Adopting a case study methodology and examining eight subsidiaries in Spain with their own centres of excellence, the results of this chapter, not surprisingly, support the well-established understanding that R&D activities in competence-creating subsidiaries are supply-driven. They also reveal that the Spanish environment does not appear to be exceptional in terms of either its demand-side or supply-side factors, and that it runs the risk of becoming 'stuck in the middle' (Porter, 1980) with no distinct comparative advantages for the location of international R&D. The most surprising result here is that despite the 'liability of the location' of the Spanish context, several subsidiaries have succeeded in developing high R&D-contributing roles. The main reason for this unexpected finding is the latent relational component of many of the R&D location advantages examined. Many of the key determinants of the location of

[1] The first essay was made possible thanks to the support of the Fundación I+E and the financing of the Fundación Española para la Ciencia y la Tecnología (Spanish Ministry of Science and Innovation).

R&D activities are based on the possibility of establishing more or less permanent relations in the environment, whereby subsidiaries are able to be more receptive to new knowledge, ideas and opportunities. As such, subsidiaries can be located in an intermediate economy with less advanced technology, yet collaborate with domestic agents in highly knowledge-intensive activities. This serves to emphasise that in order to fulfil competence-creating mandates, subsidiaries must be able to build suitable relationships, and not just depend on the site activities in a munificent location (Cantwell, 2009), which are captured in the network embeddedness approach (Dyer & Singh, 1998; Gulati et al., 2000; Uzzi, 1996). These findings provide some preliminary insights as to why some subsidiaries acquire high R&D-contributing roles while operating in a moderately innovative country. This alternative approach is used in reorienting the subsequent research in this dissertation.

The second essay[2] examines the evolution in the subsidiary's R&D role as a consequence of interacting with a variety of networks. So we examine the question: 'How do internal and external knowledge embeddedness act together in determining subsidiary R&D roles over time?'. This issue is addressed by conducting four longitudinal case studies of subsidiaries operating in Spain. Using an inductive approach to theory building, the essay provides a general theoretical framework considering the subsidiary's embeddedness in knowledge networks within the MNC (internal) and within the host country (external) and demonstrates that evolving towards an R&D-contributing role is a response to the simultaneous growth in knowledge embeddedness in the local environment and within the corporate network. Otherwise, when the rise in either internal embeddedness or external embeddedness prevails, a subsidiary may gravitate, respectively, towards a competence-exploiting mandate or a situation of geographical isolation in terms of mandate assignment. By contrast, when there is a fall in the degree of both

[2] The analysis reported in the second essay was part of a major research project conducted in the framework of a research contract with the regional innovation agency (ACC1Ó) of the Catalan Government (Spain).

internal and external embeddedness, the subsidiary faces the risk of seeing its R&D mandate being diminished. These findings are useful in furthering our understanding of how best to manage and frame the dynamics of the dual-embeddedness of subsidiaries' R&D roles, and their subsequent contribution to MNCs' competitive advantage. This in turn prompts a focus on dual-embedded competence-creating subsidiaries and guids the ensuing research.

The results obtained in the first and second essays challenged us to disentangle the confounding effects of country factors, corporate factors and dual-embeddedness by asking in the third essay[3]: 'Does the R&D-contributing role of subsidiaries stem from munificent internal and external environments or from the interaction with agents in these contexts?' The fragmented and contradictory findings regarding the effect of corporate- and country- level factors on subsidiary R&D-contributing role are the main motivations for combining data on country, corporate and dual embeddedness to tackle this problem. This thesis finds that favourable internal and external context conditions do not necessarily lead to the enhancement of a subsidiary's R&D-contributing role unless dual embeddedness is well established. Adopting a partial least square approach to structural equation modelling, we provide empirical evidence for the interaction of these elements based on a survey of 111 foreign-owned subsidiaries located in Spain. The main contribution of this essay is the development of a multiple mediating model that disentangles the way in which corporate- and country-level factors interrelate with internal and external subsidiary embeddedness in the configuration of high-contributing R&D roles. Specifically, the model brings to the fore the following significant relationships: (1) internal and external embeddedness respectively mediate the relationship of corporate- and country-level factors with subsidiary R&D; (2) dual embeddedness (defined as a three-path mediation where external embeddedness

[3] The third essay received the generous support of the Ministry of Industry of the Spanish Government within the National Plan for Scientific Research, Development and Technological Innovation.

precedes internal embeddedness) also sequentially mediates the relationship between country-level factors and the subsidiary R&D-contributing role.

Consequently, the three essays collectively examine the R&D internationalization strategy of foreign MNCs in Spain, paying special attention to the proactive use of dual-embeddedness in the location in which they wish to be present. The main features of each essay making up this PhD dissertation are summarized in the following table:

Table 1.1. Overview of the essays included in the thesis

	First essay	Second essay	Third essay
Title of the essay	The role of the environment in the location of R&D activities in the subsidiaries of foreign multinationals.	Knowledge sharing and subsidiary R&D mandate development: A matter of dual embeddedness.	Disentangling the mediating effect of dual embeddedness on the subsidiary's R&D-contributing role.
Purpose	Revisiting the most relevant determinants within the local environment when the subsidiaries of an MNC compete with each other to attract R&D activities to their host country.	Developing an integrated framework of the interaction effects of changes in internal and external network embeddedness on a subsidiary's R&D role from an evolutionary perspective of competence mandates.	Unravelling the confounding effects of country factors, corporate factors and dual-embeddedness on the subsidiary's R&D-contributing role.
Research question	How important are the different location advantages for the subsidiary's R&D-contributing role?	How internal and external knowledge embeddedness interact determining subsidiary R&D roles over time?	Does the R&D-contributing role of subsidiaries stem from the munificent internal and external environments or from the interaction with agents in these contexts?
Theoretical framework	Transaction costs. Resource-based view.	Network-based view.	Industrial-organizational perspective. Resource-based view. Network-based view.
Methodology/ approach / design	Qualitative method based on cross-sectional multiple case-study. Deductive approach to theory verification through the matching patterns across eight foreign owned subsidiaries in Spain.	Qualitative method based on longitudinal multiple case-study Inductive approach to theory building though the narrative technique applied to four foreign-owned subsidiaries operating in Spain.	Quantitative method based on partial least square approach to structural equation modelling. Testing of a serial multiple mediator model on a sample of 111 foreign owned subsidiaries located in Spain.
Main finding	Spanish environment does not appear to be exceptional in terms of either its demand-side or supply-side factors, when it comes to attracting foreign direct investment in R&D and innovation, and it runs the risk of becoming 'stuck in the middle'	Evolving towards a competence-creating mandate is characterised by the simultaneous growth of embeddedness in both internal and external networks; otherwise, a subsidiary may gravitate away from upgrading its R&D role.	The model brings to the fore internal and external embeddedness as mediators in the relationship between corporate- and country-level factors with the R&D-contributing role of subsidaries.

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CHAPTER 2. THE ROLE OF THE ENVIRONMENT IN THE LOCATION OF R&D ACTIVITIES IN THE SUBSIDIARIES OF FOREIGN MULTINATIONALS

2.1. INTRODUCTION

Attracting direct investment in the R&D[4] of foreign multinational enterprises (MNCs) constitutes a major source of potential benefit for any country as well as providing it with possibilities of economic growth. Over 95% of the 700 firms with the highest R&D expenditure in the world are MNCs and they account for roughly half the global expenditure on such activities (UNCTAD, 2005). As such, attracting R&D activities is fundamental in fostering the development of national innovation systems (NIS)[5] and in helping generate the innovative climate and culture that are vital for improving a country's competitiveness.

Yet, while several indicators show there to be an increasing number of MNCs undertaking more and more of their R&D beyond the frontiers of their country of origin[6], attracting it is no easy task. According to the 2008 *EU Survey on R&D Investment Business Trends* (2009)[7], more than 50% of the MNCs questioned reported the parent company's country of origin to be the 'most attractive' location and, therefore, the site preferred for investing in R&D.

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[4] According to the Frascati Manual published by the OECD (2002) "*research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge* (…) *and the use of this stock of knowledge to devise new applications*" (OECD, 2002: pp. 30).

[5] In line with Buesa (2003), a national innovation system can be defined as a network of institutional and business organisations that interact within a given territory to assign resources for the undertaking of activities that generate and disseminate knowledge on which innovations (above all, technological innovations) are based, and which constitute the foundation of economic development. For the most insightful studies of national innovation systems, see Lundvall (1992), Nelson (1993) and Edquist (1997).

[6] Between 1995 and 2005, the R&D expenditure of foreign subsidiaries in the countries of the OECD more than doubled (OECD, 2008). In Spain, according to the *Activity of Foreign Affiliates* database, the expenditure of foreign subsidiaries on R&D in 2005 as a percentage of total private sector expenditure stood at around 27% (less than that in countries such as Ireland, the United Kingdom, Portugal and France). Moreover, 30% of all the patents at the European Patent Office for innovations developed in Spain between 2001 and 2003 were registered by the subsidiaries of foreign MNCs (in the main of European origin) with a direct presence in Spain (OECD, 2008).

[7] A survey conducted by *Industrial Research Investment Monitoring* (IRIM), the *Joint Research Centre* (JRC) and the *Directorate General for Research* (DG RTD) of the European Commission. For more information, visit http://iri.jrc.ec.europa.eu/research/survey_2008.htm.

As a result, in the current global context, the foreign subsidiaries of the same MNC compete fiercely with each other to attract the activities of greatest value added to their country and, thus, they lower the risk of their being delocalised by the parent company and at the same time, increase their prospects of survival. In this internal struggle, the characteristics of the local environment in which the foreign subsidiary is sited play a fundamental role in determining the location of new activities and responsibilities at the international level (Bartlett & Ghoshal, 1989; Birkinshaw & Hood, 1998), since the development of resources and capabilities is largely conditioned by the degree of embeddedness of the subsidiary in its environment (Andersson et al., 2002).

However, the International Business literature does not appear to offer a single theory that can account for the establishment of R&D activities in foreign subsidiaries, neither does there appear to be unanimity regarding the factors of the local environment that have the greatest impact on their location. According to internalisation theory (Buckley & Casson, 1976; Teece, 1986; Hennart, 1989), the motivations leading a multinational corporation to locate its R&D activities based on demand criteria lie in facilitating the transfer of technology from the head office in order to exploit its competitive advantage in another country. By contrast, according to the resource-based view (Prahalad & Hamel, 1990; Cantwell, 1991), MNCs are more strongly attracted by supply-side factors of technology when making decisions to expand their capacity for technological innovation (Kuemmerle, 1999a).

Most empirical studies of the drivers of foreign investment in R&D have traditionally been undertaken in countries considered by the Innovation Union Scoreboard (IUS) to be 'innovation leaders', such as the United States and Japan (Kumar, 2001), while recently they have centred on the emerging economies of Eastern Europe and Asia (Li & Yue, 2005; von Zedtwitz, 2005; Ambos & Ambos, 2009; Demirbag & Glaister, 2010). However, few studies have been carried out in countries considered to be

'moderate innovators' such as Spain[8], although a number of exceptions do exist, including González (1999); Bajo & Díaz (2002); Álvarez & Molero (2004); Molero (2005, 2007); Guimón (2008); Miravitlles et al. (2010); IESE (2010a; 2010b) and Valls et al. (2009).

This study has two specific objectives: first, it seeks to analyse the determinants of location in the local environment, classed as either factors of *technology supply* or *market demand*, that favour to varying degrees the attraction of the R&D activities of foreign MNCs; and, second, it seeks to determine whether these factors constitute strengths or weaknesses in the context of Spain, a country considered a 'moderate innovator'.

Based on views gathered from eight foreign subsidiaries sited in Spain that have been given a competence-creating mandate, to use Cantwell and Mudambi's (2005) classification, this article reflects on the most relevant determinants within the local environment when the subsidiaries of an MNC compete with each other to attract R&D activities to their host country[9].

The rest of this study is organised as follows: in the next section the principal theories of the internationalisation of R&D are reviewed together with the main location factors that attract direct foreign investment, in

[8] Based on 25 different indicators, the IUS prepared its *Summary Innovation Index*, which provides an overview of aggregate national innovation performance. Based on this, it ranks the 27 member states according to their level of innovation and classifies them in four groups: (1) innovation leaders, (2) innovation followers, (3) moderate innovators and (4) the catching-up countries. According to the 2012 IUS, Spain ranks 16th among the 27 countries analysed and is classified among the moderate innovators together with such countries as Greece, Italy and Portugal.

[9] According to the Oslo Manual, published by the OECD (2006), "*innovation activities also include R&D*" (OECD, 2006: pp. 47). While R&D is not necessarily terminated when a prototype has been developed, "*a common feature of an innovation is that it must have been implemented*" (OECD, 2006: pp. 47), that is, incorporated or launched on the market in the shape of a new (or improved) product, process or organisational or marketing method. Since any firm can innovate by assimilating the technologies developed by other agents, in the innovative process we need to differentiate between activities that generate R&D (that is, which seek the production of knowledge and new applications) and activities that assimilate R&D (that is, which seek to understand and absorb the research results of others in order to innovate). The distinction between generating R&D and assimilating R&D applied to the MNC is analogous to Cantwell & Mudambi's (2005) distinction between fulfilling a *competence-creating* mandate or a *competence-exploiting* mandate.

general, and R&D activities, in particular. Section three presents the rationale for the methodology that has been adopted here. This is followed by an examination of the location factors of foreign R&D that have an influence on a country's capacity to attract these activities and a specific analysis is undertaken of the relative strengths and weaknesses in the Spanish case. The main conclusions and final comments are presented in the last section.

2.2. THEORETICAL FRAMEWORK

2.2.1. Internationalisation of R&D

From the traditional perspective of internationalisation based on transaction cost theory (Buckley & Casson, 1976; Teece, 1986; Hennart, 1989), the MNC exploits its competitive advantage internally beyond its national borders. Thus, it is held that it is the parent company that determines the type of activity and strategic role that the subsidiary will perform abroad, with the subsidiary being considered a passive tool that acts solely at the discretion of the MNC's headquarters.

A more recent theoretical conception, by contrast, sees the MNC as an internal market system in which the subsidiary enjoys considerable freedom to define its own destiny (Birkinshaw, 1999, 2001). From this perspective, the subsidiaries of the same corporation compete with each other to receive greater international mandates. Here, the attraction and location of high value-added activities are crucial for the survival of any foreign subsidiary. In the model of the transnational firm (Bartlett & Ghoshal, 1989), the MNC is like a heterogeneous interorganisational network in which the foreign subsidiaries operate with distinct charters and strategic roles[10]. Thus, in line with Jarillo & Martínez's (1990)

[10] The term 'strategic role' serves to designate the function undertaken by an affiliate, determining the strategic positions, responsibilities or charters that it might assume within the MNC.

typology, the same MNC may operate subsidiaries in some countries that adopt highly active roles (i.e. which lead the group's products lines internationally, serving as the location for strategic activities in the value chain and enjoying important decision-taking power within the corporation) and, by contrast, have subsidiaries in other countries whose role is that of 'implementer' with little decision-taking power and with responsibility for activities of little strategic importance (for example, affiliates that operate as assembly plants or commercial satellites).

Among the various activities that make up the value chain, R&D is undoubtedly one of those with the greatest strategic character and value added for any MNC. For this reason, the geographical dispersion of R&D activity beyond the borders of the parent company's country of origin is infrequent. MNCs tend to concentrate such activity at a single site (typically, near headquarters) due to the pre-eminence of *centripetal forces* – including, economies of scale and agglomeration, coordination and control problems, protection of results, etc., as opposed to *centrifugal forces* – proximity to markets and technology supply (Hirschey and Caves, 1981; Pearce, 1989). As a result, a foreign subsidiary that succeeds in attracting and locating international R&D activities can achieve greater decision-making power and responsibility within the MNC group. To use the terminology coined by Cantwell & Mudambi (2005), the subsidiary that achieves a competence-creating mandate, transferring relevant knowledge and innovations to the rest of the group, constitutes a strategic unit for the global competitiveness of the MNC and, therefore, is less likely to be delocalised in the future.

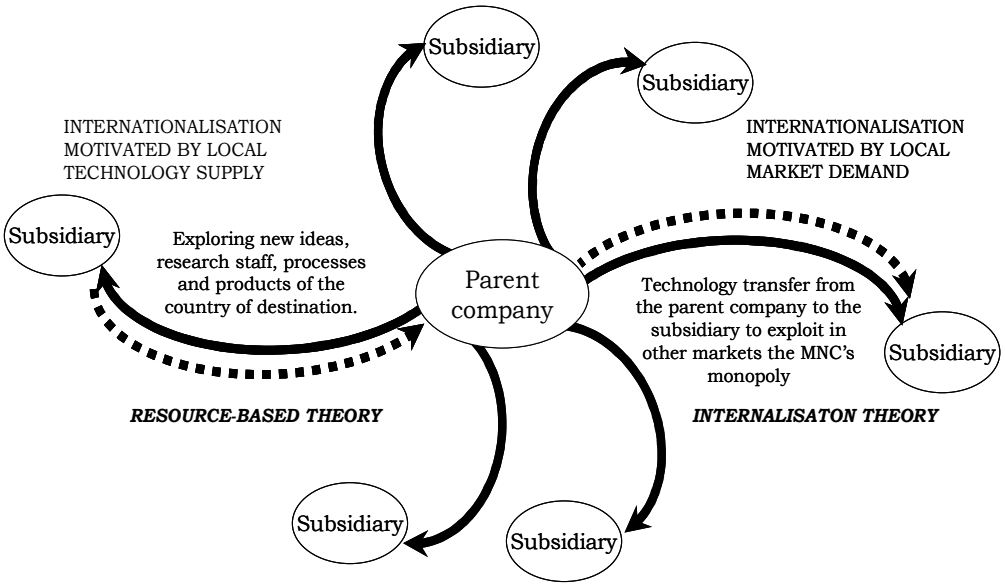
One of the most important factors accounting for the location of activities in subsidiaries, and which determines to a great extent their strategic role, is the local environment in which the affiliates operate (Bartlett & Ghoshal, 1989; Birkinshaw & Hood, 1998). Among other aspects, the deterministic role played by a subsidiary's local environment exercises a considerable influence in defining its strategic function. Foreign subsidiaries compete with each other, presenting their respective cases

before the parent company on the basis of the factors present in their local environment, as they seek to attract high value-added activities and, thus, improve their strategic position within the MNC group. Indeed, each foreign subsidiary operates under a set of unique environmental conditions to which it must adapt if it hopes to be competitive, and so the development of an affiliate's resources and capabilities is largely conditioned by its relationship with its environment. As a result, it can be concluded that the different roles assumed by subsidiaries explicitly reflect the differences in the foreign environments in which they are located (Bartlett & Ghoshal, 1986).

The environmental factors that determine a particular country's capacity to attract R&D activity can be grouped into two basic categories: demand-side aspects related to the market, henceforth market demand, and supply-side aspects linked to technology, henceforth technology supply (see Figure 2.1). The former are related to such factors as local market regulation, how demanding local consumers are, market dynamism, etc. According to the theory of internalisation (Buckley & Casson, 1976; Teece, 1986; Hennart, 1989), the reasons why an MNC locates its R&D activities on the basis of the criteria of market demand are so that it can facilitate technology transfer from the parent company to the subsidiary and, thus, exploit its competitive advantage in another country. This means internationalising R&D to provide technical support to its production units located in the overseas market and seeking to differentiate the standardised products of the MNC by adapting them to local needs and tastes. As Howells (1990) notes, the internationalisation of R&D is a tool that firms use to defend and extend their market power across national borders. Here, Kuemmerle (1999a) and Cantwell & Mudambi (2005) show that the propensity to internationalise R&D, motivated by the desire to exploit a competitive advantage, increases with the increasing attractiveness of the market of the country of destination compared with that of the MNC's country of origin.

The technology supply criteria are linked to such factors as government R&D policy, the local presence of leading scientific institutions, the availability of qualified research staff in the country of destination, etc. According to the resource-based view (Prahalad & Hamel, 1990; Cantwell, 1991), MNCs that are attracted by factors of this type consider internationalisation to be a source of value creation and for achieving new competitive advantages (Madhok, 1997) and, so, they seek to increase their technological innovation capacity by taking advantage of the knowledge that other countries can supply. Here, Kuemmerle (1999a) shows empirically that the propensity to internationalise R&D for reasons of technology supply increases when the resources committed to R&D (both public and private) in the foreign country increase, when the quality of the human resources dedicated to research improve and when the overall scientific level is raised.

Figure 2.1. Internationalisation of R&D



Source: Miravitlles, Núñez & Guitart (2010)

2.2.2. Market demand and technology supply factors

Although the determinants of the location of the R&D of MNCs have attracted considerable attention since the late seventies (Ke & Lai, 2011), it was primarily in the 80s and 90s when the literature published on the subject turned its attention to an examination of the host country's demand factors. As Table 2.1 shows, studies such as those conducted by Mansfield et al. (1979), Lall (1979), Hirschey & Caves (1981), Pearce (1989), Zejan (1990), Florida & Kenney (1994) & Kumar (2001) have analysed the various motives from the point of view of the market demand factors, finding that market size and potential are major reasons for the location of R&D activities abroad. This factor is of particular importance in cases in which the aim is to adapt the product or the production process to the local context (Mansfield et al., 1979), although it does not seem so important to firms that seek to undertake R&D at a global scale (via centres of excellence) (Bas & Sierra, 2002). Likewise, according to Pla-Barber et al. (2009) MNCs also see entry into certain countries as a platform for accessing adjacent markets.

In a similar vein, authors such as Meyer-Krahmer & Reger (1999), Gerybadze & Reger (1999), Doz et al. (2001) & Beise (2004), among others, believe that demand characteristics play an important role in the location of R&D centres. These studies conclude that firms locate technology centres in dynamic and competitive markets, in which new practices are continuously emerging to satisfy a more demanding and sophisticated consumer.

Proximity to production subsidiaries is often another reason that leads MNCs to locate their R&D activities abroad (Pearce & Singh, 1992). Given that the availability of qualified suppliers and the endowment of market infrastructure and logistics systems are critical elements for productive foreign direct investment (FDI) (Galán et al., 2007), these factors play a complementary role as R&D location factors (Rao, 2001; Sachwald, 2008; Demirbag & Glaister, 2010).

As the internationalisation of R&D has become a common phenomenon, interest has increased in the technology supply factors (Ke & Lai, 2011) listed in Table 2.1. According to Criscuolo et al. (2005), in the last decade multinational companies have given greater importance to the location of R&D activities abroad so as to increase their existing technology assets. Specifically, the aim has been to establish R&D centres that can absorb and acquire technology spillovers, either from local knowledge or from specific local firms (Feldman & Florida, 1994; Söjvel & Zander, 1995; Cantwell & Molero, 2003; Criscuolo et al., 2005; Molero & Garcia, 2008; Sachwald, 2008), or which can access highly qualified personnel (scientists, engineers, technicians, etc.) (Pearce & Singh, 1992; Florida, 1997; Kuemmerle, 1999b; Guimón, 2008; Molero & Garcia, 2008; Sachwald, 2008, & Ke & Lai, 2011). This last factor is closely linked to the quality of higher education and foreign language proficiency in the host country (Guimón, 2008; Sachwald, 2008; Molero & Garcia, 2008).

Labour costs are another relevant factor, above all in the case of R&D activities (Guimón, 2008), although recent research suggests that MNCs attach greater significance to the availability of talented researchers than to their cost.

Similarly, empirical evidence shows that the degree of labour market flexibility and the mobility of R&D personnel (Bassani & Ernst, 2002; Siedschlag et al., 2009), as well as the ability to retain scientific and technical talent (Guimón, 2008; Sachwald, 2008), are other factors taken into consideration by MNCs when deciding where to locate R&D.

On the other hand, among the factors related to the host country's technology supply (see Table 2.1), many authors suggest that the main location factors of foreign R&D are the availability of excellent research infrastructure (Kaounides, 1999; Lam, 2003; Bas & Sierra, 2002; Cantwell & Priscitello, 2002; Davis & Meyer, 2004; Chaminade & Vang, 2006; Guimón, 2008; Sachwald, 2008) and the dynamism of the national innovation system, that is, the degree of interaction and collaboration

between companies, universities and research centres (Mowery & Rosenberg, 1993; Hane, 1999; Spencer, 2001; Cohen et al., 2002; Lam, 2003; Santoro & Bierly, 2006; Jelinek & Markham, 2007; Guimón, 2008; Link et al., 2008, & Li, 2010). Similar conclusions have been reached in studies of the Spanish innovation system (Benavides & Quintana, 2008; Molero & Garcia, 2008). This literature reports that the ability of a specific R&D centre to exploit and/or increase its technological competence is a function not only of its own resources, but also of the efficiency with which it uses the resources of the environment related to the system of local innovation.

Finally, public institutions also exercise a strong influence on the technological and innovation activities undertaken in a host country. Aspects such as priority lines in R&D policy (Rama, 2008; Guimón, 2008), support for investment and the level of bureaucracy in relations with the state (Cantwell & Mudambi, 2000; UNCTAD, 2005; Zanatta et al., 2006; Edler, 2008; Tassey, 2007; Atkinson, 2007; Guimón, 2008) as well as the protection of intellectual property (Florida, 1997; Kuemmerle 1999b; Cantwell & Piscitello 2002, Hagedoorn et al., 2005) emerge as strong factors in decisions regarding the location of the R&D of MNCs.

Table 2.1. Environmental determinants of the location of foreign R&D activity

	Demand factors	Attraction of foreign direct investment	Attraction of foreign R&D activity
Market demand factors	Size and potential of the market.	Galán et al. (2007) ; Tahir & Larimo (2004) ; Zhou et al. (2002); Cheng & Kwan (2000); Buckley & Casson (1998); Tatoglu & Glaister (1998); Dunning (1988, 1998)	Guimón (2008); Kumar (2001); Florida y Kenney (1994); Zejan (1990); Lall (1980); Hirschey y Caves (1981); Pearce (1989); Mansfield et al. (1979)
	Market dynamism and competition in terms of constant launching of new products.	Galán et al. (2007); Buckley & Casson (1998); Tatoglu & Glaister (1998); Dunning (1988, 1998)	Sachwald (2008); Guimón (2008) Beise (2004); Doz et al. (2001); Gerybadze & Reger (1999)
	Demanding and sophisticated consumers.		Sachwald (2008); Beise (2004); Doz et al. (2001); Meyer-Krahmer y Reger (1999)
	Platform for accessing adjacent markets.	Pla-Barber et al. (2009)	
	Factors related with productive networks	**Attraction of foreign direct investment**	**Attraction of foreign R&D activity**
	Availability of qualified suppliers.	Galán et al. (2007); Buckley & Casson (1998); Dunning (1988, 1998)	Sachwald (2008)
	Availability of infrastructure and logistics systems.	Galán et al. (2007) ; Zhou et al. (2002); Cheng & Kwan (2000); Buckley & Casson (1998); Tatoglu & Glaister (1998); Dunning & Kundu (1995); Porter (1990); Gomes-Casseres (1990); Dunning (1988, 1998)	Demirbag y Glaister (2010); Rao (2001)
Technology supply factors	**Factors related with labour market**	**Attraction of foreign direct investment**	**Attraction of foreign R&D activity**
	Availability of qualified personnel (scientists, engineers, technicians, etc.).	Inzelt (2008); Galán et al. (2007); Zhou et al. (2002); Cheng & Kwan (2000); Buckley & Casson (1998); Tatoglu & Glaister (1998); Gomes-Casseres (1990); Dunning (1988, 1998)	Ke y Lai (2011); Demirbag y Glaister (2010); Molero y García (2008); Sachwald (2008); Guimón (2008); Kumar (2001); Kuemmerle (1999b); Florida (1997); Fors y Zejan (1996); Akerblom (1994); Pearce y Singh (1992)
	Cost of qualified personnel (scientists, engineers, technicians, etc.).	Galán et al. (2007); Tahir & Larimo (2004); Hannigan (1999); Cooke & Noble (1998); Buckley & Casson (1998); Dunning (1988, 1998)	Ke y Lai (2011) ; Demirbag y Glaister (2010) ; Lewin et al. (2009); Guimón (2008); Sachwald (2008); Thursby y Thursby (2006)
	Quality of higher education and training capacity/ Command of foreign languages.	Galán et al. (2007); Hannigan (1999); Cooke & Noble (1998)	Sachwald (2008); Molero y García (2008); Guimón (2008)
	Degree of flexibility in the Spanish labour market and the mobility of qualified personnel.	Clevel& et al. (2000); Crouch & Streeck (1997); Dunning (1993)	Siedschlag (2009); Bassani y Ernst (2002)

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	Factors related with the innovation system	Attraction of foreign direct investment	Attraction of foreign R&D activity
Technology supply factors	Presence of leading scientific institutions.	Hannigan (1999); Cooke & Noble (1998); Dunning (1988); Barkema & Vermeulen (1998); Barkema et al. (1996); Kogut & Zander (1993)	Sachwald (2008); Guimón (2008); Chaminade & Vang (2006); Davis y Meyer (2004); Bas & Sierra (2002); Cantwell y Priscitello (2002); Kaounides (1999); Lam (2003)
	Ability to attract scientific and technical talent.		Guimón (2008); Sachwald (2008)
	Links between the business world and the scientific/academic world.		Li (2010); Guimón (2008); Link et al. (2008); Jelinek y Markham (2007); Santoro y Bierly (2006); Cohen et al. (2002); Spencer (2001); Lam (2003); Mowery y Rosenberg (1993); Hane (1999)
	Presence of industrial districts and the spillover effect.	Galán et al. (2007) ; Zhou et al. (2002); Cheng & Kwan (2000); Buckley & Casson (1998); Porter (1990); Gomes-Casseres (1990); Dunning (1988, 1998)	Sachwald (2008); Molero y García (2008); Criscuolo et al. (2005); Cantwell y Molero (2003); Sõjvel y Zander (1995); Feldman y Florida (1994)
	Factors related with R&D policy	**Attraction of foreign direct investment**	**Attraction of foreign R&D activity**
	Government R&D/innovation policy.	Galán et al. (2007)	Guimón (2008); Rama (2008)
	Government support for investment in R&D/innovation and bureaucratic procedures when applying for funding.	Galán et al. (2007); Buckley & Casson (1998); Dunning (1988)	Guimón (2008); Tassey (2007); Atkinson (2007); Edler (2008); Zanatta et al. (2006); UNCTAD (2005); Cantwell & Mudambi (2000)
	Protection of intellectual property.		Hagedoorn et al. (2005); Florida (1997); Kuemmerle (1999b); Cantwell y Piscitello 2002)

2.3. METHODOLOGY

To analyse the environmental determinants of the location of the R&D activities of the MNC foreign subsidiaries we adopt a qualitative case-study methodology. This is particularly suited to research that seeks to further understanding of a phenomenon using an inductive approach, since it allows us to address more fully the complexity of the problem, the nature of the context and the behaviour of the agents involved and the relations between them (Gummesson, 2006).

The study focuses on those subsidiaries that carry out significant R&D activities and which have achieved, in the words of Cantwell & Mudambi (2005), a competence-creating mandate within the MNC group. The

selection of cases meets the criteria of theoretical sampling and theoretical saturation, given that they have been chosen for their relevance and not according to their representativeness. In other words, they have been selected according to their expected contribution to the objectives of the research, since, given the limited number of cases that can typically be studied, the selection is justified on the grounds that cases are chosen in which the phenomena under study are 'transparently observable' (Eisenhardt, 1989). Therefore, to identify the case studies we turned to the *Fundación I+E Innovación España*, which recognises eight subsidiaries that are notable for their activity and efforts in the field of R&D. The achievements of these subsidiaries have resulted in the creation of consolidated centres of R&D in Spain, which generate applications for their respective corporations worldwide. They are, in short, cases that deserve to be studied given their experience and technological potential, and whose model of development can be taken as a point of reference within Spanish business and industry. Table 2.2 provides an overview of the eight companies.

Table 2.2. Case studies

Alstom
General profile of the Spanish subsidiary
Alstom, based in Paris, is a multinational with operations in more than 70 countries. It is a world leader in power generation and transmission infrastructure and rail transport, and a point of reference for innovative and environment friendly technology. With an industrial presence in Spain since 1989, Alstom reported a turnover for the financial year 2011-2012 of more than 899 million euros and provided employment to around 4,000 workers. Alstom has a permanent industrial presence in 14 of the 17 Autonomous Communities of Spain, including Andalusia, Castilla y Leon, Catalonia, Galicia, Madrid, Navarra and the Basque Country and undertakes all kinds of projects, from design, engineering and manufacturing to maintenance in the power generation and rail transport sectors.
Innovation profile of the Spanish subsidiary
Alstom España has a mean annual R&D expenditure of between 20-25 million euros, dedicated to applied research (20%), experimental product development (50%) and experimental process development (30%). The R&D knowledge transfer between the business units moves primarily from the parent company to the subsidiary. A good example of this is the world R&D headquarters that AlstomWind operated in Spain, employing 120 staff members, and which delivers its innovations and developments to the rest of the world. It also maintains links with the rest of the group by creating joint technological capabilities in the development of new products and processes.
ArcelorMittal
General profile of the Spanish subsidiary
ArcelorMittal was created following the merger of the Arcelor Group and the Mittal Group in 2006. Its headquarters are in the city of Luxembourg. It is a global steel group with considerable intra-sectoral diversification within the steel industry, undertaking activities in the automobile, construction, household appliances and packaging markets, among others.
Innovation profile of the Spanish subsidiary
With a total annual R&D expenditure of 7.33 million euros, Arcelormittal España S.A. dedicates approximately 50% to applied research, 40% to experimental process development and 10% to basic research. The R&D centre of this subsidiary concentrates on its own design and development of new production processes, the outcomes of which can then be transferred to the rest of the MNC group. It works jointly with the parent company to create or enhance technological capabilities for new product and process development. It also engages in some specific R&D projects with Spanish universities of an operational nature.

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Ericsson

General profile of the Spanish subsidiary

Ericsson is a Swedish corporation founded in 1876 as a telegraph equipment repair shop. Today it is a multinational company with a presence in 175 countries and the leading supplier of telecommunications equipment and related services and multimedia solutions for operators of fixed and mobile networks.

The multinational began operations in Spain in 1922, although it had operated in the country as a commercial agent since its inception (in 1876). The first major customers of Ericsson in Spain were the State Administration and Telefónica, Spain's telephone company. In 1993, Ericsson began to supply Telefónica with its GSM mobile network. Today, the company supplies telecommunication systems to Spain's leading operators.

Innovation profile of the Spanish subsidiary

The Swedish multinational's spending on R&D in Spain stands at around 70 million euros. Of this, approximately 80% of the activity of *Ericsson I+D Madrid* is dedicated to applied research, 10% to basic research and a further 10% to experimental product development. The centre has technological innovation capabilities for developing new products or components for the entire MNC group and for improving product quality.

In *Ericsson I+D Madrid* research outcomes are transferred to the rest of the group and the centre works proactively to transmit new product and process developments and to influence the strategic decisions of the MNC group.

The centre works in close and ongoing collaboration with its customers in developing strategic R&D activities, with high knowledge requirements in creating technological capabilities and in solving complex problems.

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Hero
General profile of the Spanish subsidiary
Hero is a multinational consumer food group founded in Switzerland in 1886 and which entered Spain in 1922 to ensure the supply of raw materials for its Swiss jams. It currently produces around 400 different products including jams, marmalades, preserves, pickles, sauces, ready meals, diet foods and infant nutrition products. Similarly, the Spanish subsidiary also operates in a wide range of activities in the food sector, above all the infant nutrition business. Under the brand name HeroBaby, it sells such products as infant formula, juices, and cereals.
Innovation profile of the Spanish subsidiary
Hero's Spanish business unit, *Alimentación infantile,* has a current annual R&D expenditure of 5 million euros for experimental product development (50%), applied research (30%), basic research (10%) and experimental process development (10%). This R&D centre makes minor adaptations to products for different geographical markets, designs and develops its own new production processes, improves product quality and develops new products or components for the entire MNC group. The transfer of the R&D results between the business units moves primarily from the parent company to the subsidiaries. The links maintained between this R&D unit and the parent company and the rest of the foreign affiliates in the group comprise interactions for the joint creation and improvement of technological capabilities for developing new products and processes, as well as proactive interactions to transmit new product and process developments and to influence the strategic decisions of the MNC group. It also works closely in the constant development of strategic R&D activities, with high knowledge requirements, and in the creation of technological capabilities with customers, suppliers, universities and research centres in Spain

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Hewlett Packard

General profile of the Spanish subsidiary

This US company was founded in 1939 and initially produced electronic measurement and laboratory instruments. Today, Hewlett Packard supplies technological solutions for consumers, firms and institutions all over the world with a product range that includes printing systems, PCs, software, and IT services and infrastructure.

In 1971 Hewlett Packard created its Spanish subsidiary - until then its presence in Spain had been limited to an agreement with a Spanish firm that distributed its products in the domestic market.

Innovation profile of the Spanish subsidiary

Barcelona is currently home to the Global R&D Centre for large format printing, with a total annual R&D expenditure of 60 million euros. The centre undertakes experimental product development (60%), applied research (20%), basic research (10%) and experimental process development process (10%).

The R&D centre has the capacity to undertake technological innovation for the development of new products or components for the U.S. multinational, transferring its knowledge and results from the subsidiary to the rest of the group, enjoying a strong influence in the corporate decision-making process.

Sony

General profile of the Spanish subsidiary

The Japanese firm was founded in 1946 under the name of *Tokyo Telecommunications Engineering Corporation*, assuming the name of Sony Corporation in 1958. Today, Sony operates all over the world in a range of business areas, manufacturing audio, video, communication and IT products.

Sony's activity in Spain dates back to 1967, when it granted a licence to a Catalan firm to manufacture televisions. In 2010, Sony closed its LCD television plant in Viladecavalls (Catalonia), but continues to operate an R&D unit in Barcelona.

Innovation profile of the Spanish subsidiary

Currently, *Sony Electronics* has a total annual R&D expenditure in Spain of 4 million euros for undertaking primarily applied research (70%) and experimental product and process development (30%).

In line with the subsidiary's role of prominence, the R&D unit aims to increase the technological knowledge of the entire multinational group by exploiting the comparative advantages that the host country enjoys over the country of origin. Thus, R&D knowledge transfer takes place within the Japanese group in all directions, both from the parent company to the Spanish subsidiary and vice versa.

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ThyssenKrupp Elevator
General profile of the Spanish subsidiary
The German corporation ThyssenKrupp was founded in 1999 with the merger of two steel firms, Thyssen and Krupp. Thyssen had had operations in Spain since 1974 and was the original parent company of the Spanish subsidiary, *ThyssenKrupp Elevator*. ThyssenKrupp Elevator operates in the elevator sector manufacturing lifts, escalators, and airport walkways, and accessibility systems for people of reduced mobility.
Innovation profile of the Spanish subsidiary
Currently, the business unit, ThyssenKrupp Elevator Innovation Centre has a total annual R&D expenditure of 5.7 million euros, dedicating approximately 30% of this budget to basic research, 40% to applied research and 30% to experimental product and process development. The R&D centre has the capacity to undertake technological innovation for the development of new products or components for the whole group and the transfer of knowledge and R&D outcomes move mainly from the subsidiary to the parent company or to the group's other subsidiaries. Thus, the subsidiary seeks to increase the technological knowledge of the entire MNC group exploiting the comparative advantages offered by the host country compared to those of the MNC's country of origin.
Vodafone
General profile of the Spanish subsidiary
Vodafone is a mobile telecommunications company with network operations in 31 countries and network partnership dealings with a further 40 on all five continents. It offers complete voice (sending and receiving calls), data (courier services) and internet services. In Spain, it initially operated as *Airtel Móvil, S.A.*, while the Vodafone brand did not emerge until 1994. Its second generation (2G) mobile service was launched in October 1995 to compete with the monopoly in the Spanish telecommunications market. In October 2001, after a brief period operating under the dual Airtel-Vodafone brand, it was one of the group's first subsidiaries to fully adopt the Vodafone brand name.
Innovation profile of the Spanish subsidiary
Currently, the *Vodafone España* R&D Centre has a total annual R&D expenditure of 3 million euros, primarily dedicated to undertaking experimental product development (80%). It also conducts some applied research (10%) and experimental process development (10%). The R&D unit is principally engaged in adapting products developed in the home country of the English MNC to the tastes and needs of customers in different countries, and in adapting processes to the subsidiary's available resources. The transfer of knowledge within the MNC occurs in all directions, with transmission both from the parent company to the Spanish subsidiary and vice versa.

Source: Web pages of the firms and information obtained from interviews conducted as part of study.

To ensure the reliability of the case study analysis, a research protocol (Yin, 2009) was used, the aim of which was to ensure that if a researcher at a later date were to follow the exact same procedures as described here in undertaking the same case study, they would obtain identical results. The data were collected in two rounds of semi-structured interviews of approximately two hours duration. The first round was completed between March and June 2010 and the second in June 2012. Joint meetings were held with executives and middle managers of the subsidiary responsible for R&D. They generally included the General Managers, the R&D managers and the staff responsible for R&D in the subsidiary (Table 2.3).

The interviews were structured in two blocks: the objective of the first block was to obtain an overview of the R&D activities and processes and of the technological innovation undertaken by the subsidiary. In the second block, a systematic examination was undertaken, in accordance with a predetermined script based on a review of the literature, of the determinants of the location of the subsidiaries' R&D centres. Respondents were asked to categorise these factors according to their importance (a factor of high, moderate or low impact), assessing at the same time whether they considered these factors to constitute specific strengths or weaknesses in the Spanish context.

As well as capturing the perspective of the subsidiaries of foreign MNCs based in Spain, by way of a counterpoint, we also sought to determine the official government perspective. For this reason, we also interviewed, in this instance via conference call, the Technology Director of the Centre for the Development of Industrial Technology in Spain[11] (see Table 2.3).

[11] The CDTI (the Spanish Centre for the Development of Industrial Technology) is a public business entity affiliated to the Ministry of Science and Innovation, which promotes innovation and technological development in Spanish firms. Since 2009 it has processed applications for funding and support for R&D received by the Ministry of Science and Innovation from Spanish firms both in Spain and abroad.

Table 2.3. Organisations and managers interviewed

VIEWPOINT: Subsidiaries of foreign MNCs with R&D centres in Spain				
Organisation	2011 sales figures (million €)	Number of employees in 2011	Interviewees	Location of R&D centre in Spain
ALSTOM[1]	589.02	2,200	• *S&P Transport / R&D Director* • *R&D Engineer*	Santa Perpètua de la Mogoda (Barcelona)
ArcelorMittal	2,697.60	6,578	• *Director of R&D Centre*	Avilés
Ericsson	746.34	1,250	• *Manager of Policy & DPI Product Management* • *Manager of Policy & DPI Product Management* • *Senior Manager R&D Operations & Support*	Madrid
Hero	218.12	770	• *Vice President Infant Nutrition HERO Goup/Director Quality and R&D HERO España S.A.* • *Legal Manager / HERO GTC Infant Nutrition* • *Scientific Manager / HERO GTC Infant Nutrition* • *Director General HERO España y Portugal*	Murcia
Hewlett Packard	1,318.15	2,683	• *Director of R&D* • *Director of Research and Development* • *R&D Planning / Large Format Division (LFP)*	San Cugat del Vallès (Barcelona)
Sony[2]	1,166.25	2,787	• *Safety & Compliance Dept Senior Manager* • *Director Finance & Operations*	Viladecavalls (Barcelona)
ThyssenKrupp Elevator	444.86	3,394	• *Director of Corporate Development*	Asturias
Vodafone	5,504.37	4,368	• *Manager of External Relations* • *Head of Vodafone R&D Centre Spain*	Madrid
VIEWPOINT: Spanish Government				
Centre for the Development of Industrial Technology (CDTI). *Ministry of Science and Innovation*			• *Technology Director*	Madrid

(1) Figures include Alstom Power and Alstom Transporte, but interviews were conducted only within the latter business line.
(2) Data correspond to the financial year 2010.

Source: Sistema de Análisis de Balances Ibericos

Two strategies were employed to strengthen the validity of the study (Yin, 2009). On the one hand, the information obtained from conducting in-depth interviews was complemented with other sources of information, either obtained directly from the corporation or from external sources (corporate websites, company reports, industry reports or newspaper articles), to strengthen quantitatively the main results of the case analyses. In addition, interviews were conducted with various managers from the same company, in which several interviewers also participated. This served to enrich greatly the data collection process. Finally, each of the case reports that were drafted was reviewed by the informants themselves. All these strategies served to complete the triangulation of data, which further strengthens the reliability of the research (Miles & Huberman, 1994).

2.4. RESULTS

The research results are summarised in Table 2.4. This shows, first, the degree of importance (factor of high, moderate or low impact) of the various environmental determinants of the location of the R&D activities of MNCs outside the parent companies' national borders; second, whether these determinants can be classed as market demand or technology supply factors; and, third, whether the environmental factor under analysis can be considered a strength or a weakness in the Spanish case.

2.4.1. High impact factors

The first category includes those factors considered by the subsidiaries analysed here as having a high impact in attracting the R&D activity of foreign MNCs. Three of these factors are classed as market demand factors and seven as technology supply, which points to the greater attractiveness of the latter. Additionally, based on the findings of the fieldwork conducted, economic and socio-political stability can also be considered key factors.

Table 2.4. Characteristics of the location factors of the R&D centres of foreign MNCs: Spain's strengths and weaknesses

DEGREE OF IMPORTANCE	LOCATION FACTORS OF FOREIGN R&D	Market factor	Supply factor	Strengths & weaknesses in Spain
High impact factors	Size and potential of the market.	✓		●
	Platform for accessing adjacent markets.	✓		●
	Availability of qualified suppliers.	✓		●
	Availability of qualified personnel (scientists, engineers, technicians, etc.).		✓	●
	Government R&D policy.		✓	●
	Government support for investment in R&D: direct subsidies.		✓	●
	Government support for investment in R&D: tax incentives.		✓	▲
	Ability to attract scientific and technical talent.		✓	▲
	Presence of leading scientific institutions.		✓	▲
	Links between the business world and the scientific/academic world.		✓	◆
	Economic and socio-political stability.	-	-	◆
Moderate impact factors	Market dynamism and competition in terms of constant launching of new products.	✓		●
	Demanding and sophisticated consumers.	✓		●
	Quality of higher education and training capacity.		✓	●
	Cost of qualified personnel (scientists, engineers, technicians, etc.).		✓	▲
	Government funding for R&D investment: soft loans.		✓	▲
	Presence of industrial districts and the spillover effect.		✓	◆
	Command of foreign languages.		✓	◆
	Degree of flexibility in the Spanish labour market and the mobility of qualified personnel.		✓	◆
	Bureaucratic procedures when applying for funding.		✓	◆
Low impact factors	Protection of intellectual property.		✓	●
	Availability of infrastructure and logistics systems.	✓		▲

●	Factor considered a strength
▲	Factor considered neither a strength nor a weakness
◆	Factor considered a weakness

Note: *Based on the assessment of each of the location factors of the R&D centres, Spain's strengths and weaknesses could be identified through matching patters analysis: When all the subsidiaries, or all but one, considered the factor a strength, it was assigned the symbol* ●. *When all the subsidiaries, or all but one, considered the factor a weakness, it was assigned the symbol* ◆. *Factors which the subsidiaries considered to be neither a weakness nor a strength, or factors which fewer than half of the subsidiaries identified as a strength or weakness, were assigned the symbol* ▲.

Among the market demand factors are the size and potential of the market and the fact of being a platform for accessing adjacent markets. The characteristics of the host country, such as the size and potential of the market, have a positive and significant influence on the location of R&D in an MNC's subsidiaries. According to Hero, "*when a market gains weight, this justifies greater investment in innovation, since a significant turnover in a country means that development activities should be undertaken, especially of an adaptive nature to that particular market*". In other words, these factors are primarily facilitators of the location of development activities and not so much of basic research activities. Thus, in the subsidiaries analysed here, the location of activities of this type is primarily aimed at adapting products and technologies developed in the MNC's home country to Spanish market conditions (regulations, standards, consumer tastes and preferences, proximity to customers, etc.). Moreover, Spain acts as a pole of attraction for accessing countries that are close both geographically (the countries of southern Europe and North Africa) and culturally (Latin America). For Alstom, "*the Spanish subsidiary is an important location for the marketing of the products of the multinational in South America: the language and culture greatly facilitate entry into this market*".

A further key market factor and one linked to the country's production networks is the availability of qualified suppliers. In common with the above factors, this also serves to attract development activities as opposed to research activities. Thus, the MNCs analysed internationalise process development activities to support local production, adapt technologies and cooperate with local partners and suppliers and to permit the simultaneous launch of products in different geographical regions. Despite the fact that the competition to choose a supplier today is global, in some of the cases examined the existence of, and proximity to, qualified suppliers is an important determinant of location as it substantially reduces the time taken to launch an innovation on the market. Thus, the establishment of pilot plants or units by subsidiaries requires close proximity to their suppliers to enhance communication and

speed of response. According to Hero, "*we need infrastructure and suppliers that are close at hand and which are reliable and responsible, because without these factors it is not possible to innovate*". Likewise, Hewlett Packard believes that "*the ideal situation is to find a country with suppliers that are both competitive as regards their production costs and which have the resources and capabilities needed to undertake R&D activities*". For the Spanish case, this factor has therefore been classed as a strength.

Ericsson and its supplier network

The suppliers with which Ericsson's Spanish subsidiary work are predominantly Spanish. They are companies that offer a high quality service at a very competitive price at the European level. The proximity to these suppliers ensures considerable flexibility and good response times, which represents growth opportunities for the MNC. However, the Swedish firm also operates with highly competitive Polish suppliers which, thanks to their geographical location, enjoy certain advantages in terms of the time frame they operate (working hours in the two countries are similar) and in terms of air transport (greater offer of cheap flights and shorter journey time compared to flying to Spain).

Among the aspects of technology supply analysed, a key factor for MNCs related to the labour market, and which represents a strength, is the availability of qualified personnel. The supply of highly skilled scientific staff encourages MNCs to locate part of their R&D programmes abroad. In the Spanish case, and in the opinion of the subsidiaries questioned, the level of training of scientists, engineers and technicians is quite high. Indeed, the level of theoretical knowledge and technical training of the human resources in science and technology in Spain is comparable to that of other European countries. Accordingly, this factor is recognised as a strength.

Other high impact factors identified include government policy and support for investment in R&D. Public incentives for R&D, whether of a fiscal or financial nature, are a policy tool providing direct support to businesses. Although the specialist literature supports the view that such

incentives are not a key determinant for the location of foreign investment in R&D, it is recognised that they can influence the eventual decision if two places with similar location factors are competing with each other. For Alstom "*support of this kind is seen as a factor for retaining activity rather than necessarily attracting new or increased activity in a country*".

The scientific training of Sony's research staff and the withdrawal of the Japanese multinational

In 2009 Sony initiated a strategic restructuring of its international operations which had repercussions for its television manufacturing business worldwide. In September 2010, its Spanish factory felt the impact of this policy. However, to avoid losing the technological potential of the 15% of the workers were employed in the plant's divisions of engineering, and research and development (and who enjoyed a good reputation based on their high performance and skills levels), the Sony management offered them the possibility of forming part of an R&D centre that they jointly owned (50%) with Ficosa and Comsa-Emte, both backed by Spanish capital. The centre undertakes activities aimed at developing new products related with its automotive, construction and renewable energy businesses, taking advantage of the training, experience and talent of the former Sony laboratory staff. In this way, knowledge has been transferred to two local companies and remains in the Spanish innovation system.

Among the various forms of support made available, the one preferred by affiliates with a competence-creating mandate are direct subsidies, as they ensure financial resources are transferred directly to the R&D projects, and in some cases they represent a decisive factor in retaining the foreign multinational's R&D centre in the host country. For the Spanish case, although the subsidiaries analysed here believe that government grants are a good facilitator of the location of R&D, they also comment that many incentives target small and medium enterprises (SMEs) and microenterprises, and that the research and innovation potential of multinationals should not be ignored.

The CENIT programme run by the CDTI

An example of a direct subsidy that has been highly effective in attracting foreign investment for R&D is provided by the CENIT (National Strategic Consortia for Technical Research) programme, introduced in 2006 by the CDTI (Centre for Development of Industrial Technology) to improve cooperation between the public and private sectors in matters of research.

The results of the CENIT program suggest that this type of direct subsidy to R&D is widely welcomed among the subsidiaries of foreign MNCs present in Spain. Of the 79 CENIT projects approved to date, 42 have involved a foreign multinational subsidiary and nine of them have been led by a subsidiary. In all, the amount received directly by the 58 subsidiaries involved in the programme is 106,897,645 euros, representing about 11% of CENIT's total budget. The research projects cover such areas as pharmacy and diagnostic equipment (15.91%), computers and telecommunications (13.64%) and the automotive industry and fuels (13.64%). About 20% of the subsidiaries involved in the CENIT programme are German, followed by Dutch (15%), French (15%), American (12%) and Swiss (12%) companies.

Tax incentives are also considered key determinants (high impact) for foreign subsidiaries. However, in the Spanish case this factor is not considered a strength (yet neither is it considered a weakness). In the opinion of the multinationals interviewed, the Spanish tax relief system should be redefined to improve its effectiveness in comparison with other economies that enjoy more attractive tax incentives. The subsidiaries claim that Brazil, for example, grants tax relief of between 40 and 60% on R&D expenditure. Russia does not levy a tax on intellectual property transactions and firms in the SEZs (Special Economic Zones) are exempt from corporate taxes. In India, the law provides for 100% tax relief on R&D expenditure from the taxable income of the R&D business units.

In Spain, however, the tax treatment of innovation activities has two main limitations: first, the time limits placed on the application and on the treatment of pending tax deductions, which have an expiry date and which cannot, therefore, be accumulated (as a result of which many of the tax deductions cannot be applied in either the short- or medium-term); and, second, the organisational structures of MNCs are usually

complex and often do not coincide with their legal structures. Thus, if the Spanish R&D centre of the MNC does not have a separate legal identity but rather is integrated in the subsidiary (which operates, for example, other manufacturing or trading divisions in the same country), then, paradoxically, its entitlement to tax relief is conditioned by the commercial success and the profits of the subsidiary in the Spanish market and not by the outcomes or the success of the research activity carried out in its R&D unit. Therefore, support in the form of tax incentives is not usually presented as an argument to persuade the parent company to locate R&D in Spanish subsidiaries.

Tax incentives and separate legal identity

In the cases analysed, the R&D units do not have a separate legal identity from that of their production or trading units, but rather form part of the trading company or companies operating in Spain. For example, the technology centres are fully integrated units of Alstom Transporte, S.A., ArcelorMital España, S.A., Ericsson España, S.A., Hero España, S.A., Hewlett Packard Española, S.L., Sony España, S.A. and ThyssenKrupp Elevadores, S.L. Thus, in these cases, the tax relief on R&D activities is recorded in the general accounts of these companies and has no direct impact on the R&D centre responsible for the project granted financial support. Thus, if in a given year the commercial or manufacturing divisions of the subsidiary suffer losses, even though the R&D centre generated successful innovations for the multinational group, the support is not tax deductible.

Tax incentives and the organisational structure of MNCs

Tax incentives are even less efficient in attracting R&D to Spain, particularly when organisational structures differ depending on the function or business area in which the subsidiary operates. Thus, the R&D functions of Ericsson, Hewlett Packard and ThyssenKrupp depend, in organisational terms, on different headquarters from those that are responsible for such areas as sales or production, despite the fact that they all belong to the same legal entity in Spain. Consequently, the promise of tax benefits is no argument for convincing headquarters to locate R&D activities in Spain, as they will apply to the whole of the Spanish subsidiary and not just to the technology centre.

Also linked to the technology supply, and considered to be of high impact, the subsidiaries identified factors related to the host country's national

innovation system (NIS). Here, the capacity to attract international scientific talent is, without doubt, a very important factor in the location of the most intensive forms of R&D activity. This capacity is dependent on policies that can increase the number of researchers (scientists and engineers) by promoting technical education among the young, fostering international mobility and the exchange of researchers between public and private sectors, as well as increasing the budgets of universities and research centres. Building a strong base of human capital also means attracting talent. For Vodafone, "*the search for talent and bridging the gap between the worlds of science and business are critical for the innovation processes of MNCs. Countries need to make a firm commitment to foster innovation activities that can attract and retain all available talent*". According to the subsidiaries questioned, Spain's climate and high quality of life make it easier to attract and retain foreign scientific and technical talent. In fact, according to Vodafone, "*in recent years the Spanish subsidiary has been a major recipient of expatriates within the British multinational*". However, the current economic recession is having the opposite effect on Spanish scientific and technical talent, pushing it to seek work abroad. For Alstom, "*it is vital to create real possibilities of return for those researchers who have had to leave the country in order to advance their research careers abroad; that is, it is essential to reverse the current brain drain*". This would be a way to improve the competitiveness of Spain's NIS.

The level of a country's scientific institutions is also considered a key determinant. For ThyssenKrupp, "*although proximity to universities is not an exclusive location factor, it is nevertheless very interesting to be located near centres of knowledge and creativity*". According to the subsidiaries interviewed here, the level in Spain is comparable to that of other European countries. However, the failure of Spain's institutions to stand out above the average means that their presence is neither a facilitator nor an obstacle to the location of the R&D of foreign MNCs in their Spanish subsidiaries.

Finally, the quality of the links between the academic/scientific world and the business world is considered a weakness by the subsidiaries questioned here. They suggest that the goals of the academic/scientific world are out of line with those of the business world. For Sony, "*there is a great distance between the two and, despite the great potential of Spain's research centres and the resources they invest, their goals are very different and distant from those of the business system*". This represents a weakness in Spain's innovation system as it prevents the transmission of knowledge. It is necessary therefore to build bridges aimed at improving cooperation between the two systems. Here, Hewlett Packard and Alstom have proposed the creation of a directory with updated information about research groups and lines at Spanish universities, technology centres and public institutions. "*Businesses are often confronted with problems, the complexity of which requires the help of an expert from outside the firm; however, they do not know who to turn to for advice. A directory of this type would help in bringing researchers and businesses together to work jointly on solving specific problems as well as to undertake joint research projects*". Additionally, it would foster the creation of a national network of innovation, in which both the public and the business sector could participate thereby contributing to the cohesion and improving the competitiveness of the country's NIS.

Hewlett Packard's training plan

In order to recruit qualified young researchers for its R&D activities, Hewlett Packard's Spanish subsidiary has recently created a training program called INNO+TALENT25 in partnership with LEITAT, an advanced technological centre located in Terrassa (Barcelona). The program aims to help recent graduates make the transition from university to the business world. Under the program, 25 graduates with technical and scientific degrees (for example, industrial design, mathematics or physics), a good academic record and a good command of English will receive well-paid two-year employment contracts with training courses in innovation-related, multidisciplinary topics such as project management, production design, eco-design, and printing technologies.

Although the economic and socio-political stability of a country is not linked to either the technology supply or the market demand, the subsidiaries interviewed here repeatedly mentioned it as another of the key determinants of the location of a multinational's innovation activities, possibly because of the macroeconomic situation that Spain currently faces. Specifically, the country's social and political stability and risk indices are the aspects that appear to be of greatest relevance. For Sony, "*the unfavourable economic situation, with a very high risk premium, does not help attract R&D. At times of change and volatility, characterised by international uncertainty, MNCs do not commit themselves to rigid countries with high exit barriers*". Moreover, for Ericsson "*the macroeconomic instability makes things more difficult and complex if you are trying to put into action a long-term, local industrial development strategy*".

Although the financial crisis is international in its impact, some countries, such as Spain, have been hit particularly hard. For ThyssenKrupp, *"Spain's macroeconomic instability may negatively impact the country's public funding capacity and so deteriorate the image of the country abroad, which if it is prolonged might even result in the relocation of multinational R&D centres in Spain to other countries, such as Germany, for reasons of company policy, or China, for more obvious market reasons*".

2.4.2. Moderate impact factors

The second category groups the factors considered to have a moderate impact, that is, factors that can have a substantial, but not decisive, influence on the location of R&D in foreign subsidiaries.

The dynamism of the market, in terms of the frequency with which new products are launched, the extent to which the market is characterised by demanding and sophisticated consumers, and a high degree of market competition are market demand factors considered to have a moderate impact. In the case of Spain, the subsidiaries consider the market to be fairly dynamic as regards new product launches. For Ericsson, "*Spanish*

consumers are increasingly clear about what they want. Their profile is becoming more sophisticated and they require better services that are more closely in line with their personality". On the other hand, they do not see well-established competitors as an impediment for carrying out activities of innovation. Thus, these three factors linked to the market are seen as strengths, facilitators of the location of foreign innovative activity in Spain.

Alstom and the demands of the Spanish market

The reasons why Alstom has chosen to increase its R&D resources in Spain are primarily market-related. Spain is a market leader in the rail transport sector, having more miles of high-speed rail lines than any other country in the world. Among others, RENFE is a key customer internationally buying trains from various multinational manufacturers. In addition, the Spanish passenger is considered to be more demanding than other European consumers, especially as regards comfort, acoustics, design and the style of trains.

As a result, Alstom has located large-scale R&D activities in Spain to offer a totally customised product that meets the needs and specific requirements of the Spanish customer. The innovations developed and introduced in the Spanish market are then transferred, wherever possible, to other customers in different parts of the world. Therefore, Spain represents an ideal pilot market in which to develop new innovations and products that will have a significant impact not only for the Spanish subsidiary, but also for the rest of the multinational group's affiliates worldwide.

As for the factors of technology supply, in the Spanish case the quality of higher education is considered a strength since there is a good supply of highly trained scientists, comparable in this regard to that of other European countries. However, the subsidiaries seek better management skills and greater entrepreneurial vision from the country's scientific and technical personnel, which would help improve links between the academic and scientific domains and the business world. According to Alstom, "*although Spain has excellent universities training engineers and scientists that can compete at the international level, they need to give greater importance to training in entrepreneurial skills*".

As far as the cost of scientific personnel is concerned, the subsidiaries believe that although the factor is less important in attracting R&D than that of their availability, Spain's comparative advantage over other countries, including the BRIC bloc (Brazil, Russia, India and China) and Eastern Europe, is being progressively reduced. Therefore, the factor is being increasingly taken into consideration by MNCs, since there is a growing tendency for Spanish subsidiaries to compete directly with other affiliates from the same group in these emerging countries, where they enjoy greater access to scientific talent at very competitive costs, According to Hero, however, "*multinationals don't make their R&D location decisions based solely on costs but also on their results forecasts and, in this regard, Spain, for the time being, offers a better quality/price ratio than that provided by Brazil, China or India*". Similarly, according to Hewlett Packard, "*to equal the performance of a Spanish researcher we would need the work of more than one Chinese or Indian researcher*". This is particularly true of radical innovations (new developments representing a significant shift in technology) as opposed to incremental innovations (new versions of existing technology), as the former require a greater transfer of knowledge. This becomes complicated if the parties involved fail to establish close communication and a good understanding. As such this factor currently constitutes neither a strength for the subsidiaries, as it was in the past, nor a weakness, as it is likely to be in the future, given that in the face of increased competition from emerging economies, Spain will struggle to provide qualified research staff at a competitive cost.

The other labour market factors are considered to be weaknesses. First, compared with other EU countries, Spain encounters some difficulties in recruiting staff for subsidiaries proficient in foreign languages. According to Hero, "*the level of English of Spanish research staff is not always optimal, yet they seem to handle themselves well*". Additionally, as far as the geographical mobility of staff is concerned, Spaniards, compared with other nationalities, show little inclination to emigrate for professional reasons, although there has been a recent reversal in this tendency among young graduates because of the recession affecting Spain.

Remaining with the factors of technology supply, affiliates report that, although industrial districts (or geographical clusters) are a pole of attraction for international R&D business in Spain, they are not powerful enough. Despite government initiatives to develop them further, for the time being this element is considered a weakness in Spain's innovation system.

Initiatives for research and innovation in the Principality of Asturias

Arcelormittal and the steel cluster

This is an atypical cluster, since it comprises the plants of the same group and their suppliers. Some 10,000 people work directly in this sector with a further 30,000 working indirectly in related activities. The presence of this cluster has helped strengthen the technological centre, making Asturias' stronger than any of the group's R&D centres in the world. In fact, ArcelorMittal's R&D activities in Spain include an external scientific and technical network employing more than 100 full-time researchers that work in close cooperation with the Centre.

Between 10 and 15% of the workers in this company are from abroad (including expatriates from the parent company and researchers from other points of Europe). This favours the participation of the Spanish subsidiary in international projects (participating in more than 100 projects over the last 10 years), cooperation with R&D centres of international standing, and the inclusion of its researchers on expert committees for the monitoring and supervision of EU-funded R&D projects.

ThyssenKrupp and the Manuf@cturias platfom

Under an agreement with the regional government of Asturias, ThyssenKrupp Elevator undertakes to promote research, development and innovation by cooperating with universities, and educational, research and technological centres throughout the region.

ThyssenKrupp forms part of the technological platform Manuf@cturias, a regional initiative based on the European Technology Platform MANUFUTURE, which aims to reactivate and restructure traditional industrial sectors through a strategy based on research and innovation designed to facilitate the rapid transformation of Asturian industry.

This project represents an opportunity for industrial firms in Asturias to make radical innovations in technology and to participate actively in the EU R&D Framework Programme. It also acts as a forum for the exchange of experiences and knowledge between different industrial sectors, government bodies, universities and technology centres.

In the case of local government R&D policy, the subsidiaries stress the need, and the importance, of maintaining the stability and reliability of public funding, and of avoiding the bureaucratisation of the research centres as a result of their having to apply for such funding. In this regard, the Spanish subsidiaries consider government bureaucracy as an area that requires considerable improvement.

Soft loans are seen as being neither a strength nor a weakness, and are not considered an attractive option for Spanish subsidiaries. Given the low prevailing interest rates, coupled with the need for large bank guarantees, soft loans are not competitive when compared with traditional bank loans. Moreover, the subsidiaries of foreign MNCs do not tend to seek funding from Spanish banks to finance their R&D projects.

2.4.3. Low impact factors

Finally, in the third category, there are two factors that can be classified as having a low impact on the location of R&D, one related to the technology supply and the other to market demand.

First, the protection of intellectual property is one of the factors that matters most to MNCs when operating in emerging economies, but less so when operating in developed countries where the legal framework is more robust. According to Vodafone, "*In Spain, intellectual property protection poses no problems; on the contrary, it can be considered one of its strengths*". Of the 30 patents that the Vodafone subsidiary registers roughly each year, all are triadic: first, they are registered in Spain and then they are taken up by the multinational group, which registers them at the European level, and then globally. In addition to the protection that the various patent and trademark agencies and offices (at the state, regional or international levels) can provide, more and more owners of property rights ensure that all intermediaries in the value chain (suppliers, distributors, etc.) comply with non-disclosure requirements and the laws of industrial and intellectual property. For the subsidiaries

interviewed here, intellectual property protection policy is classed as a low impact factor because obtaining legal protection for the results of their R&D activities does not worry them, as they tend to protect their innovations within a supranational legal framework. Even though the innovation might be the result of work undertaken by researchers in Spain, the application for patents is usually centralised in the country of origin of the parent company, which takes out a patent simultaneously for all the countries in which they operate.

Hero and the protection of innovation

To protect the results of the research activity of its Spanish subsidiary, patents are not usually used. In the food industry, product innovation primarily involves new recipes, which means it is usually more appropriate to register trademarks and designs, or to sign non-disclosure agreements with researchers and suppliers. Food companies that register a patent are obliged to disclose the product innovation, thereby making it easier for competitors to imitate it by introducing minor changes to the ingredients.

Consequently, although patent registration is one of the indicators most commonly used to measure R&D, it is not suitable for assessing the innovative activity of Hero's subsidiary in Spain.

Second, the availability of infrastructure and logistics systems has a greater impact on production networks and, as such, are more oriented towards product and process development activities, which are not so important in the field of R&D, where the availability of information and communication technologies facilitates the coordinated work of multiple research teams in different countries. For this reason, the subsidiaries interviewed consider this to be a low impact factor and believe that Spain has sufficient logistics centres to attract the production of foreign companies and the development activities that accompany them. However, they believe that much remains to be done, which is why this factor is considered neither a weakness nor a strength in the location of R&D.

2.5. CONCLUSIONS

The results show that subsidiaries fulfilling competence-creating mandates attribute greater power of attraction to supply-side factors impacting technology. These are more important determinants of the location of research activities, while demand-side market factors are more attractive for the location of activities for the development and adaptation of products and processes. This is in part explained by the fact that, proportionally, a greater number of technology supply factors are considered high impact factors than are market demand factors.

According to the subsidiaries interviewed, Spain's market demand factors present more strengths than weaknesses, while the country's technology supply factors are more evenly balanced between strengths and weaknesses. This suggests that the country is in an intermediate position as regards competition for the location of international R&D. By analogy with Porter's generic competitive strategies (1980), the subsidiaries analysed here did not detect any great strengths in terms of the advantages attributable to the technology supply nor in terms of comparative costs, with the result that Spain runs the risk of becoming 'stuck in the middle' with no distinct competitive advantage in the location of international R&D. Spain's standing might arguably be undermined by the threat of the new emerging economies, which are shifting from a strategy based solely on costs to a hybrid strategy based on the quality of the technology supply. As such, the challenge for countries like Spain that find themselves in an intermediate position is to strengthen their competitive advantage in technology supply before they are caught by their new rivals. For this to happen, Spain needs to implement a policy based on the country's technology supply so that it is not seen simply as a geographical market to satisfy, but also as a key country within the corporate strategy of MNCs. The first step would involve the introduction of a policy that retains and enhances the investment of the MNCs that are already present in Spain. This is important bearing in mind that short- and medium-term investment in

innovation originates primarily from the foreign subsidiaries that already have a presence in Spain but which are engaged in other activities, such as production.

Thus, in order to both successfully retain and attract FDI in R&D, below we detail some transversal measures that might help Spain escape from being 'stuck in the middle':

First, Spain needs to create the market conditions and business environment that can promote open innovation practices in which the generation of ideas, knowledge transfer and entrepreneurial initiatives can have a 'magnetic effect' on foreign MNCs. The relationships between the various economic agents operating nationally and internationally (business clusters, technology parks, organisation of meetings, workshops, fairs, etc.) need to be improved. The promotion of R&D partnerships between local and foreign companies, on the one hand, and the collaboration of universities and research institutes with MNCs, on the other, would enrich the generation of ideas and attract additional financial resources to the national innovation system.

Secondly, Spain needs to commit itself to the development of research centres and universities of excellence which can establish themselves as global points of reference. These institutions are essential for achieving international competitiveness and standing, not only for their innovative capacity and potential but also for their ability to train research staff. Thus, the country's educational programmes need a new focus on innovation and the promotion of international mobility, while establishing a good system of training grants for young research staff that can enhance the practical training of researchers, with a particular orientation towards the acquisition of management and entrepreneurship skills. At the same time programmes need to be designed to retain and attract scientific talent to Spain (reverse brain drain). In this way, the country will be more attractive by being able to offer local partners with enhanced technological capabilities.

Thirdly, Spain has to close the gap between the worlds of science and of business, aligning goals and facilitating dialogue that can enhance collaboration and knowledge transfer. Recommendations include the drawing up of a directory with updated information about research groups and lines and the creation of a national innovation network, in which both the public and the business sector participate.

Finally, it is essential that an open dialogue and close institutional cooperation be maintained with the managers of foreign subsidiaries that have successfully located innovation centres of excellence in Spain and who enjoy international responsibility. Their experience and knowledge of the decision-making process of the MNCs' parent companies can be of great assistance in orienting the policies of attracting and retaining high value-added FDI. This, in turn, should help in defining a legal framework and a system of tax incentives that might help Spanish subsidiaries to persuade the parent company to locate R&D in Spanish centres.

In sum, it can be concluded from these recommendations that if Spain wants to take strides towards becoming a veritable, competitive knowledge-intensive economy, rather than just simply implementing actions to improve the country's 'technological image' in the eyes of the MNCs, the actors in the Spanish innovation system must work together to strengthen those factors that have the greatest impact on the country's technology supply.

Finally, this study has several limitations that should be pointed out. It has focused its analysis on subsidiaries that have set up consolidated R&D centres in Spain and which fulfil a competence-creating mandate, i.e. they generate applications for their respective corporations worldwide. Consequently, the conclusions and recommendations presented here are based on the location of subsidiaries of this type; yet, these conclusions may have certain limitations if applied to units that take less active roles

in terms of innovation. Future lines of research therefore need to extend this analysis.

Likewise, the study has focused on analysing the determinants of the location of foreign investment in innovation within a territory, but less importance has been attached to the underlying network effects, particularly those that arise as a consequence of interaction with local agents. However, the results reveal that many of the key determinants of the location of R&D activities are concern with the possibility of establishing more or less permanent relations in the environment, whereby subsidiaries are able to be more receptive to new knowledge, ideas and opportunities (i.e. availability of qualified suppliers and qualified staff, presence of leading scientific institutions, distance between the business and academic world). As a result, the degree of embeddedness of the affiliate in the local networks emerges as a high impact factor and should be analysed in conjunction with the other location factors in future research.

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CHAPTER 3. KNOWLEDGE SHARING AND SUBSIDIARY R&D MANDATE DEVELOPMENT: A MATTER OF DUAL EMBEDDEDNESS

3.1. INTRODUCTION

The role played by subsidiaries and their competitive position within their respective multinational corporations (MNCs) are perceived as being subject to change over time. Historically, headquarters was considered the only source of competitive advantage for an MNC and this was leveraged overseas by the transfer of knowledge to foreign subsidiaries (Dunning, 1981; Vernon, 1966). Recently, linked to the closer integration of subsidiaries into international networks, the latter have been able to generate new knowledge for the whole MNC. In fact, heterarchical (Hedlund, 1986) and transnational (Bartlett & Ghoshal, 1989) corporate models reflect the existence of an internal network within the MNC, where knowledge flows freely in all directions. At the same time, the metanational corporate model (Doz, Santos, & Williamson, 2001) emphasizes the emergence of the company's external network. A subsidiary, thus, absorbs knowledge through its business linkages with local partners, which represent an important source of technological competencies enabling it to contribute to the MNC's overall capabilities (Andersson, 2003). Thus, the ability to manage dispersed capabilities effectively within this 'double network' – comprising internal and external networks (Zanfei, 2000) – is seen as the key to an MNC's competitive advantage (Frost, Birkinshaw, & Ensign, 2002). At the MNC level, this double network implies managing a portfolio of scattered capabilities in multiple heterogeneous local contexts through the corporation's affiliate units, whilst devising strategies to embed these units as efficiently as possible in each of these multiple contexts (Meyer, Mudambi, & Narula, 2011). At the subsidiary level, it implies that each of the subsidiaries plays a differentiated strategic role within the global MNC network.

Focusing on R&D activities, the International Business literature has recently identified the emergence of technologically advanced foreign subsidiaries (Blomkvist, Kappen, & Zander, 2010). Today, we see foreign subsidiaries not only as knowledge receivers, or in the terminology of Cantwell & Mudambi (2005) as the performers of a 'competence-

exploiting' role, but also as knowledge creators in a fully integrated network (Di Minin & Zhang, 2010), fulfilling what Cantwell & Mudambi (2005) label as a 'competence-creating' role. This shift is important, as recent research highlights the more active role played by subsidiaries in the globalization of innovation, while examining their influence on MNC innovative ability (Blomkvist et al., 2010; Phene & Almeida, 2008). R&D networking allows firms to benefit mutually from each unit's R&D competences (Pla-Barber & Alegre, 2007).

In this sense, the configuration of subsidiary R&D roles has become an issue of great interest in International Business research (see, for example, Bartlett & Ghoshal, 1990; Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; Gupta & Govindarajan, 1991; Kuemmerle, 1997; 1999; Pearce, 1992; Sachwald, 2008; von Zedtwitz & Gassmann, 2002). However, the research presents two major shortcomings: First, most of the studies take a static approach. Since they are primarily concerned with identifying the specialized roles adopted by overseas R&D laboratories, they neglect the prior evolution of capabilities within the subsidiary that takes on this function (notable exceptions are Cantwell & Mudambi, 2005; Kim, Rhee, & Oh, 2011). But as the specific R&D role of a subsidiary is a direct outcome of this evolution, the way in which these capabilities are created must first be analysed. In this sense, it is widely acknowledged that technological capability building is the outcome of complex processes of interaction both within the firm and between the firm and external actors (Iammarino, Padilla-Perez, & Von Tunzelmann, 2008). This leads to the second shortcoming: many of the studies analyse the drivers of a subsidiary's R&D role in isolation and so neglect any network effect. Specifically, they identify three main factors in the configuration of strategic roles: task assignment by headquarters, the subsidiary's own choices and local environmental factors (Birkinshaw & Hood, 1998; Kim et al., 2011; Westney & Zaheer, 2001). However, less importance is attached to any underlying network effects, particularly those arising as a consequence of simultaneous engagement in internal and external networks.

While some authors have examined the effect of headquarters-subsidiary relationships and knowledge transfer between units of the MNC (Bartlett & Ghoshal, 1990; Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; Kuemmerle, 1997; 1999; Pearce, 1992; von Zedtwitz & Gassmann, 2002), others have examined the impact of local embeddedness (Andersson & Forsgren, 2000; Andersson, Forsgren, & Pedersen, 2001; Andersson, Forsgren, & Holm, 2002; 2007; Dörrenbächer & Gammelgaard, 2010). However, only a few recent studies have considered their simultaneous impact on subsidiary innovation, albeit not specifically on their evolving R&D roles (see, for example, Birkinshaw, Hood, & Young, 2005; Gammelgaard, McDonald, Stephan, Tüselmann, & Dörrenbächer, 2012; Garcia-Pont, Canales, & Noboa, 2009; Helble & Chong, 2004; Yamin & Andersson, 2011). Only Wang, Liu, & Li (2009) analyse the role of subsidiaries within their internal and external networks, although they do so separately and statically. In sum, despite the increasing interest in taking a double-network approach to study MNCs, the analysis of the interface between internal and external network embeddedness has not been fully applied to the R&D strategic roles of a subsidiary, and even fewer studies adopt a dynamic approach.

To fill this gap in the literature, we develop an integrated framework that includes the interaction effects of changes in internal and external network embeddedness on a subsidiary's R&D role from an evolutionary perspective of competence mandates. Building on Wang et al.'s (2009) study and taking Dörrenbächer & Gammelgaard's (2010) work as our starting-point, we examine subsidiary R&D evolution patterns by analyzing the distinction between competence-creating and competence-exploiting typologies of subsidiary R&D mandates (Cantwell & Mudambi, 2005). Hence, we respond to recent calls to investigate the simultaneous change experienced by internal and external networks in models of coevolution (Madhok & Liu, 2006; Nell, Andersson, & Schlegelmilch, 2010). We address this issue by undertaking longitudinal case studies of four subsidiaries operating in Spain. Adopting an inductive approach to theory building (Yin, 1990), we find that the evolution towards a

competence-creating mandate is characterized by the simultaneous growth of embeddedness in the local environment and in the corporate network; otherwise, a subsidiary may gravitate away from upgrading its R&D role. Thus, the main contribution of this paper is the development of a dynamic model that can illustrate how internal and external knowledge embeddedness interact to affect a subsidiary's R&D roles.

The paper is structured as follows: the next section develops our main theoretical argument regarding the interrelation between internal and external knowledge networks. Section three discusses our research methods. We then present the analyses and results of our case studies identifying four generic processes and developing propositions based on the underlying network drivers of each process. Finally, we present the inductively obtained model and highlight a number of conclusions and implications for future research.

3.2. THEORETICAL FRAMEWORK

3.2.1. External MNC network

The International Business literature has tended to emphasise the importance of environmental factors in determining MNC subsidiary roles and evolution (Birkinshaw & Hood, 1998; Cantwell & Mudambi, 2005; Kuemmerle, 1999; Pearce & Papanastassiou, 1999; Pearce, 1999). However, most of these studies treat the external context quite generally, seeing environmental forces just as a driver to concentrate R&D where local conditions are most conducive to technology creation (Cantwell & Kosmopoulou, 2001). In other words, most studies confide their interest in location issues at a country level and neglect firm-location interactions as a potential platform for leveraging environmental effects. In its relationships with local actors a subsidiary is exposed to new knowledge outside the organization and this knowledge constitutes one of the key inputs for developing and accumulating the capabilities required for

technological and organisational innovation (Andersson et al., 2002). For example, Andersson, Björkman, & Forsgren (2005) report that external embeddedness has a positive impact on the development of products and processes in the MNC. Almeida & Phene (2004) suggest that a subsidiary's knowledge linkages with the host country have a positive effect on innovation in the subsidiaries of the MNC. And Santangelo (2009) concludes that local linkages creation is greater when subsidiaries have 'competence-creating scope' within the corporate organizational structure.

In sum, the reason why some subsidiaries achieve better innovative performance than others operating in the same environmental context can be explained by the frequency, depth and quality of subsidiary linkages to local partnerships. Thus, arguably, improvements in a subsidiary's R&D role depend upon effective integration within the local host country's environment rather than simply on siting activities in a munificent location (Cantwell, 2009). In other words, the potential of environmental factors as a source of competitiveness lies in a subsidiary's awareness of how to benefit from the welfare effects of the country's science base through a certain degree of embeddedness.

3.2.2. Internal MNC network

It is widely assumed that two of the key internal factors associated with subsidiary role development are subsidiary initiative-taking (Birkinshaw, 1997; Birkinshaw & Hood, 1998; Dörrenbächer & Gammelgaard, 2006), on the one hand, and parent company determinism in the allocation of mandates (Birkinshaw & Hood, 1998; Hood & Taggart, 1999), on the other. However, in terms of R&D roles, the mechanisms driving the evolution are not so straightforward: one argument advocates that subsidiaries with acknowledged advanced R&D mandates may enjoy higher levels of autonomy and, hence, lawfully display greater initiative (Birkinshaw & Hood, 1998; Birkinshaw et al., 2005; Delany, 2000). Nonetheless, a counter-argument claims, on the grounds of the strategic

sensitiveness of knowledge-related activities, for tighter control from headquarters (Ambos & Schlegelmilch, 2007; Young & Tavares, 2004), which may act as a barrier to R&D role development through initiative-taking (Ambos, Andersson, & Birkinshaw, 2010). These inconclusive findings may reflect the mediating effect of the level of integration within the MNC network, i.e. the degree of internal embeddedness. The stronger the linkages that a subsidiary builds with its partners within that network, the greater will be its predisposition to share knowledge (Michailova & Minbaeva, 2012), which in turn will influence its subsequent R&D role. However, while not all subsidiaries are equally predisposed to launching or leveraging knowledge among other units of the MNC (Gold, Malhotra, & Segars, 2001), MNC headquarters can strengthen its control by creating an organizational setting (i.e. reshaping the internal MNC network) that is most conducive to knowledge sharing (Björkman, Barner-Rasmussen, & Li, 2004; Ciabuschi, Martin Martin, & Stahl, 2010; Foss & Pedersen, 2004), In this sense, the assignment of R&D roles, such as the establishment of a centre of excellence, is a deliberate mechanism available to headquarters to enhance knowledge development and sharing (Adenfelt & Lagerström, 2006).

Consequently, as previous studies highlight, the configuration of the internal network is an important issue in the development of subsidiary R&D roles within an MNC. The reason for this is that the relatively autonomous subsidiaries develop knowledge abroad and the internal network linkages are the channel by which such knowledge is made available to the rest of the MNC (Adenfelt & Lagerström, 2006). This in turn influences the internal strategic context for decision making in an MNC (Garcia-Pont et al., 2009) and, thus, affects decisions regarding which subsidiaries to invest in and which to allocate mandates to (Bouquet & Birkinshaw, 2008).

3.2.3. Subsidiary double-network embeddedness: internal and external network

As noted before, subsidiary initiative and parent company determinism are more closely related than hitherto thought. Arguably, they are involved in a 'perpetual bargaining process' (Andersson et al., 2007). Subsidiary power in this relationship, as far as its R&D evolution is concerned, can be associated with the possession of knowledge-related capabilities and a favourable host country environment (Dörrenbächer & Gammelgaard, 2006). Subsidiaries strengthen their competitive position within the corporate group by accumulating over time the competencies needed for innovation (Figueiredo, 2011). This is possible through their entrepreneurial undertakings that tap into new opportunities in the local environment, i.e. subsidiary initiative (Birkinshaw, 1997; Rugman & Verbeke, 2001) and the acquisition of value-adding resources, especially knowledge, on which the rest of the MNC can draw (Birkinshaw et al., 2005). When these resources are unique and valuable for other units in the corporate group, a subsidiary can occupy a central position within the MNC network (Bouquet & Birkinshaw, 2008) and upgrade its power situation vis-à-vis the parent company (Forsgren, Holm, & Johanson, 2005). For Dörrenbächer & Gammelgaard (2006; 2011), a subsidiary's influence on the allocation of headquarters' mandates often depends on ownership of valuable resources that can be used when bargaining with headquarters. Luo (2005) emphasises that it is the quality and rarity of these resources that determines the likelihood of the subsidiary gaining corporate support and parent mandate assignments. The result is an increasing capacity to influence headquarters' R&D strategic decision-making in favour of the subsidiary's own interests (Ambos et al., 2010; Andersson et al., 2007). This is positively associated with gaining mandates so as to increase the scope for R&D evolution.

This somewhat circular argument provides important insights regarding the feedback loops between subsidiary initiative and headquarters determinism. Indeed, subsidiaries address their own future by balancing

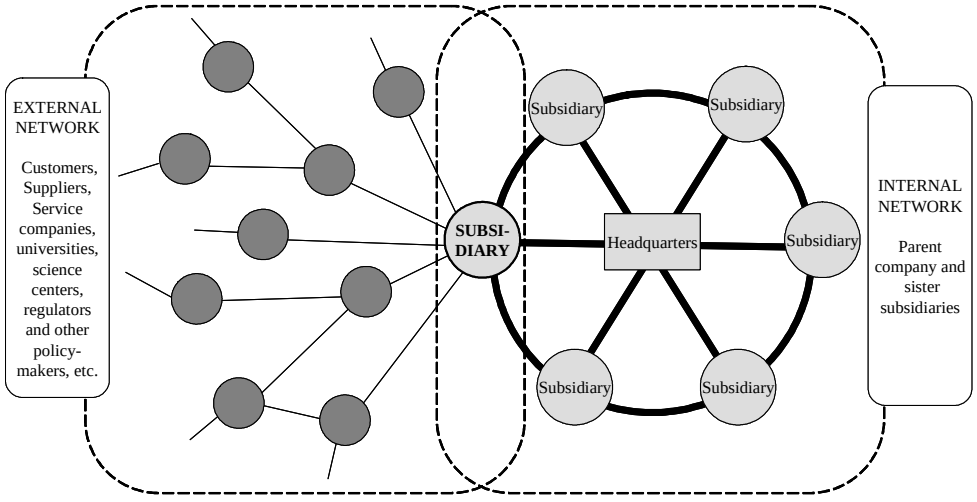
their own initiatives against requests from headquarters (Garcia-Pont et al., 2009). Headquarters' power within internal network relationships depends on formal authority. The parent company managers have the recognized legitimacy to organize the activity of the MNC by delegating business areas and strategic responsibilities to its dispersed subsidiaries overseas (Dörrenbächer & Gammelgaard, 2010), i.e. the allocation of mandates. This formal authority can be exerted through the use of different planning and control mechanisms, including the distribution of decision-making rights and the allocation of resources (Ghoshal & Bartlett, 1988), which constitute a major instrument in the hands of headquarters for changing subsidiary roles (Birkinshaw & Hood, 1998).

However, in the last decade, the shift towards 'supply-side' motivations to perform R&D operations overseas (Criscuolo, Narula, & Verspagen, 2005) has strengthened subsidiary autonomy to the detriment of headquarters control. MNCs have an increasing interest in the exploration of local knowledge and in accessing expertise complementary to the firm (Ivarsson & Jonsson, 2003; Santangelo, 2012). In such a situation, it is not easy for headquarters to manage and control knowledge development because of context specificity and information deficiencies (Ferner, 2000). Hence, subsidiary autonomy and initiative would appear necessary (Young & Tavares, 2004) to absorb knowledge effectively from the host country environment. Seen from this perspective, a subsidiary's external network can be considered a strategic source of knowledge and competitive advantage (Figueiredo, 2011; Uzzi & Lancaster, 2003) that can be exchanged with the parent company and sister subsidiaries (Ambos, Ambos, & Schlegelmilch, 2006). The logic of the arguments presented in these and other papers (see also Andersson et al., 2002; Andersson, 2003; Andersson et al., 2007) implies that headquarters allocates different R&D mandates to specific subsidiaries so as to tap knowledge linked to the host environments of these subsidiaries.

Nevertheless, changes in a subsidiary's mandate depend not only on the endowment of the external environment but also on its potential to embed

itself in the host country environment and to make local resources available to other MNC units (Andersson & Forsgren, 2000; Dörrenbächer & Gammelgaard, 2010). Thus, as Figure 3.1 illustrates, the subsidiary acts as a bridge for knowledge transfer between the host country environment and the international corporate network, including headquarters and peer subsidiaries (Forsgren et al., 2005; Giroud & Scott-Kennel, 2009). This means that subsidiaries are embedded, at one and the same time, in their own internal network, which includes headquarters and all the other MNC units, and in their external local network, which in the case of R&D activities involve other actors besides customers, suppliers and service companies, such as universities, science centres or regulators and other policy-makers. In this respect, Andersson et al. (2005) have shown the degree of local embeddedness to be an important indicator of a subsidiary's ability to create new knowledge, while Andersson et al. (2002) have empirically demonstrated that high external embeddedness can be correlated with an assignment of higher technological subsidiary mandates.

Figure 3.1. Subsidiary double-network embeddedness



Therefore, it seems reasonable to expect that a subsidiary's R&D role evolves according to changes in both its degree of external network embeddedness (so as to learn and assimilate knowledge from the host

country environment) and its degree of intra-corporate embeddedness (allowing it to transfer its knowledge to the parent company and other subsidiaries). By focusing solely on the inter-organizational network, or only taking the intra-organizational network into account, is to see only *half of the picture.*

3.3. METHODS

Based on the ideas drawn from the preceding literature review, we explore the dynamics of internal and external embeddedness and the evolution in subsidiary R&D roles. Given the current standing of the extant theory regarding dual embeddedness, here we use a case-study approach to build an inductive model. Thus we analyse the dynamics of the R&D roles of four Spanish subsidiaries over time. Multiple-case studies of this kind, employing inductive methods, are well suited to the study of longitudinal change processes (Eisenhardt, 1989; Santos & Eisenhardt, 2005). Moreover, this methodology allows us to conduct a more in-depth investigation of the processes than would otherwise be possible if employing other methods (Eisenhardt, 1989; Yin, 1990), since it enables us to understand the relationships between individual units as well as the content of these relationships (Garcia-Pont et al., 2009).

3.3.1. Case selection

The four cases analysed in this article were selected from a database of 65 firms built in the framework of a research contract with the regional innovation agency (ACC10) of the Catalan Government (Spain)[12]. This agency launched several series of surveys of large Spanish companies between 2006 and 2010 aimed at analysing their role in the regional innovation system. Our study explores in greater detail the qualitative research material provided by this project.

[12] The reports were entitled 'R&D investment by the 50 largest companies in Catalonia I' (2007) and 'R&D investment by the 50 largest companies in Catalonia II' (2011). In addition to the four case studies analyzed herein, a total of 65 case studies were reported.

In choosing the case studies we followed non-probabilistic criteria to ensure the selection of four subsidiaries that were of particular interest for our study (Eisenhardt & Graebner, 2007; Glaser & Strauss, 1968). The specific profile sought was delimited by six criteria: (1) the firm had to be a dominantly owned subsidiary, since the literature addressing subsidiary roles has tended to focus on such cases (Birkinshaw & Hood, 1998); (2) it had to operate in an R&D intensive sector, such as the Chemical and Pharmaceutical Industry, since such industries report a relatively high percentage of R&D departments in their Spanish subsidiaries, which indicates their forward-looking potential to exhibit a range of different R&D roles and their long-established tradition in the internationalization of research activities (Manolopoulos, 2006); (3) its MNC headquarters had to be located in an EU country, since membership of a 'deep' integration scheme, such as the EU (based on the regional convergence of economic structures and the establishment of common institutions and coordinated policies), has been found to affect subsidiary roles (Benito, Grøgaard, & Narula, 2003), especially at a disaggregated value chain level (Rugman & Verbeke, 2004; Rugman, Verbeke, & Yuan, 2011); (4) it had to be located in the same geographical area, thus presenting the same opportunities for becoming embedded within the local environment (Figueiredo, 2011), in this instance Catalonia, home to the largest concentration of the chemical industry (ranging from petrochemicals to biotechnology industries) in southern Europe and responsible for approximately 50% of Spain's chemical production (Arguimbau & Alegret, 2010); (5) it had to possess a long track-record of operating in Spain, with sufficient time to have established and developed deeply embedded relationships, given that effective partnerships require time and attention (Håkansson & Snehota, 1995); (6) it had to be a large company (in terms of the number of workers), since a subsidiary's size is an indication of its resources (Yamin & Andersson, 2011), and large subsidiaries can undertake a considerable range of R&D activities (from large R&D units to non-existent units).

Having applied these six criteria to the 65 firms, 12 subsidiaries were found to meet the specified profile (six operating in the Pharmaceutical industry and six in the Chemical industry). By examining various documents (including industry publications, company reports, newspaper articles, previous case studies, etc.) we acquired the necessary background knowledge to narrow them down to just four. Eventually, we selected four subsidiaries that are paradigmatic of MNC motives for operating in Spain, i.e. two represented knowledge-seeking motives and two market-seeking motives. The rationale was that R&D strategies in competence-creating subsidiaries are supply-driven while those in purely competence-exploiting subsidiaries are demand-driven (Cantwell & Mudambi, 2005). Therefore, as established by the so-called theoretical sampling, the selection of cases was made in accordance with their expected contribution to the theory (Yin, 1990). Table 3.1 provides an overview of the four companies selected and their basic characteristics. To guarantee the anonymity of all respondents, the subsidiary names are withheld and all numbers are rounded. In line with the aim of the study, our unit of analysis is the companies' activities of technological innovation and not the subsidiary itself, since capability development does not proceed at a uniform rate for every activity in the value chain (Kim et al., 2011; Rugman et al., 2011), e.g. a subsidiary might play an active role in manufacturing but a receptive one in R&D.

Table 3.1. Characteristics of the four subsidiaries (case studies A-D)

Case study	**Home country**	**Year of entry into Spain**	**Industry and activity**	**Nº of employees (2010)**	**Strategic orientation**
Case A	Germany	Early 1970s	Chemical: engineering plastics	350	Knowledge-seeking
Case B	Netherlands	Late 1970s	Chemical/Pharmaceutical: cosmetics, hygiene and cleaning products	550	Market-seeking
Case C	Germany	Late 1960s	Chemical/Pharmaceutical: agrochemical and biotechnology	950	Market-seeking
Case D	France	Late 1960s	Pharmaceutical: dermocosmetics and medicines	450	Knowledge-seeking

3.3.2. Data collection and analysis

Data were gathered through face-to-face, semi-structured interviews conducted at the subsidiaries in two rounds. The first round was held in September 2006 and the second in June 2010. While the case study data included any relevant events occurring from the time of the establishment of the selected subsidiaries in Spain until 2010, we particularly scrutinized the changes that had occurred over the last ten-year period (between 2000 and 2010). As it can be seen in Table 3.2, interviews were conducted with managing directors and top and middle R&D managers, and lasted, on average, 90 minutes. The interviewees were chosen on the basis of their first-hand experience of the phenomenon being studied (Wacheux, 1996). The interviews were recorded whenever possible and detailed notes were also taken. Both records were usually transcribed within 48 hours, summarised chronologically and the key segments of the interviews highlighted and coded (Strauss & Corbin, 1998).

Table 3.2. Interviewees profile (case studies A-D)

Case study	First interviews round: September 2006	Second interviews round: June 2010
Case A	▪ Managing director ▪ R&D Coordinator & MDI Process Engineer	▪ Managing director ▪ R&D Coordinator & MDI Process Engineer ▪ Lead Investigator, Defect Elimination
Case B	▪ President ▪ Technical Manager	▪ President ▪ Technical Manager
Case C	▪ Managing director ▪ Phytosanitary, Dispersions, Styropor Laboratory Chief	▪ Phytosanitary, Dispersions, Styropor Laboratory Chief ▪ Phytosanitary, Dispersions, Styropor Laboratory Technician ▪ Deputy Manager For Production
Case D	▪ Managing director ▪ R&D Director	▪ R&D Director ▪ Lead Investigator for medicines

To ensure reliability, we adhered to a research protocol that established the sequence of steps to follow and the topics to cover (Yin, 1990). Specifically, the interview script was designed so as to ascertain the 'story' of the subsidiary's R&D activities in the beginning, middle and end

phases, identifying any critical incidents of change in the light of the theoretical framework presented (Flanagan, 1954), keeping track of all changes in internal and external network relationships during these incidents, and recording how these differed from 'intervening' periods of (relative) stability (Turner, 2011). Overall, respondents were asked to provide an overview of the subsidiary's technological innovation activities in Spain from the time of their arrival. Later, respondents were asked to describe the dynamics associated with the subsidiary's linkages including the quantity, scope, and quality of the network relationships over time. In seeking to keep an account of past events and to integrate them into a coherent whole, we used narrative techniques to construct the story. The use of narrative analysis has proved useful in longitudinal field research for examining processes of organizational change (Miles & Huberman, 1994; Pentland, 1999), especially those that involve a 'how' question, which requires a 'process theory' explanation based on a story or historical narrative of the temporal sequence of events that unfold as an organizational change occurs (Van de Ven & Huber, 1990). This procedure serves to identify the main outcomes of each period (beginning, middle and end phases) and highlights the logical connections between factual events (Garcia-Pont et al., 2009). Furthermore, narrative analysis provides a powerful sense-making tool that helps to create new meanings through storytelling (Bruner, 1991; Reissner, 2005; 2011; Silverman, 2006). The narratives of the key events in the history of each subsidiary are recorded in the following section.

Specifically, we ascertained the network embeddedness type by indirect methods of assessment. Thus, rather than asking interviewees to classify their internal and external network relationships directly, we identified, from their storytelling, the 'revealed attributes' of the embeddedness that showed not only the frequency of the most relevant linkages but also their content and quality. This research strategy proved advantageous for various reasons. First, individuals tend to provide less persuasive inputs through indirect evidence than they do through direct evidence (Kantola,

Karwowski, & Vanharanta, 2005) and, second, it mitigates the subject bias commonly present in self-definition (Dessler, 2003).

Next, we identified the type of network linkages based on the descriptors in Figueiredo's (2011) framework[13]. Figueiredo (2011) operationalizes degrees of embeddedness as sources of subsidiaries' capabilities according to the intensiveness of knowledge in the linkages.

Previous contributions have tended to categorize embeddedness into an absent/weak or present/strong relationship. However, if embeddedness is assumed to develop over time, it should be treated as a continuous variable rather than as a dichotomy (Dacin, Ventresca, & Beal, 1999). Figueiredo's (2011) framework overcomes this drawback and allows progressive levels of knowledge-intensive linkages to be graduated. This ranking of linkage types, in its extremes, is closely related to earlier gradations reported in the literature. Table 3.3 summarizes the relationship between Figueiredo's (2011) framework and these degrees of embeddedness.

[13] It is important to stress that originally, according to the research design, the identification of network ties had to carried out based on the descriptors in the 'tailored typology of technology-centred inter-organisational links' provided by Ariffin (2000). However, the later apparition of the Figueiredo's (2011) framework, which is more knowledge centred and fits better to the aims of the study, encouraged us to adopt this later model instead of the one initially planned. As Figueiredo's (2011) classification was mainly built on the Ariffin's (2000) model, the transition from the former to the later risked a marginal cost in terms of losing information, for a potential gain in terms of internal validity.

Table 3.3. Framework for assessing the quality of subsidiaries' linkages in dual embededdness

Low	DEGREE OF INTERNAL LINKAGES		High
Arm's length	**Learning for production**	**Learning for intermediate innovation [a]**	**Research and development**
Business-type linkages based on the sales of goods and services involving no element of building capability	Knowledge acquisition to enhance capabilities to adapt product models and adopt new production systems	Knowledge acquisition to create or enhance capabilities to create new product models and new production systems	Knowledge acquisition and sharing based on collaborative research, development and design of new products, processes, components based on new technology
Operational embeddedness [b] (Garcia-Pont et al., 2009)		Capability embeddedness [b] (Garcia-Pont et al., 2009)	Strategic embeddedness [b] (Garcia-Pont et al., 2009)
Arm's length	**Minor adaptation, modification [a]**	**Joint adaptation, modification**	**Joint research**
Informal and/or one-off type of interactions based on minimum exchange of information	Exchange of information with local organizations for simple improvements in process efficiency or products without changing their functionality.	Acquisition and sharing knowledge with local organizations for basic and intermediate innovation activities	Collaborative efforts on different types and degrees of research, development and design of new products and processes, and joint problem-solving involving high degrees of trust and complexity.
Arm's-length relationships [b] (Andersson et al., 2002) Arm's-length ties [b] (Uzzi, 1996; Uzzi & Lancaster, 2003)			Technical embeddedness [b] (Andersson et al., 2002) Embedded ties [b] (Uzzi, 1996; Uzzi & Lancaster, 2003)

Source: Adapted from Figueiredo (2011)

[a] These degrees of embeddedness have been redefined and adapted to the present study.
[b] Examples of alternative subsidiary internal/external type linkages existent in the international business literature.

In turn, we analysed subsidiary R&D role changes based on the distinction between competence-creating and competence-exploiting typologies of subsidiary R&D mandates (Cantwell & Mudambi, 2005). Table 3.4 yields some examples of explicit competences underlying this dichotomy of subsidiary types.

Table 3.4. Framework for assessing competence-creating and competence-exploiting mandates

Competence-creating subsidiary mandate	**Competence-exploiting subsidiary mandate**
Knowledge/competences of a more novel nature relative to the current practices in the MNC:	Knowledge/competences of a more duplicative nature relative to the current practices in the MNC:
Cutting-edge research (basic research)	Product quality improvement, licensing and assimilating new imported product technology
Applied research into new product generations	
Development of new products or components	Equipment stretching, process adaptation and cost saving, licensing new technology
Research into new materials and new specifications	Assimilation of product design, minor adaptation to market needs, replication of fixed specifications
New product design	Debugging, balancing, quality control preventive maintenance, assimilation of process technology
Development of prototypes	
Major improvements to machinery	

Source: Adapted from Lall (1992) and Cantwell & Mudambi (2005)

In constructing the stories of the four case studies, we have successively iterated between extant theory and the data, seeking explanations in existing conceptual frameworks and making comparisons with similar empirical results (Pettigrew, 1997). Whenever doubts concerning interpretation arose, respondents were contacted again and clarifications were sought (Yin, 1990). To further enhance validity, the interview information was triangulated (Eisenhardt, 1989; Yin, 1990) by drawing on the company's own or external secondary sources. Additionally, since the study relies on several respondents per R&D unit at different times we juxtaposed and compared the stories and impressions of the informants (Moschieri, 2011). Finally, two external researchers read the cases independently to form their own judgement and to corroborate the final

interpretations made from the raw data (Moschieri, 2011). This procedure ensures the consistency of this indirect method of assessment.

3.4. ANALYSIS AND RESULTS

In this section, we discuss the four narratives in which the key events, which emerged as being relevant in the interviews, are structured and connected into a meaningful whole. By scrutinising these narratives, a detailed picture is formed of how internal and external embeddedness interact to generate outcomes in the evolution of the subsidiaries' R&D role over time. Subsequently, we reconciled these evolutions with concepts drawn from the literature and integrated them into the following four narratives.

3.4.1. Case A: The 'increasingly-embedded' subsidiary, evolving towards a competence-creating mandate

Situation at outset

The establishment of this subsidiary in Spain in the early 1970s was a strategic response to a policy of import substitution industrialization. Its creation reflected the desire to supply Spain's industrial sectors - at that time in full expansion - with intermediate chemical products, the importation of which was hindered by the prevailing autarchic environment. As a result, the Spanish subsidiary barely undertook any R&D, being primarily concerned with production. It then marketed these products exclusively in the domestic market.

The MNC's R&D operations were concentrated in the home country, and the socio-political situation of Spain did no more than reaffirm the ethnocentric attitude of the head office, fostering the concentration of the corporation's R&D activities in the group's headquarters (Gassmann & von Zedtwitz, 1999). The Spanish subsidiary acted as an executor or implementer of the technology developed in the central laboratories, and

maintained a hierarchical relationship of subordination in the face of the assignment of production projects from the company headquarters. As the managing director explained "*we were confined to adapt products and processes to the Spanish market without any possibility of developing our own innovations"*. That is to say, subsidiary played a competence-exploiting role.

At the internal level, the information flows between headquarters and the subsidiary comprised commands intended to control the subsidiary, and were virtually devoid of any learning component. At the external level, the subsidiary's interactions within the local market were characterised by a minimal exchange of information and included no elements that might lead to the building of technological capabilities. Thus, in this beginning phase, the subsidiary maintained 'arm's-length' type linkages in both its internal and external knowledge networks.

Evolution in R&D activity

In the nineties, as the Spanish market became more important and as a result of the MNC committing itself to the production of engineering plastics (a more sophisticated product with lower volumes of production and greater added value obtained from the transformation of more widely consumed commodity plastics), the Spanish subsidiary undertook its first innovative activities, specifically involving this new product. In managing director's words, "*the rationalization of international production enabled the site of Catalonia to specialize and begin to develop their own technological know-how in engineering plastics"*. This facilitated technology transfer from the headquarters in order to serve more competitively a national market that was becoming increasingly more attractive (Beise, 2004; Howells, 1990; Kuemmerle, 1999).

A crisis in one of the MNC's business units in 2002 marked a turning point in the company's R&D strategy. In the first stage, between 2002 and 2004, the central laboratories in Germany were restructured and an externalization process was initiated within the same country. In a

second stage, in the years after 2005, an off-shoring of its R&D activities was begun based on the principle of locating laboratories close to the company's centres of production around the world. This process culminated in 2008 with a network of laboratories managed from the headquarters in Germany, but based on a policy of competing centres. At the MNC level, this meant the end of the ethnocentric attitude of the managers at headquarters and the introduction of a mechanism for the competitive assignment of resources internally. Thus, the location of R&D activities shifted in responds to strictly to the criteria of the technology supply of the various sites.

As a result, the subsidiary's technological strategy steered a different course in three senses: first, it took initiatives to improve learning and innovation through 'scouting' and the development of close ties with Spain's leading R&D centres. The introduction of an internally competitive mechanism for the distribution of responsibilities allowed the Spanish subsidiary to develop an awareness of its own R&D capacities vis-à-vis those of the other subsidiaries, and this forced it to seek out the knowledge and learning needed to develop its capabilities in the local environment. To do this it established increasingly stronger ties of collaboration with local agents, thus forging 'joint-research' type linkages. "*Before 2002 the relationships with local universities and research centres was trivial, limited only to isolated cooperation agreements; however, at the moment these collaborations have become a key factor to attract new R&D investment to our site",* stated R&D coordinator. Consequently, in the terms employed by Figueiredo (2011), the subsidiary conscientiously increased its external embeddedness as part of its 'strategic asset-seeking strategies'.

Second, the subsidiary's strategy shifted as it sought to provide useful competences and knowledge assets to the rest of the units in the firm: its strategy was based on creating, over time, a 'research and development' type linkage, which involved the sharing of knowledge with the MNC as a whole. In other words, the subsidiary exploited the internal technological

asset interdependencies through such means as the accumulation of proprietary knowledge. Thus, the subsidiary managed its internal embeddedness by means of exerting influence over the allocation of resources and mandates (Garcia-Pont et al., 2009).

Finally, the subsidiary sought to defend itself at the parent office and obtain the recognition of headquarters, this recognition being essential to increase its influence and occupy a central position within the corporate network through initiative-taking (Ambos et al., 2010). The subsidiary wilfully utilized its critical linkages with key external actors that the other corporate units could not otherwise access (Dörrenbächer & Gammelgaard, 2010) as a key source of its bargaining strength (Andersson et al., 2007) in the mandate assignment processes. In fact, to convince headquarters to locate its basic R&D activities in the country, the R&D coordinator drew on three main arguments: *"the talent of the country's team of scientists, the excellence of the local research centres with which we collaborate and the backing of the host government in the form of subsidies and financing for R&D".*

In this strategic shift, the then R&D coordinator played a leading role. The senior manager's efforts in promoting boundary-spanning interaction with external entities (Geletkanycz & Hambrick, 1997), as well as his background characteristics (Hambrick & Mason, 1984), were influential in the subsidiary's strategic choices and performance. First, his environmental scanning practices can be related to the subsidiary's differential means of competing (Hambrick, 1982). In this instance, joint research with advanced R&D centres and universities was possible thanks to the fact that the R&D coordinator had more than five years' experience as a researcher in these institutions, a PhD in chemistry and a long track record teaching on several university training programs. As himself retells: "*My past experience makes me more proactive to collaborate with universities and research institutions and provided me with an overview of the best specialist in each fiel".* Moreover, the manager's German-Spanish origins meant he was able to share the

values of both the MNC's headquarters and those of the local environment, which facilitated knowledge transfer within the internal network (Sekiguchi, Bebenroth, & Li, 2011) and provided additional bargaining power in the internally competitive mandate allocation processes. Thus, in line with the upper-echelons perspective (Hambrick & Mason, 1984; Hambrick, 2007), this executive's profile greatly influenced the interpretation of the situation and the choices made and, in turn, affected the evolution in the subsidiary's R&D roles.

Table 3.5. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedness	Arm's length	Increase	Research and Development
External type embeddedness	Arm's length	Increase	Joint research

Current situation

Since 2010, the Spanish subsidiary has been one of the most competitive in the corporation in terms of applied research and technological development applied to the production of engineering plastics. Thanks to the results of its applied research, achieved jointly with external scientific institutions in the local environment, the Spanish subsidiary currently supplies innovations to the entire corporation. Hence, building strong linkages of trust with the host country's actors has been vital for developing critical resources and knowledge assets for the other units in the organization (Andersson et al., 2001, Andersson et al., 2002; Dörrenbächer & Gammelgaard, 2010). Thanks to this work the subsidiary has finally been granted recognition in the form of a competence-creating mandate. However, the group's basic research continues to be conducted essentially in German centres, complemented by a small number of centres in other countries including the US, Japan and, prudently now, in China. The inclusion of the first two countries responds to the logic of the triadization of technology (Archibugi & Iammarino, 2002; Meyer-Krahmer & Reger, 1999), while that of China responds to the need to

integrate emerging economies onto the world map of R&D (Edler, 2008; Thursby & Thursby, 2006).

In the long term, the management of the Spanish subsidiary has a clear goal: to ensure that headquarters recognizes the superior capabilities developed in its research of engineering plastics and, consequently, to be given the opportunity to open a basic research centre in Spain. The managing director of the Spanish subsidiary is well aware that "*to survive we need to attract more R&D activity"*, and to do so, *"we need to seduce our parent office"* adds the R&D coordinator. That is, gaining headquarters attention through internal linkages (Bouquet and Birkinshaw, 2008). Moreover, the Spanish subsidiary has a deeply rooted culture of entrepreneurship and it has always extended itself beyond headquarters' mandates. The evidence presented here is very much in keeping with the upper echelons theory, which establishes that executives' values and personalities greatly influence their interpretations and affect their strategic choices (Hambrick & Mason, 1984; Hambrick, 2007), and also with most studies that offer empirical support for the positive relationships established between initiative-taking and external embeddedness (see, for example, Birkinshaw et al., 2005; Gammelgaard et al., 2012; Young & Tavares, 2004).

Thus, the fact that this Spanish subsidiary has taken the initiative to exploit external networks and to enhance its potential for using and generating new knowledge, as well as, to ensure the dissemination of technological capabilities back to the parent company, so as to manipulate dependencies and exert influence over the allocation of mandates, has enabled the subsidiary to evolve towards a competence-creating mandate.

Hence:
Proposition 1: The more a subsidiary increases its external and internal network embeddedness, the greater is its likelihood of evolving towards a competence-creating mandate.

3.4.2. Case B: The 'decreasingly-embedded' subsidiary, experiencing a mandate-depletion process

Situation at outset

When this subsidiary was created in Catalonia in the late 70s, it had its own R&D department, dedicated primarily to developing products for the Spanish market. The subsidiary supplied the local market with a highly diverse consumer product range comprising all kinds of soaps and detergents, toiletries and cosmetics, as well as food products that shared a common technology base with its other products (for example, margarines). The mission of the R&D department was to oversee the production and marketing activities of the subsidiary in the foreign country and to launch new and differentiated products on the local market. As the president of the Spanish subsidiary said, "*we had total freedom to decide which products manufacture and commercialize providing that we had good financial results"*. In keeping with this multi-domestic strategy, the policy of the parent company was to reproduce the value chain in the various subsidiaries with the aim of ensuring a rapid and effective response to the characteristics of local demand and to any changes in it. As such, the creation of a competence-exploiting R&D unit was a response to the attractiveness of the market and to the exploitation of a technological advantage created in the country, (a process of internationalisation that is supported by Kuemmerle, 1999; Patel & Pavitt, 1991; Patel, 1995, among others). It implied the need to maintain contacts, on the one hand, with internal agents so as to produce the models transferred from headquarters ('learning for production' type linkages) and, on the other, with external agents so as to carry out minor adaptations to local market requirements ('minor adaptation, modification' type linkages).

Evolution in R&D activity

In the year 2000, the strategy of the parent company regarding the group's R&D activities acquired a decidedly global outlook. In the words of the president of the Spanish subsidiary: "*At the start of the year 2000,*

the company began, under its current growth plan and a project of unification, to implement a global restructuring process aimed at reducing the multiplicity of trade and firm names. This was followed by a rationalization at the international level of all departments". The globalization of R&D activities resulted in the elimination of the R&D departments of its subsidiaries, including that in Spain, and the creation of Regional Development Centres and Global Development Centres, which when they coincided in the same centre, were given the name of Centres of Excellence. These contribute to the corporations overall process of innovation and their outcomes generate applications for different countries. The search for scale economies (De Meyer, 1993; Pearce & Papanastassiou, 1999), combined with historical motives (Granstrand, Hakånson, & Sjölandera, 1993) led to the concentration of its R&D activities in just a few centres, some of excellence, located in the MNC's country of origin (the Netherlands) and a number of others that the company incorporated by acquisition (located mainly in Germany). The specialization of the centres of excellence was by technology rather than by product categories, so as to maximize synergies and technical economies of scale. Thus, very different products, such as foodstuffs and hygiene products, might be the responsibility of the same R&D unit in the MNC if they have the same base technology.

This centralization process of the R&D activities meant the Spanish subsidiary lost its ties with the rest of the corporate units. In the words of the technical manager: "*If all decisions are taken at parent office, you do not need anything from anyone else but managers at headquarters"*. Thus, the subsidiary's ties with the group were limited to flows of information to headquarters that were terminated as soon as the necessary specifications for the adaptation of a product to the local market were given. The headquarters became the interlocutor of the subsidiary with the other units in the group as far as R&D were concerned: "*The subsidiary might have an idea, but its development is undertaken in a centre of excellence for the global market and always at the request of headquarters, never at that of the subsidiary"*. Furthermore, in the new

global strategy the legitimacy to have a voice in the wider corporate group came to be conditioned by the unit's financial turnover, and in this case, "*a 5% share of the European turnover did not grant very strong powers of negotiation*". Thus, the subsidiary's internal embeddedness became characterized by the so-called 'arm's-length' relationship, that is, by business-type linkages based on sales of products and services involving no element of building capability (Figueiredo, 2011).

As regards the subsidiary's external embeddedeness, business network studies have shown that giving a subsidiary little leeway can lead to a low level of external interaction (Birkinshaw et al., 2005; Gammelgaard et al., 2012; Young & Tavares, 2004). This is precisely what has happened to this subsidiary. It pays little attention to the potential of its domestic environment in terms of R&D, since any initiatives it seeks to take in this activity in the value chain are nearly always vetoed. According to the subsidiary's president, "*it is difficult to be innovative when all initiatives are essentially global*". Therefore, the limited role of the subsidiary as regards R&D and the lack of initiatives to improve this situation in the past, largely condition the small degree of interaction with the local environment in this area (resulting in 'arm's-length' type linkages). The result is that the limited involvement of the subsidiary with its local scientific environment has inhibited the effects of technological dynamism in the local setting, preventing the absorption of external knowledge and the development of competences in the subsidiary itself (Frost, 2001). In short, the subsidiary has clearly evolved towards an 'arms-length' external linkage according to Figueiredo's (2011) classification.

Table 3.6. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedness	Learning for production	Decrease	Arm's length
External type embeddedness	Minor adaptation, modification	Decrease	Arm's length

Current situation

Since 2010, the role of the Spanish subsidiary has been reduced to sales operations (the distribution and promotion of products) and trade marketing (presentation and packaging). The role of the subsidiary as regards R&D is limited, on the one hand, to the adaptation of products to the local market by identifying tastes and preferences, but not implementing these adaptations, and on the other, to the observation and monitoring of its closest competitors in order to report back to headquarters. Those individuals linked to innovation activities are now referred to as 'Support Teams' and they are dedicated to providing local support on technical issues of product adaptation that are completed in other units of the MNC. The innovative process is based on what the MNC calls 'baskets of global innovation', from which the Spanish subsidiary chooses the products they wish to launch in the local market. Having selected a product, they choose a marketing and communication campaign designed globally which they believe to be best suited to the Spanish market and they give the necessary specifications for product adaptation (preferences, local legislation, etc.), which is always carried out in the centres of excellence in other countries. According to the president of the Spanish subsidiary, "*Our previous freedom has been drastically cut not only at the innovation activity but also in other value chain activities. As a result we have clearly lost voice and power within the international corporation… but there is nothing to do against globalization"*.

Consequently, the underdeveloped nature of the subsidiary's network exchange with both its parent company and partnerships in its local environment has triggered the gradual depletion of the subsidiary's R&D role, and led eventually to the complete removal of this activity from the value chain; in other words, it has resulted in mandate depletion. Here, the subsidiary lost its mandate as a consequence of a global rationalization program, in a context, *ceteris paribus*, in which other subsidiaries with higher levels of embeddedness have been able to acquire and share knowledge more effectively.

Hence:
Proposition 2: The more a subsidiary's external and internal network embeddedness decreases, the greater is its likelihood of evolving towards mandate depletion.

3.4.3. Case C: The 'prevailing-internally embedded' subsidiary, evolving towards a competence-exploiting mandate

Situation at outset

Since the creation of the subsidiary, in the late 1960s, decisions regarding R&D have been highly centralized in company headquarters and concentrated in the company's large international research centres. Specifically, the core of these activities is concentrated in two points: in the home country of the parent company, Germany, where the focus is on the group's traditional research areas, namely basic chemistry, chemical engineering and plastic raw materials; and, in the United States, where the laboratories undertake research in areas where the competitive advantages of the country can be best exploited (thanks to the availability of its technical infrastructure and qualified staff). This is the case of agrochemistry, pharmaceutical research and biotechnology. The search for scale (De Meyer, 1993; Pearce & Papanastassiou, 1999) and agglomeration economies (Cantwell & Janne, 1999), and the ethnocentric attitude of headquarters (Gassmann & von Zedtwitz, 1999) account for this policy of the concentration of R&D activities in a small number of centres (in Germany and in the US), the main one being the MNC's home country. In the words of the managing director, "*our German headquarters did not expect any valuable contribution derived from a Spanish subsidiary. They only thought of Spain as a country with low wages that represented an important opportunity market to cover*".

In this context, the site in Catalonia was classed from the outset as a production centre. The mandate assigned to the Spanish subsidiary, in common with that assigned to the company's other plants in other

countries, was to contribute to the global optimisation of operations through low-cost production and the minimization of delivery times to the local market. Thus, in the field of R&D, the site in Spain only applied the knowledge transferred from the German headquarters to its local factory, and the only interaction it enjoyed with rest of the group was in relation to the sale of goods and services. As such, the subsidiary's interactions with the internal organizational network were based on 'arm's-length' type linkages. In turn, the degree of company centralization resulted in a substantial distance between the Spanish subsidiary and its local market, resulting in weak knowledge ties with local organizations. In short, the subsidiary maintained 'minor adaptation, modification' type linkages with the external organizational network.

Evolution in R&D activity

The great diversification undergone by the chemical industry, and the restructuring of the organisation initiated by the MNC group in the nineties into business units and by regions, intensified competition between the subsidiaries as they sought to attract the manufacturing of new products to their respective industrial sites. This competition was seen by the Spanish subsidiary to place it at a marked disadvantage vis-à-vis its other sister subsidiaries located in countries with lower labour and material costs. Hence, to gain an advantage in the productive sector, the subsidiary chose to carry out technology development activities applied to chemical production or what those responsible for R&D within the subsidiary called "*applied research to production"*. These were the only innovation activities that the headquarters allowed them to undertake. As the managing director said, "*providing more cost competitiveness and more value added in manufacturing was the only way to survive within the MNC".* The subsidiary's strategy which was designed to enable it to become a key player at the production level was based upon three pillars: first, the subsidiary fostered internal knowledge transfer channels among the company's plants, in particular with the laboratories operating in other units, so that they might access any useful corporate knowledge to help them in the internal manufacturing competition. Second, the

subsidiary combined the knowledge transferred from headquarters and from the other units in the group with its own knowledge in order to improve production. Third, the subsidiary's production managers were encouraged to bargain internally within the MNC to obtain projects and products. Thus, here, to use the terms employed by Garcia-Pont et al. (2009), the subsidiary changed its limitations by developing a strategy based on its internal embeddedness. This process led the subsidiary to develop 'learning for production' type linkages over time. As a consequence, the level of capabilities developed by the local subsidiary consisted mainly in changes to its process technology and enhanced efficiency based on its experience from conducting existing tasks. Indeed, "*some efficiencies developed at this site have been exported successfully to the rest of the MNC"*, stress the deputy manager for production. However, as Yamin & Andersson (2011) point out, increased internal embeddedness promotes the development of existing areas of competence within the MNC.

By contrast, the subsidiary's external embeddedness was characterized by informal or one-off types of interaction based on the minimum exchange of information (Figueiredo, 2011), that is to say, by the 'arm's-length' relationships. Over time, the level of centralization of R&D decision-making has been progressively increased thus reducing the freedom of the Spanish subsidiary to act in this area, to the point that when the MNC needs to establish contacts with a Spanish university, institute or research centre "*it does so directly from Germany and the subsidiary plays no part in the process"* according to the subsidiary's management. The support from the host government in the form of incentives and funding for R&D, allows the subsidiary to justify and legitimise the resources it dedicates to process innovation before company headquarters, even though the latter does not consider the exploitation of this link for attracting greater mandates to the Spanish site a priority. Therefore, its efforts to develop competence through internal embeddedness have undermined the subsidiary's efforts to develop

competence in externally embedded networks. The latter evidence is in line with Yamin & Andersson's (2011) findings.

Table 3.7. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedness	Arm's length	Increase	Learning for production
External type embeddedness	Minor adaptation, modification	Decrease	Arm's length

Current situation

Since 2010, the subsidiary has gained a high reputation across the MNC, based upon its manufacturing excellence in plastic raw materials and agrochemical manufacturing, both of which are now carried out exclusively at the Spanish site for the whole group. The frequent and intense interactions with its internal counterparts have allowed the subsidiary both to acquire and show off its competences developed in the innovation processes (optimisation of layout designs, leading production technology, self-developing equipment, etc.), since these activities help it conduct its tasks in the production area (an activity for which its legitimacy is now fully recognised) in its struggle to attract new products. In the words of the laboratory chief, "*although the subsidiary has never been given the opportunity to develop its R&D capabilities, not to mention the chance to open a research centre so that it might be designated as a production centre, the subsidiary has managed to introduce process innovations"*, adding that many of the group's other units around the world "*do not even undertake this process development activity*". However, focusing on internal network linkages has allowed the subsidiary to tailor the current practices of other MNC units and to trim back on its efforts to develop external network relationships, and thus, develop new knowledge for the entire MNC.

Consequently, this third case study reveals that by focusing only on internal knowledge embedded relationships a subsidiary may be able to

enhance its existing competences within the MNC and to develop knowledge of a more 'replicative nature'. This means that the efforts to enhance its capabilities, independent of its relations with the environment, have allowed the Spanish subsidiary to have its competence-exploiting mandate be recognised within the MNC group.

Hence:
Proposition 3: The more a subsidiary increases its internal network embeddedness to the detriment of its external network embeddedness, the greater is its likelihood of evolving towards a competence-exploiting mandate.

3.4.4. Case D: The 'prevailing-externally embedded' subsidiary, evolving towards an isolated mandate

Situation at outset

The first ventures mounted by the French MNC in Spain date back to the late 1960s, at a time of considerable industrial protectionism and the strict regulation of the chemical and pharmaceutical sectors by government authorities. To protect domestic firms, direct imports were prohibited and foreign companies were required to buy and manufacture raw materials in Spain. In this context, in order for the French MNC to enter the Spanish market it purchased an autochthonous laboratory that was operating in Barcelona. Thanks to this transaction, the company could introduce its activities in Spain.

The strict regulations imposed by the health authorities at that time, meant all products had to be adapted to the prevailing legislation in Spain. This was the role of the Spanish subsidiary, which focused its efforts on developing process and, to a much lesser extent, product innovations based on the knowledge transferred from headquarters. Subsidiary purely replicated fixed specifications and designs extant in the MNC, performing a competence-exploiting mandate. Therefore, the set of

technological knowledge relations between the subsidiary and the headquarters were mainly concerned with manufacturing issues, i.e. they maintained 'learning for production' type linkages, while interaction with local agents was very much a secondary concern, maintaining with them transactions solely based on economic considerations, without any exchange of information other than that of prices, i.e. 'arm's length' type-linkages. As the managing director said, "*at that moment we had to make so much effort to assimilate and adapt processes and products from the parent company that we even could not think about the possibility of developing our own innovation".*

Evolution in R&D activity

A change in government policies supporting industrial development had considerable repercussions on the situation and on the R&D strategies of the French MNC in Spain. Between the eighties and the nineties, the 'Development of Pharmaceutical Research Plan' was implemented, also known as the *FARMA* Plan. The plan sought to stimulate the sector by increasing expenditure in R&D in the pharmaceutical industry and was structured in three stages: (I) 1986-1990; (II) 1991-1993; (III) 1994-1996. The subsidiary was incorporated into the second stage of the plan (1991-1993), which meant the designation of resources from headquarters for the creation of its own R&D centre.

As the director of R&D explained, "*At first, the company joined this plan to lend its support to the subsidiary and to boost its growth in the Spanish market, but then, over time, the centre acquired a certain maturity and experience, accumulating knowledge that gradually led to the dominance of a particular technology and the subsidiary became a strategic centre for the MNC"*. In other words, the allocation of resources from headquarters to exploit the advantages offered by the FARMA plan gave the subsidiary the opportunity to develop new R&D capabilities. This course of events fits within the framework provided by the organizational learning paradigm (De Meyer, 1992; Zander, 1997).

For the French MNC, the country's access-related knowledge resources have had, from the outset, a major influence on the decision to locate and maintain an advanced R&D centre at its Spanish site. Because of the complexity of the technology used in the subsidiary's R&D activities, it focuses on applied research and resorts to external ties for the use of certain pieces of equipment and for conducting the final stages of clinical development. "*This requires a need for collaboration with local research institutions"*, pointed the lead investigator for medicines. Furthermore, the scientific dynamism of the local business environment, measured by the presence of large chemical and pharmaceutical corporations undertaking preclinical and clinical research with which the Spanish subsidiary cooperates to optimize its product research cycle, has been vital to the development of new R&D capabilities; "*keeping in touch with local cutting-edge scientific institutions have become the cornerstone of our development",* emphasised the director of R&D. The subsidiary's ability to embed itself in the local technical milieu and to develop 'joint research' type linkages with external counterparts has become of paramount importance in fostering its further development. In such cases, the subsidiary's knowledge-sharing network is likely to have its geographical locus in the host country environment (Frost, 2001). This is in line with Andersson et al.'s (2007) 'paradoxical effect of external embeddedness': a high degree of external embeddedness denotes a subsidiary that is largely involved in long-term local linkages, with the possible result that issues external to the MNC are prioritised, rather than investing time and resources on maintaining relationships within the MNC.

The context specificity of the knowledge created at the subsidiary level raised a high barrier to knowledge transfer (Andersson et al., 2002), which led, as far as its research activities were concerned, to a reduction in the subsidiary's relationships with the rest of the corporate units, resulting in 'arm's length' type linkages. This downward trend in internal embeddedness was stimulated, according to the director of R&D, by the '*laissez faire*' attitude that the management at headquarters adopted regarding the subsidiary's R&D activities. This was an opportunity that

the subsidiary took advantage of to accumulate experience, scientific knowledge and distinctive capabilities in the domain of a specific technology outside the company's core business. Thus, the subsidiary became a specialist in the field of new drug delivery systems. "*As we were the only multinational unit that owned the know how about NDDS* [new drug delivery systems] *and this line of research was a hope of future for the parent company, we were free to make our own decisions",* stated the lead investigator for medicines. However, this degree of specificity made this subsidiary a kind of outlier (Andersson et al., 2007), because it creates technologies that are difficult to apply in other corporate units (Asakawa, 2001). According to Frost (2001), in extreme cases such as this, where the subsidiary is the only competent centre for a particular technology, there may exist few ties with the corporate counterparts, thus triggering the subsidiary to evolve towards an isolated mandate.

Table 3.8. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedness	Learning for production	Decrease	Arm's length
External type embeddedness	Arm's length	Increase	Joint research

Current situation

In 2010 the Spanish subsidiary was the largest in the group and the only one with its own R&D centre outside the MNC's home country. "*The Spanish subsidiary is the only exception to the policy of concentration of R&D in the (French) hexagon"*, noted the R&D director of the subsidiary. The continuous reinforcing of the external embeddedness by the subsidiary in order to create its own new competences at the expense of transferring them to other units, has turned it into the only competent centre within the firm for a particular technology, new drug delivery systems, even though, it has led to its isolation from the organization of

which it is a part. This process corresponds to that of the so-called mandate isolation.

Hence:
Proposition 4: The more a subsidiary increases its external network embeddedness to the detriment of its internal network embeddedness, the greater is its likelihood of evolving towards a geographically isolated mandate.

3.5. DISCUSSION AND THEORETICAL DEVELOPMENT

Based on the preceding case analyses, it becomes clear that dual embedding allows subsidiaries to gain access to knowledge from different sources and then to reverse these knowledge flows with their internal and external counterparts (Tallman & Chacar, 2011). Therefore, changes in the quality of the linkages developed by a subsidiary can lead to differences in the level of absorption, creation and sharing of knowledge and, thereby, to possible changes in their level of competences and their contributory R&D roles. As a result of changes in the degree of knowledge embeddedness (increasing or decreasing) within subsidiary networks (internal or external), four patterns of R&D role evolution can be identified: (1) Gaining an R&D competence-creating mandate, (2) Risk of R&D mandate depletion, (3) Gaining an R&D competence-exploiting mandate, and (4) Risk of geographical R&D mandate isolation. Figure 3.2 presents the general framework derived from these interactions between the different degrees of internal and external knowledge embeddedness.

Specifically, we find that the evolution towards a competence-creating mandate is a response to the simultaneous growth in knowledge embeddedness in the local environment and within the corporate network; otherwise, when the rise in either internal embeddedness or external embeddedness prevails, a subsidiary may gravitate, respectively, towards a competence-exploiting mandate or a situation of geographical

isolation in terms of mandate assignment. By contrast, when there is a fall in the degree of both internal and external embeddedness, the subsidiary faces the risk of depletion in its R&D mandate.

Figure 3.2. Subsidiary R&D role development from a double-network perspective

		External network	
		Decreasing embeddedness	**Increasing embeddedness**
Internal network	**Increasing embeddedness**	Gaining an R&D competence-exploiting mandate	Gaining an R&D competence-creating mandate
	Decreasing embeddedness	Risk of R&D mandate depletion	Risk of geographical R&D mandate isolation

These results allow us to advance in the general theoretical development of the field and to complete previous explanations as to how external embeddedness might affect subsidiary R&D activities. It has been stressed that a subsidiary's external embeddedness is a good predictor of the role that subsidiary might play within the overall MNC network (Garcia-Pont et al., 2009), particularly with regard to the level of its contribution to the technological and strategic renewal of the MNC group (see, for example, Andersson & Forsgren, 1996; Andersson & Forsgren, 2000; Andersson et al., 2002; Andersson et al., 2005; Forsgren et al., 2005; Frost, 2001; Ghoshal & Bartlett, 1990; Nell et al., 2010; Schmid & Schurig, 2003). However, these studies are at times incomplete, as they do not offer an integrated explanation of how a subsidiary's external relationships impact on the evolution of its R&D roles. While some authors report that externally embedded subsidiaries provide access to a variety of competencies and, thus, perform an advanced R&D role (Andersson & Forsgren, 2000; Andersson et al., 2001; Andersson et al.,

2002; Frost et al., 2002), others suggest that external embeddedness might drive a wedge between the subsidiary and its MNC, and thereby disrupt its contribution to the MNC as a whole (Andersson et al., 2007; Mudambi & Navarra, 2004), resulting in what Jarillo & Martínez (1990) labelled as an autonomous strategic role for the subsidiary. Although, since Bartlett & Ghoshal's (1989) pioneering work, the existence of an internal MNC network of subsidiaries has implicitly been assumed, internal embeddedness has not been thoroughly examined in R&D subsidiary role research. Thus, it is our belief that the concept of internal embeddedness may represent the 'missing link' between studies of external embeddedness (Andersson & Forsgren, 1996; Andersson & Forsgren, 2000; Andersson et al., 2002; Andersson et al., 2005; Forsgren et al., 2005; Frost, 2001; Ghoshal & Bartlett, 1990; Nell et al., 2010; Schmid & Schurig, 2003) and knowledge-based notions of a subsidiary's contribution to the competitive advantage of the MNC (Frost, 2001; Ghoshal & Bartlett, 1990; Rugman & Verbeke, 2001). Thus, this article contributes to network theory by analysing dual embeddedness and its implications for the evolution of the R&D role of subsidiaries, concluding that internal embeddedness can explain the differences in the effects of external embeddedness on R&D roles.

3.6. CONCLUSIONS

The main contribution of this paper has been to develop a model that illustrates how internal and external network embeddedness interact to generate specific outcomes in the evolution of subsidiaries' R&D roles. The dynamic approach adopted is particularly appropriate given that internal and external embeddedness evolve in a path-dependent process (Gulati, Nohria, & Zaheer, 2000), thus resulting in an idiosyncratic pattern of development in the R&D roles that each subsidiary adopts. Indeed, most network studies conducted to date lack this dynamic perspective (Rugman & Verbeke, 2001). Furthermore, we have assessed the quality and types of linkages in terms of their knowledge intensity. This approach sheds fresh light on our understanding of network

embeddedness, answering the call in the literature for more attention to be dedicated to examining the scope and quality of network relationships (Giroud & Scott-Kennel, 2009).

These findings are useful in furthering our understanding of how best to manage and frame the dynamics of the dual-embeddedness of subsidiaries' R&D roles, and their subsequent contribution to MNCs' competitive advantage. Hence, this study is of managerial relevance to both subsidiary managers and MNC headquarters. For subsidiary managers, the model highlights an important strategy by which they can purposely set about upgrading their R&D role within the MNC. Although most of the network literature associates the development of external embeddedness with the genesis of the evolution in a subsidiary's R&D role, managers should also seek to develop internal embeddedness so as to exploit dependencies and influence the assignment of mandates. In short, a subsidiary can shape its own evolution by enhancing both its internal and external knowledge embeddedness. For MNC headquarters, if internal and external embeddedness are properly managed, these network linkages facilitate their task of seeking advantages originating in the global spread of the firm. Managing embeddedness allows headquarters to exploit its existing assets more effectively within the multinational (an asset-exploiting strategy), and to tap into new market opportunities and new technology (an asset-seeking strategy). If we shift the focus from the perspective of headquarters to that of the subsidiary, these strategies have obvious parallels with the subsidiary's competence-exploiting and competence-creating roles as depicted in our dynamic model. In short, MNC headquarters can promote different sources of knowledge by devising strategies aimed at embedding or disembedding their subsidiaries in the internal and external corporate networks.

Several limitations of this study should be noted. First, in this article, we have developed theoretically grounded predictions regarding the effects of changes in the interactions between internal and external network embeddedness on a subsidiary's R&D roles. However, we do not fully

explore the optimal balance between the development of external and internal embeddedness, nor do we examine the consequences of over-embeddedness (Nell & Andersson, 2012) or of network redundancy (Nell, Ambos, & Schlegelmilch, 2011). Future research needs to analyse in greater depth the specific nuances of dual embeddedness.

Second, the present study has focused on four subsidiaries located in Spain with a carefully determined profile. As such, the context of this study is quite specific and the explanatory power of our findings may be limited to this particular country, industry, or type of company, and even more, to the fact that the research has been conducted in a 'backward-moving economy'. Since 2008 Spain has seen a sharp fall in its GDP growth rate. Furthermore, most of the research to date has been devoted to analysing either subsidiaries in developed economies or, more recently, those in developing countries. Hence, an analysis conducted in a situation of economic downturn may well be of relevance. Evidence from similar economies would enable us to devise new patterns for international involvement in the current complex economic situation. Future research needs to undertake quantitative studies with a broader sample and a more heterogeneous technological setting. This would allow us to strengthen the inductively obtained model described here.

Third, this study has paid only limited attention to the impact that senior executives and top management teams can have in shaping the relationships of the subsidiary inside and outside the MNC. Yet, our findings in relation to the 'increasingly-embedded' subsidiary (case A) suggest that senior managers operate in a social context that spans organizational boundaries, and that the type of linkages developed by a subsidiary is dependent upon the background characteristics of these managers. Therefore, the upper-echelons perspective (Carpenter, Geletkanycz, & Sanders, 2004; Hambrick & Mason, 1984; Hambrick, 2007) can further our understanding of how subsidiary dual-embeddedness becomes a reflection of its top-management team, and as

such our consideration of the evolution in the subsidiaries' R&D roles is incomplete and needs to be extended.

Finally, we have assumed that the subsidiary acts as a bridge in the knowledge transfer between the host country and the international corporate network. This implicitly means that all MNCs' ties to the foreign host country are articulated through their subsidiaries (Nell et al., 2010). However, the case studies reported here, in particular the 'prevailing-internally' embedded subsidiary (case C), show that headquarters can also maintain their own network linkages with the subsidiary's local environment. Indeed, a recent study claims that headquarters are also embedded in their subsidiaries' external networks (Nell et al., 2010). In the light of this claim, more attention needs to be paid to these linkages. However, despite the aforementioned limitations, this study, by focusing simultaneously on internal and external network embeddedness, provides some initial insights in helping us to see *the fuller picture.*

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CHAPTER 4. DISENTANGLING THE MEDIATING EFFECT OF DUAL EMBEDDEDNESS ON SUBSIDIARY R&D-CONTRIBUTING ROLE

4.1. INTRODUCTION

The International Business literature has documented the increasingly important role played by the subsidiaries of multinational corporations (MNCs) in building corporate competitive advantages in an international basis. This phenomenon has its origins in the shift from a perspective of the MNC based on transaction costs and internalization (Buckley & Casson, 1976; Hennart, 1982; Rugman, 1981) to one that takes a resource-based view (Madhok, 1997). Thus, rather than seeking foreign markets so as to exploit rent-yielding firm-specific advantages based primarily on some form of know-how, MNCs have increasingly pursued knowledge-seeking strategies for enhancing and developing new capabilities (Madhok, 1997; Moore, 2001). Accordingly, some subsidiaries are given mandates to explore local knowledge and gain access to expertise that is complementary to the firm (Santangelo, 2012), which when leveraged through the transfer of knowledge between MNC units provides a competitive advantage for the whole corporation (Birkinshaw et al., 1998; Foss & Pedersen, 2004; Frost, 2001).

This latter view has emerged at the same pace as that with which MNC structures have evolved towards network-based systems (Wang & Suh, 2009). The notion of the internationally networked MNC, and its corollary, the geographical dispersal of sources of knowledge (Cantwell, 2009), has recognised the subsidiary's potential to access and share knowledge within two distinct contexts (Ghoshal & Bartlett, 1990): within the MNC itself and with the host countries in which it operates. According to the network model of the MNC, a competence-creating subsidiary absorbs knowledge through its business linkages with local partners, which represents an important source of technological competences enabling it to contribute to the MNC's overall capabilities (Andersson, 2003).

This view has revived interest in the location of competence-creating subsidiaries as key players in the promotion of knowledge-seeking strategies that can ensure competitive advantage (Cantwell & Mudambi,

2005; Cantwell, 2009; Nachum & Zaheer, 2005). Thus, here we seek to further this line of research by examining the drivers of high-contributing subsidiaries[14].

Existing research on subsidiary roles has paid inadequate attention to the impact of subsidiary involvement in corporate and local network linkages (Wang, Liu, & Li, 2009). On the one hand, traditional academic models view the MNC as a set of units operating in multiple environments and the role of each subsidiary, to a large extent, as a function of the characteristics of its local environment (Ghoshal & Nohria, 1989). As such, dynamic and strategically important markets aid and abet subsidiaries in their development as strategic leaders (Ghoshal & Nohria, 1989), as centres of excellence (Frost, Birkinshaw, & Ensign, 2002) or in fulfilling a range of contributory roles (Birkinshaw et al., 1998). These models, stemming from the industrial-organizational perspective (Porter, 1990), consider the environment as a determinant force manifested by the dynamism of the local business environment through, for instance, local rivalry, demanding customers, or governmental support (Birkinshaw & Hood, 1998; Foss & Pedersen, 2002; Frost et al., 2002; Holm, Holmström, & Sharma, 2005), which tends to affect all units operating at the same location equally. On the other hand, by focusing on the internal corporate management, many studies have concentrated on the traditional facets of headquarters-subsidiary relationships, such as headquarters control (Ciabuschi, Martin Martin, & Stahl, 2010), coordination mechanisms (Luo, 2005) or the deliberate assignment of mandates (Adenfelt & Lagerström, 2006) used in directing the behaviour of subsidiary managers and, as such, determining subsidiary roles. Other studies have likewise considered subsidiary initiative (Ambos, Andersson, & Birkinshaw, 2010; Birkinshaw, 1997; Delany, 2000; Young & Tavares, 2004), their specific resources (Birkinshaw & Morrison, 1995; Birkinshaw

[14] Terms such as subsidiary contributor, strategic leader, centre of excellence or global mandate have been used to refer to those subsidiaries that contribute substantially to firm-specific advantage (Birkinshaw, Hood, & Jonsson, 1998). In this study, more closely focused on their R&D roles, we use the generic denomination of 'R&D-contributing role' and we refer to those subsidiaries that have been assigned a competence-creating mandate (Cantwell & Mudambi, 2005).

et al., 1998) or their bargaining power (Dörrenbächer & Gammelgaard, 2006), which depend on subsidiary choices in defining themselves. These approaches implicitly assume that the subsidiaries of the same MNC enjoy similar opportunities to draw on the same corporate-level factors.

Nevertheless, in the course of earlier research, it was noted that subsidiaries located in the same country and subsidiaries of the same MNC operating in different countries varied markedly in their ability to fulfil international responsibilities, ranging from their undertaking of multiple global subsidiary mandates to their fulfilling of none whatsoever (Moore, 2001). As such, country-level factors and corporate-level factors by themselves cannot fully account for the heterogeneity of subsidiaries. This situation points to the existence of a third explanatory factor related to unequal access to knowledge resources in both internal and external contexts. This is best captured by the concept of network embeddedness, whereby the way in which, and the extent to which, subsidiaries are embedded in internal and external networks can vary. Differences in their relational embeddedness, understood as the variety of interactions and the quality of the linkages developed by subsidiaries in their surrounding networks (Figueiredo, 2011; Giroud & Scott-Kennel, 2009; Santangelo, 2009), lead to differences in their levels of absorption, creation and sharing of knowledge, and thereby to the different levels of competences and R&D roles of subsidiaries. This perspective has inspired a recent stream of research concerned with the creation, assimilation and diffusion of knowledge and where the emphasis has been placed on the interface of the subsidiary's dual network embeddedness.

However, this new literature has two major shortcomings: First, there is no consensus about the effect of intra- and inter-organizational network relationships on subsidiary R&D roles. While some authors identify external embeddedness as being responsible for the genesis of subsidiary R&D competencies (Andersson, Björkman, & Forsgren, 2005; Andersson, Forsgren, & Holm, 2007; Mudambi & Navarra, 2004), others place internal embeddedness at the centre of subsidiary innovation processes

(Ciabuschi, Dellestrand, & Martin, 2011; Garcia-Pont, Canales, & Noboa, 2009), and even argued in favour of an inverse relationship between internal and external embeddedness (Andersson et al., 2007). To clarify this discussion, a better understanding of the twin impacts of internal and external embeddedness needs to be pursued. The second weakness is that the few studies to date that have adopted a dual embeddedness perspective are flawed when they do not also integrate corporate and country factors in their analyses (see e.g. Figueiredo, 2011; Helble & Chong, 2004; Wang et al., 2009; Yamin & Andersson, 2011), and so neglect the antecedents to intra- and inter-organizational network relationships. Only Almeida & Phene (2004) have focused on the relationship between a subsidiary's innovative ability, corporate and country contexts and dual knowledge exchange, but they opt to test their model using patent citations rather than using a subsidiary's interaction linkages with a variety of entities. In this sense, little is known to date about the factors affecting the creation of network linkages (e.g. demand market conditions or subsidiary initiative) and considerable research is required (Santangelo, 2012).

In sum, the literature on subsidiary R&D is either fully concerned with relational embeddedness or with organizational issues. It is our contention that these two perspectives are complementary yet only partial explanations of the same phenomena. To fill this gap in the literature we seek to develop a model that includes the effects of the interaction of all these elements. We posit that the differential role of subsidiaries as contributors to the MNC competitive advantage can best be understood by analysing both the characteristics of the corporate and country-level factors and the dual embeddedness of the subsidiaries within these contexts. Hence, this study seeks to provide fresh answers to the traditional questions of: (1) Why do the subsidiaries of the same firm in different locations develop different competences? And, (2) why do the subsidiaries of different firms in the same location develop different competences?

By taking a multiple mediating approach, we provide empirical evidence for the interaction of these elements based on a survey of 111 foreign-owned subsidiaries in Spain. Because the concept of dual embeddedness is still at an early stage of development, we have adopted the partial least square (PLS) approach to structural equation modelling, since it is better suited to predictive research models and theory building, that is, to exploratory studies (Chin, 2010). Our results indicate that favourable corporate-level factors and country-level factors are necessary but insufficient conditions to develop subsidiary R&D-contributing roles, as has been argued in the traditional literature. We find that performing a competence-creating mandate depends not only on corporate and country-level factors, but also on the subsidiary's simultaneous embeddedness in the internal and external networks. While internal embeddedness mediates the impact of corporate-level factors on competence-creating mandates, external embeddedness does the same for the influence of country-level factors on competence-creating mandates. The analysis also reveals that a significant relationship exists between the two variables of embeddedness.

Hence, the main contribution of this paper is the development of a model that sheds light on how corporate- and country-level factors interact with internal and external subsidiary embeddedness in the configuration of high-contributing R&D roles. By bringing together concepts and insights from the literature on subsidiary R&D roles and network-based view, we take the analysis one step further than previous studies and uncover several mediations determining the strength of internal and external influences. In that sense, this paper responds to the recent call from Foss & Pedersen (2004) for an examination of the causal mechanisms and underlying factors that mediate between knowledge processes and other organizational arrangements.

The paper is organized as follows: the next section provides a brief overview of different perspectives on the contribution made by subsidiaries to the firm-competitive advantage. The third section develops

the theoretical argument and presents hypotheses that might serve to disentangle the confounding effects of country- and corporate-level factors and dual embeddedness on R&D roles. A description of the data and research methods and an evaluation of the model employed follow in the fourth section. Then, the findings of the multiple mediation analysis are presented before discussing the results in the sixth section. The paper concludes with a presentation of the main contributions and a discussion of the implications and directions for future research.

4.2. THEORETICAL FRAMEWORK

For many years, the motives underpinning a firm's strategy of internationalisation were dominated by the idea of accessing new markets with existing products or of sourcing raw materials or cheap labour; accordingly, these were recognized as central reasons for the creation of MNCs in the business literature of the day (Dunning, 1993). At the same time, researchers tended to assume that the development of strategically important resources, such as technologies or new products, was concentrated at headquarters in the home country (Rugman & Verbeke, 2001; Schmid & Schurig, 2003), while subsidiary units in host countries were considered simply as passive recipients of the parent company's ownership advantages or as providers of access to location advantages (Dunning, 1988; Vernon, 1966). Later, various studies began to identify subsidiaries as key sources of innovations and of research and development, and as important actors in the creation and maintenance of the MNC's firm-specific advantage (Cavanagh & Freeman, 2012). The emerging research concerned with subsidiary roles is testament to this shift in the locus of firm-specific advantage creation (Birkinshaw & Morrison, 1995; Birkinshaw et al., 1998).

As scholars searched for new sources of competitive advantage among the units of MNCs, two prominent views emerged. First, at the beginning of the eighties, the strategic management literature was dominated by the

industrial-organisational perspective. Authors, such as Porter (1980, 1985), pointed out that the competitive advantage of firms stemmed from specific membership of an industry or was attributable to their location, where intense rivalry or customer demands provided incentives for innovation. They argued that the pressures of the external competitive environment were responsible for the patterns of innovation within and across countries (Westney, 1993). This view was supported by empirical studies that substantiated the belief that subsidiaries played differentiated roles based largely on the characteristics of the subsidiary's local environment (Bartlett & Ghoshal, 1986; Ghoshal & Nohria, 1989; Jarillo & Martínez, 1990).

Second, towards the end of the eighties, the resource-based view shifted attention back towards the resources and capabilities within the firm. According to this perspective, a firm's internal environment drives its competitive advantage, since differential performance arises from the development and accumulation of valuable, rare, non-substitutable and inimitable resources and capabilities within the firm (Barney, 1991; Grant, 1991; Wernerfelt, 1984). Building on this notion, researchers have conceptualized the MNC as a collection of internationally dispersed units possessing distinctive resources (Ghoshal & Nohria, 1989; Madhok, 1997), and, in the main, they have discussed subsidiary roles in terms of the capabilities and competences that subsidiaries develop (Bartlett & Ghoshal, 1989; Birkinshaw & Hood, 1998; Furu, 2001). All in all, these studies suggest that as subsidiaries develop their level of competences, they become better equipped to fulfil more advanced contributing roles (Cavanagh & Freeman, 2012). This means that subsidiaries develop and accumulate knowledge of their own, and they may develop these competences with or without the formal consent of their head offices (Holm et al., 2005). Hence, key to the research undertaken from this perspective has been the way in which subsidiary initiatives or autonomous actions in the development of value-added resources are managed internally, both at the level of headquarters and that of the subsidiary's managers (for a review see Young & Tavares, 2004).

Although these two perspectives have added greatly to our understanding of the way in which subsidiaries contribute to achieving a firm's competitive advantages, they overlook the fact that the MNC constitutes a network of internationally dispersed units, which in turn are each embedded in different networks (Andersson, Forsgren, & Holm, 2002; Bartlett & Ghoshal, 1990; Forsgren, Holm, & Johanson, 2005). This conceptualization of the MNC as a differentiated network gave way in the late nineties to the network-based view (Dyer & Singh, 1998; Gulati, 1999). From this perspective, the MNC is able to share existing knowledge and to combine it to build new knowledge, by tapping into a range of sources available in its subsidiaries (Frost, 2001). As such, a subsidiary's critical resources can extend across country or firm boundaries and can emerge from idiosyncratic exchange relationships with different counterparts (Dyer & Singh, 1998). Indeed, the MNC's very existence is closely related to its ability to take advantage of differences in knowledge and expertise around the world, in terms of exploiting existing repositories of knowledge and combining them to create new knowledge (Michailova & Minbaeva, 2012), simply because of its ability to access more knowledge networks, both internal and external (Adenfelt & Lagerström, 2006; Birkinshaw, Hood, & Young, 2005; Foss & Pedersen, 2004). Thus, each specific relationship may expose subsidiaries to new ideas and opportunities, which provide them with unique strategic access to new knowledge and learning opportunities (Santangelo, 2009). This perspective recognizes that network relationships are a source of competitive advantage (Andersson et al., 2002), since they are idiosyncratic and created through a path dependent process (Gulati, 1999), and that the resources being accessed are in turn relatively inimitable and non-substitutable (Gulati, 1999; Gulati, Nohria, & Zaheer, 2000). These principles of the network model of the MNC are consistent with those of the resource-based view of the firm, in that they acknowledge networks as resources in their own right (Andersson et al., 2002; Cavanagh & Freeman, 2012).

In this growing body of empirical evidence the importance of foreign subsidiaries is recognised in their assimilation of new knowledge from the local external network and in their integration into the multinational corporation. In this sense, the network-based view has gained considerable ground in the literature on subsidiary roles (see, for example, Adenfelt & Lagerström, 2006; Andersson & Forsgren, 2000; Frost et al., 2002; Holm & Pedersen, 2000; Schmid & Schurig, 2003). Furthermore, several researchers have demonstrated that the importance of different internal and external network partners for the development of competences varies according to the functional activity under consideration (Asmussen, Pedersen, & Dhanaraj, 2009; Rugman & Verbeke, 2004; Schmid & Schurig, 2003). Here, because our concern is to discover the means by which subsidiaries achieve R&D-contributing roles, the focus on technical embeddedness is prioritized as opposed to that of embeddedness in general. Technical embeddedness reflects the value of a relationship in terms of the subsidiary's capacity to source knowledge inputs for technological innovation (Andersson et al., 2002).

The preceding discussion seems to suggest that each of these perspectives – industrial-organizational thinking, the resource-based view and the network-based view – differ in their primary area of attention, be it industry or location, resources and capabilities or linkages, respectively. Yet, the central thesis of this article is that focusing on only one of these units of analysis can severely limit the explanatory power of the models developed to explain the subsidiary's contribution to a firm's competitive advantage. On the one hand, we argue that from the industrial-organizational perspective, competition promotes subsidiary external embeddedness in host countries since it generates pressure to innovate. On the other hand, from the resource-based view, the subsidiary has the ability to develop and share its own resources within the MNC. And, in turn, these premises are linked directly to the network model of the MNC. To phrase this in terms of the network-based view, to take full advantage of the opportunities in every local context, subsidiaries must be 'externally embedded' within each local context

while also being sufficiently 'internally embedded' within the MNC network for the benefits of external embeddedness to be potentially available to the rest of the MNC (Meyer, Mudambi, & Narula, 2011). This comprehensive research framework built on three different, but complementary, theoretical explanations and views, contrasts with previous studies that have tended to adopt a single theoretical perspective. Hence, what we propose and test is a comprehensive framework that integrates theoretical insights on the effect of country-level factors, corporate-level factors and dual embeddedness in the shaping of subsidiary R&D roles.

4.3. HYPOTHESIS DEVELOPMENT

4.3.1. The mediating effect of the external MNC network

Grounded in the industrial-organizational perspective, environmental factors are assumed to contribute to the development of MNC subsidiary competences and, thus, to determine subsidiary roles. Birkinshaw & Hood (1998) referred to these as factors of *'local environment determinism'* and considered the role of the subsidiary as *'a function of the constraints and opportunities found in the local market'*. Furthermore, this host country determinism can also be applied to subsidiary roles in R&D. For example, Pearce (1999) developed a typology for subsidiary-level R&D and considered the role of each subsidiary as being essentially determined by *'the attributes of the location in which it is sited'*. Additionally, Cantwell & Mudambi (2005) allude to '*location determinants'* to explain that R&D development is conditioned by the '*characteristics of the location in which the subsidiary is located'* in terms of quality and resource conditions.

The chief argument underpinning this environment determinism is that, in essence, each subsidiary operates under a unique set of conditions, as defined by Porter's (1990) diamond model, i.e. customers, competitors, suppliers and factor endowments, which constrains or determines a

firm's competitiveness. For instance, the level of competition in the environment puts pressure on firms to be innovative and to upgrade their competencies in order to outperform their competitors (Holm, Malmberg, & Sölvell, 2003). Similarly, consumer discernment and sophistication pushes MNC units to develop new practices and competences to satisfy demanding customers (Beise, 2004). Specialized suppliers, too, may stimulate competence development in firms that agglomerate in a particular location (Myles Shaver & Flyer, 2000).

Although Porter's (1990) model focuses on a '*firm's location advantage in leading-edge clusters*', its four main dimensions are applicable when assessing the dynamism of the subsidiary's external environment (Birkinshaw & Hood, 1998). In this sense, Frost et al. (2002) examined the influence of a host country's 'diamond strength' to predict the emergence of subsidiary centres of excellence, but they found no significant relationship between them. Likewise, Foss & Pedersen (2002) used the elements of Porter's diamond model to assess the transferability of knowledge sourced from subsidiaries' local environments and found 'cluster-based knowledge' the least interchangeable among a corporation's units. Moreover, Holm et al. (2005) were unable to verify a relationship between the dimensions of a competitive environment and a subsidiary's impact on MNC competence development, except through external network relationships. All in all, these inconclusive insights reveal the need to identify a catalyst of the effects of country-level factors on subsidiary R&D roles. Therefore, to understand the phenomenon it is necessary to consider not only location issues at the country-level but also location interactions as the main device for leveraging environmental factors.

Subsidiaries develop their competences by active participation in relationships with the local 'community of practice' (Frost et al., 2002); that is, by embedding in long-lasting network relationships with host-country actors such as customers, suppliers, universities, science centres and the authorities (Andersson et al., 2002). This is what is understood

as external embeddedness from a network-based view. The underlying idea is that the maintenance of strong, trustful and cooperative ties with local actors can potentially establish the basis for learning, generating and transferring knowledge beyond the boundaries of the firm (Andersson, 2003; Uzzi & Lancaster, 2003), where this knowledge is, in turn, the basis for developing technological competencies to undertake innovative activities (Figueiredo, 2011). In this way a subsidiary can develop its technological competencies which, when transferred to other units, help improve the overall level of competencies within the MNC firm (Andersson, Forsgren, & Pedersen, 2001; Yamin & Andersson, 2011). In this sense, Andersson et al. (2002) found that external technical embeddedness, which is the type of embeddedness associated with R&D activities, has a positive impact on both the subsidiary's expected performance and its role in the development of products and production processes in the MNC.

These insights reveal that the reason why some subsidiaries achieve better innovative performance than others, even though they operate in the same environment, can be explained by the breadth (the diversity of agents) and the depth (commitment and trust) of subsidiary linkages with local partnerships. Therefore, it would seem that improvements in a subsidiary's R&D role depend upon their effective integration into the local host country's environment and not just on their siting their activities in a munificent location (Cantwell, 2009). The potential of environmental characteristics as a source of competitiveness lies in the awareness of subsidiary to exploit the welfare effects of the country's science base via a certain degree of embeddedness.

In sum, while previous studies have considered the evolution in the R&D role as being driven by favourable and unfavourable environment conditions (Benito, Grøgaard, & Narula, 2003; Frost, 2001), we relate location advantages to the interaction with actors in the external environment (see Figure 4.1). In line with Rugman & Verbeke (2001), we are especially interested in the environment characteristics that are

'endogenized' by subsidiaries to enhance their knowledge basis for innovation. Thus, we argue that the degree of local embeddedness reflects how well the subsidiary takes advantage of challenging competition, demand market conditions, factor endowments, suppliers and related industries to contribute to the MNC's overall competences. Thus, the effects of favourable local conditions can be intensified through enhanced degrees of local embeddedness. Hence we posit:

Hypothesis 1: The greater the mediating effect of external embeddedness, the stronger is the impact of country-level factors on the subsidiary's R&D-contributing role.

4.3.2. The mediating effect of internal MNC network

The resource-based view has largely guided inquiries into the development of a subsidiary's resources and capabilities and the subsequent evolution and recognition of its strategic role. From this perspective, traditional research has focused mainly on the subsidiary's entrepreneurial effort, its internal initiatives and the aspirations or leadership of its managers as key determinants of the subsidiary's strategic role and the subsequent assignment of new mandates (e.g. Birkinshaw, 1997; Birkinshaw et al., 1998; Cantwell & Mudambi, 2005; Cavanagh & Freeman, 2012; Dörrenbächer & Gammelgaard, 2006; Pearce, 1999; Roth & Morrison, 1992; Scott, Gibbons, & Coughlan, 2010). These studies have demonstrated the potential of subsidiary units to achieve contributory roles through their entrepreneurial efforts, i.e. subsidiary initiatives enabling them to expand their value-adding activities, markets or responsibilities. These actions along with the leadership of the subsidiary's managers ensure that the resources and capabilities developed gain the recognition of headquarters.

Specifically, subsidiary entrepreneurship includes, among other aspects, efforts to develop new products, improvements in production processes and proactive subsidiary bids for internal corporate investments (Verbeke

& Yuan, 2013). In fact, initiative and risk-taking behaviour thrive in a true entrepreneurial culture (Barringer & Bluedorn, 1999; Covin & Slevin, 1989), which is shaped by either parent-induced or subsidiary-driven actions (Kuratko, Montagno, & Hornsby, 1990). In the case of subsidiary initiative, it has been postulated in the literature that it can positively influence a subsidiary's R&D-contributing role (e.g. Birkinshaw, 1996; Birkinshaw et al., 1998; Cantwell & Mudambi, 2005; Pearce, 1999; Scott et al., 2010; Taggart, 1996; Young & Tavares, 2004); yet, in the absence of specific initiatives, a subsidiary's entrepreneurial culture can still have a positive impact on the development of distinctive capabilities. Indeed, Birkinshaw et al. (1998) considered initiatives to be particular manifestations of an entrepreneurial atmosphere and classed them as a separate dimension.

Moreover, the leadership provided by a subsidiary's top management is also expected to have a direct influence on its R&D-contributing role, not only by providing direction and by fostering the entrepreneurial drive conducive to initiative of the subsidiary's employees (Ghoshal & Bartlett, 1994), but also by championing and sponsoring the assignment of new international responsibilities or mandates to the subsidiary (Birkinshaw, 1997; Birkinshaw et al., 1998). For example, Cantwell & Mudambi (2005) state that gaining a competence-creating mandate requires, among other aspects, the ability of a subsidiary's managers to develop and exercise a 'voice' in the wider corporate group. Ling, Floyd, & Baldridge (2005) support this view by stressing the effect of quality relationships between sellers and targeted top managers in 'issue selling'. Also, Birkinshaw & Hood (1998) noted the importance of a strong track record and the credibility of subsidiary management in charter extension processes. Indeed, Dörrenbächer & Gammelgaard (2011) document the value of bargaining power in negotiations between headquarters and subsidiaries in terms of the strategic development of the latter. All in all, a subsidiary's bargaining power is determined by the subsidiary's leadership, which is ultimately responsible for ensuring parent company recognition (Ambos et al., 2010).

Yet, headquarters might either support the further development of a subsidiary's aspirations or it might threaten to undermine subsidiary entrepreneurship. Therefore, subsidiary initiative has to learn to conform to the 'corporate immune system' (Birkinshaw & Ridderstråle, 1999) and so if the affiliate wants to be recognised and rewarded by having its mandate upgraded, it needs to operate in line with the 'dominant logic' of the corporate organization (Bettis & Prahalad, 1995; Prahalad & Bettis, 1986). Consequently, subsidiary initiative has to be expressed within a corporate context that is shaped to a very large degree by headquarters. Hence, according to traditional approaches, corporate-level factors affecting a subsidiary's R&D-contributing role include not only subsidiary leeway but also the parent company's authority.

All these subsidiary strategic role drivers have recently been expanded by internal network-based research, which highlights the interdependence of the internal corporate actors in developing competencies and creating competitive advantage through the building of close and trustful ties within the MNC. A subsidiary's internal embeddedness also affects the organizational scope of subsidiary leeway and innovation (Ciabuschi et al., 2011; Garcia-Pont et al., 2009; Michailova & Mustaffa, 2012). For example, Venaik, Midgley, & Devinney (2005) support the importance of networking and autonomy in encouraging greater innovation and competitive advantage within MNCs. Gnyawali, Singal, & Mu (2009) argue that internal network relationships boost a subsidiary's entrepreneurship. Andersson et al. (2007) conclude that the more valuable a subsidiary's initiatives are to its peer subsidiaries within the MNC network, the more its influence over them will increase. Furthermore, the stronger the linkages that a subsidiary builds with its partners within the subsidiary's internal network, the greater the position of power it will achieve (Young & Tavares, 2004).

However, subsidiaries are not able to increase their influence or central position through initiatives alone, unless they are able to gain headquarters' recognition (Ambos et al., 2010). Thus, drawing on Ambos

et al.'s (2010) work, we consider internal embeddedness as being positively related to a subsidiary's strategic importance as a competence provider to the corporation, thus motivating headquarters involvement in the development of subsidiary innovation (Ciabuschi et al., 2011). From a managerial perspective, if subsidiary managers can build good and trusting relations with their counterparts in head office and in their sister affiliates, then they can reinforce internal cooperative ties, increase their visibility and direct the parent company's attention to particular issues (Bouquet & Birkinshaw, 2008; Dutton, Ashford, O'Neill, & Lawrence, 2001).

Consequently, the building of a closely knit internal network is an important issue in the development of a subsidiary's R&D roles, as it provides the basis for leveraging subsidiary corporate-level factors and for exploiting the knowledge and capability dependency of its sister affiliates. Even though a subsidiary displays a strong entrepreneurial culture, undertakes risky initiatives or has powerful leaders in positions of command, these factors may all fall on deaf ears if it is not well connected with the rest of the MNC's units. The reason for this is that internal network linkages are the channel via which subsidiary knowledge is made available to the rest of the MNC (Adenfelt & Lagerström, 2006). This in turn influences the internal strategic context for decision making in an MNC (Garcia-Pont et al., 2009) and, thus, affects decisions regarding which subsidiaries should be allocated R&D mandates. Hence:

Hypothesis 2: The greater the mediating effect of internal embeddedness, the stronger is the impact of corporate-level factors on the subsidiary's R&D-contributing role.

4.3.3. The mediating effect of double-network embeddedness: internal and external networks

Subsidiaries can develop distinctive capabilities by combining host-country endowments with the resources and capabilities available within

the MNC (Almeida & Phene, 2004; Cantwell, 2009; Figueiredo, 2011; Frost et al., 2002; Mudambi & Swift, 2011). Therefore, subsidiaries find themselves immersed at the same time in different external and internal contexts in which they build a variety of network ties, which give them the potential to contribute to the innovative capacity of the overall firm (Collinson & Wang, 2012). This idea of dual embeddedness allows subsidiaries to gain access to knowledge from different sources and then to reverse knowledge flows to their internal and external counterparts (Tallman & Chacar, 2011). This means that subsidiaries sit at the nexus of multiple internal and external networks (Collinson & Wang, 2012) that are preceded respectively by a number of corporate- and country-level factors, as described in the two previous sections.

Moreover, a subsidiary can be embedded in various manners, and to different degrees, in internal and external networks (Dörrenbächer & Gammelgaard, 2010). Differences in the variety of interactions and the quality of the linkages developed by a subsidiary lead to differences in levels of knowledge absorption, creation and sharing, and hence to varying levels of contribution to the whole MNC (Andersson et al., 2002; Figueiredo, 2011; Giroud & Scott-Kennel, 2009; Santangelo, 2009). The more advanced R&D-contributing roles are generally associated with sourcing of knowledge abroad which is leveraged by a subsidiary's business relationships with external partners (Andersson & Forsgren, 2000; Andersson, 2003). Increasing such external network linkages is likely to enhance the expected degree of a subsidiary's contribution to that of competence development within the MNC as a whole (Andersson et al., 2002; 2007) and, thus, enhance the subsidiary's power position because of the knowledge dependency of other parts of the MNC (Mudambi & Navarra, 2004). In this context, it is expected that for a subsidiary to gain access to new knowledge it will have to engage more intensively with local partners so as to be rewarded with a competence-creating mandate. However, subsidiary R&D-contributing role consolidation can only really be culminated when explicitly acknowledged by corporate headquarters. If a subsidiary's capabilities are not valued,

its strategic role will not be recognized and, therefore, a competence-creating mandate will not be assigned (Birkinshaw & Hood, 1998). In this second part of the process, a subsidiary must use its connectivity within the MNC network (Meyer et al., 2011). After accessing local external knowledge, the subsidiary must be able to transfer it internally within the firm so as to gain recognition and to be deemed important for the whole MNC. It is argued that increasing intra-organizational knowledge exchange between the focal subsidiary and other units of the MNC is likely to boost subsidiary visibility within the MNC (Bouquet & Birkinshaw, 2008), attract headquarters attention (Ambos et al., 2010) and increase a subsidiary's influence over head office's decision making in its own favour (Mudambi & Navarra, 2004).

A counter argument to the above analysis is that an inverse relationship exists between internal and external embeddedness. According to the institutional theory, dual embeddedness means that the subsidiary is subject to institutional pressures brought to bear by the host country, on the one hand, and by the home context, via its parent MNC, on the other (Forsgren et al., 2005). This is consistent with the integration–responsiveness framework developed by Bartlett & Ghoshal (1988): a subsidiary must adapt its strategies and organizational practices to local contexts, as well as to the institutional constraints imposed by its home country (Meyer et al., 2011). This balance is often difficult to achieve. Furthermore, the resource constraints faced by the subsidiary have opportunity costs in terms of adapting to the external and the internal institutional environment. Limited resources mean that a subsidiary often experiences a trade-off between external and internal embeddedness, which may result in two situations.

First, a high degree of external embeddededness may lead a subsidiary to develop context specific capabilities, which are not readily applicable in other MNC units (Andersson, Forsgren, & Holm, 2001; Forsgren, Johanson, & Sharma, 2000). Thus, the subsidiary becomes geographically isolated in the MNC network, diminishing its level of

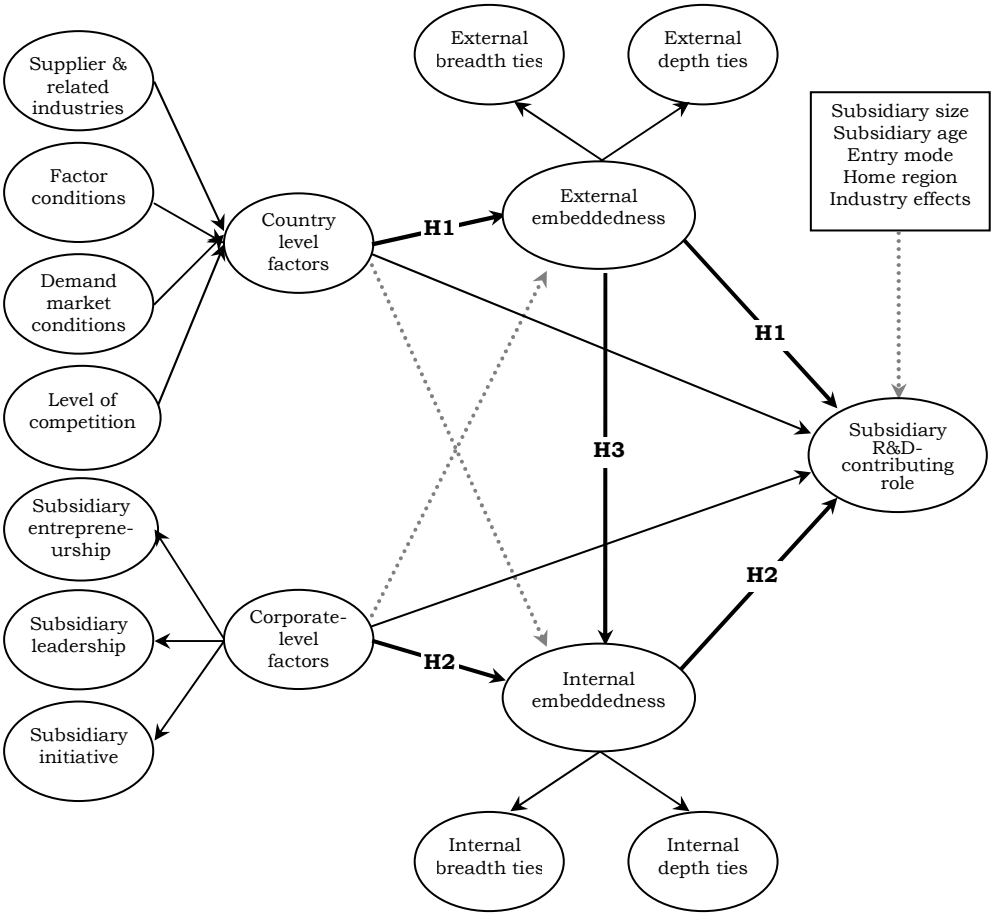
contribution to the corporate. Andersson et al. (2007) reported that externally embedded subsidiaries can provide access to a variety of competencies, but it might also reduce the subsidiaries' motivation to contribute to the overall performance of the MNC. Second, a high degree of internal embeddedness may lead subsidiaries to become heavily dependent for their resources on other parts of the MNC at the expense of sourcing new knowledge through channels of external embeddedness (Andersson et al., 2007). In this case, the subsidiary becomes a receptive unit performing a competence-exploiting mandate.

Consequently, in order to gain a high-contributing R&D role a subsidiary must be not only 'externally embedded', operating as an independent actor in its local environment where it establishes relationships so as to learn and assimilate knowledge from the host country environment (Andersson et al., 2002), but also 'internally embedded', integrating itself in the MNC network to transfer its knowledge to the parent company and sister affiliates, insofar as subsidiaries are dependent on the strategic allocation of resources and mandates within the MNC (Meyer et al., 2011). The learning effects of external embeddedness need a certain degree of internal embeddedness so that they might be converted in contributions to the competence repositories of the entire MNC. Integrating this mediation role of internal embeddedness with that of external embeddedness generates a three-path mediation model (see Figure 4.1).

As a result, dual embeddedness mediates sequentially the relationship between country-level factors and a subsidiary's R&D-contributing role. In other words, the country-level factors impact on its external embeddedness and this in turn influences a subsidiary's R&D-contributing role through its internal embeddedness, which finally permits the focal subsidiary to improve its competitive position within the MNC. Thus:

Hypothesis 3: The greater the sequential mediating effect of the external and internal embeddedness, the stronger is the impact of country-level factors on the subsidiary's R&D-contributing role.

4.1. Theoretical model



H1: Country-level factors → External embeddedness → Subsidiary R&D-contributing role

H2: Corporate-level factors → Internal embeddedness → Subsidiary R&D-contributing role

H3: Corporate-level factors → External embeddedness → Internal embeddedness → Subsidiary R&D-contributing role

4.4. METHODS

4.4.1. Questionnaire and data

Target population and sampling

The population of this study consists of foreign-owned subsidiaries with productive activity located in Spain[15] (given the exploratory nature of the study, the service sector was excluded for the sake of internal validity). In the absence of registers or directories of foreign-owned subsidiaries undertaking productive activity in Spain, the first stage involved the construction of the sample frame using data assembled from the annual directory of firms compiled by the Spanish Industrial Journal, *Fomento de la producción,* and the data base Analysis System of Iberian Balances (SABI) compiled by *Informa*. The former monitors the 30,000 main Spanish companies based on information contained in the Commercial Registries, and the latter contains general information and financial data, sourced from Commercial Registries, other agencies and the press, for more than 200,000 Spanish companies, thus covering more than 95% of the existing population. We examined both databases to obtain a description of each company and its business, the location of its factories and, above all, the composition of its capital.

We narrowed the companies down by defining foreign-owned subsidiaries as local affiliates whose parent companies held at least 51 percent of their ownership (Bouquet & Birkinshaw, 2008). The rationale is that the literature addressing subsidiary roles has tended to focus on those that are wholly foreign-owned (e.g. Birkinshaw & Hood, 1998; Birkinshaw & Hood, 1998; Ecker, van Triest, & Williams, 2011; Frost et al., 2002). After correcting for any discrepancies, inaccuracies or out-dated information through the triangulation of the data with other sources (including

[15] This study received the generous support of the Ministry of Industry of the Spanish Government within the National Plan for Scientific Research, Development and Technological Innovation.

industry publications, company reports, newspaper articles, etc.), and excluding cases with conflicting ownership information and non-active establishments, a census of 1,072 industrial foreign-owned firms were identified in Spain.

Data collection and respondents

The second stage involved the mailing of the CEOs of the aforementioned 1,072 subsidiaries. The CEO was selected as our target respondent on the basis of their assumed knowledge of the firm's strategic profile (Frost et al., 2002). In order to improve the response rate a specific procedure/protocol encompassing the main techniques and steps recommended in the literature was adopted: 1) the CEO's name and contact address was carefully collected in order to personalize the correspondence (Dillman, 1991); 2) a request for participation was made in a covering letter, which outlined the aims and nature of the study, its usefulness for subsidiary managers and the confidentiality of the respondents (Harzing, 1999; Harzing & Noorderhaven, 2006); 3) the official stationery of the university and sponsor (Dillman, 1978), in this case the Ministry of Industry of the Spanish Government was used to increase trust and legitimacy; 4) a printed colour questionnaire booklet and a stamped addressed envelope were included in the mailing (Dillman, 1991); 5) a summary report of the study's findings was offered to the CEOs to promote participation (Dillman, 1978); (6) finally, suitably spaced mailings, including a telephone follow-up to survey non-respondents were undertaken (Dillman, 2000; Fowler, 1993).

The first survey mailing was sent out in June 2008, followed up with a reminder and a replacement questionnaire (where necessary) in September 2008. Likewise, a large call round to a random selection of subsidiaries was conducted after every mailing. This process revealed that more than 400 companies had received the survey, although not all of them agreed to answer. All in all, a total of 125 questionnaires were received, providing a response rate of 11.66%, which is within the normal

range for surveys of MNC subsidiaries (Harzing, 1997) with high-level executives as respondents (Harzing & Noorderhaven, 2006). Questionnaires were completed in the main by Managing Directors and CEOs (48.57%), R&D Managers (26.67%) and Executive Directors (7.62%). On average, the respondents had more than fourteen years of experience within the MNC and almost thirteen years in the Spanish subsidiary.

The usable responses were reduced to 111, either because the subsidiary reported no R&D activity at all or for reasons of missing data, giving an effective response rate of 10.35%. Non-response bias was checked by comparing the number of employees and the industry (based on two-digit NACE classification) of the respondent subsidiaries with those of the non-respondents. The t-statistic was used to test the non-response bias for the number of employees (in log scale), as the normally distributed quantitative variable, and the Chi-square test for the economic sector, as the nominal variable. No significant differences were found between respondents and non-respondents (p-value=0.594; p-value=0.377, respectively).

The final sample covers more than 20 different types of manufacturing industry (based on two-digit NACE classification), with subsidiaries from the chemical (18.2%), pharmaceutical (12.7%) and metal products, machinery and equipment (10.0%) industries dominating the sample. Similarly, based on OECD industry classifications of technology intensity, the majority of subsidiaries (62.73%) belong to high and medium-high technological intensity industries. Within the sample, subsidiaries vary considerably in size (ranging from 5 to 7,406 employees with an average of 394), age (ranging from 2 to 118 years with an average of 35), internationalization (ranging from 0 to 96% foreign sales with an average of 28.34%) and R&D budgets (ranging from €0.02 million to €41.33 million with an average of €3.92 million). Parent company nationality is also varied (with 18 nationalities being represented): 73.64% are of European origin, 20.00% North American, and 5.45% Asian. This

guarantees a diverse sample in terms of industry, size, age and internationalization, and hence we minimize the number of sources of extraneous variance and systematic bias.

Survey instrument

The questionnaire survey was designed following an extensive and thorough review of the literature on International Business to provide evidence on a wide range of aspects associated with differentiated subsidiary roles. This review formed the basis for defining the study's core constructs, for choosing existing scales or constructing new ones where necessary and for wording specific items. Since the questionnaire was addressed to a single respondent – the subsidiary's CEO, there is a potential for common method variance bias from several sources, including the consistency motif and social desirability (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Following Chang, van Witteloostuijn, & Eden (2010), we deal with common method variance bias in the ex ante and ex post statistical analysis. In the case of ex ante remedies (the ex post tests are provided in the results section), we sought to avoid sources of potential bias in the development of the draft survey instrument. We attempted to reduce these by keeping the questionnaire short (four pages), varying the response formats of Likert scales (e.g. not important at all-very important; strongly disagree-strongly agree; and used rarely-used very often), and scattering same-construct questions throughout the questionnaire (Bouquet & Birkinshaw, 2008). Specifically, the social desirability bias was tackled by assuring confidentiality and using neutral question formulation, indicating that there were no right or wrong answers (Harzing, 1999). Furthermore, the dependent variable was specifically introduced in the survey. We asked respondents to evaluate the capabilities underlying the R&D charter of the subsidiary in question against a specific point of comparison - the same business unit in other sister subsidiary units (Chang & Rosenzweig, 2009). Consistency motif

bias was curbed by counterbalancing the order of questions relating to different scales and constructs, so that respondents could not then easily combine related items to cognitively create artificial rationality in their responses (Murray, Kotabe, & Zhou, 2005).

The draft questionnaire was subsequently pilot-tested and improved after performing various pretests with experts from both the academic and business worlds. In the case of the former, feedback from three researchers working in the field led to the modification/elimination of some of the initial survey items and the introduction of others, so as to minimize sources of possible bias and to guarantee that the indicators actually captured the constructs for which they were designed. In the case of the latter, feedback from three subsidiary managing directors resulted in minor changes to ambiguous questions and phrasings so as to enhance comprehensibility. The final questionnaire had a total of 256 variables measuring a variety of topics concerning the configuration of differential subsidiary roles. The present study specifically draws on measures of external embeddedness, internal embeddedness and R&D functional area.

4.4.2. Measures

The measures used in this paper, in line with previous studies, are based on elements captured from an initial literature review, while we extend prior operationalizations by purposely customizing them to this specific research project. Table 4.1 provides a summary of the constructs used. The complete wording of the items is displayed in Appendix 4.A.

Country-level factors

The configuration of the environment was measured using eight items, reflecting the subsidiary manager's perception of different aspects of the host country on a 7-point-scale (anchored as 1=not important at all, 7=very important). Building on the main elements of Porter's (1990)

diamond model and the scale developed by Frost et al. (1998), respondents were asked to assess the business environment in which they compete in relation to four dimensions: 'level of competition'; 'demand market conditions'; 'factor conditions'; and availability of 'supplier and related industries' (see Table 4.1). In turn, these four dimensions are each captured by two specific items. As Porter's (1990) single diamond model does not reflect the nature of MNC network activities, we corrected for a network-based view by specifying this measure as a reflective first-order, formative second-order construct. By so doing, we assume that no individual national diamond possesses all the strengths necessary for overall competitiveness and that the MNC combine the distinct strengths of various unbalanced, national diamonds that have been tapped by their subsidiaries (Asmussen et al., 2009). Based on the assumption that the country diamond might be unbalanced because one element is much weaker, or much stronger, than the others, our four dimensions do not covary with each other and individually define different characteristics of the construct. In this situation, the causality is assumed to run from the four first-order dimensions to the construct (Jarvis, MacKenzie, & Podsakoff, 2003).

Table 4.1. Operationalization of the constructs

CONSTRUCT/INDICATOR	Mean	Standard Deviation	Construct specification
COUNTRY-LEVEL FACTORS [1]			Reflective-formative hierarchical latent variable (Type II)
Level of competition			
• Domestic rivalry	2.8829	1.8671	
• Firm strategy	3.1892	2.0159	
Demand market conditions			
• Key customers	4.6486	2.0567	
• New market niches	3.3874	2.0897	
Factor conditions			
• Raw material	1.6486	1.2479	
• Skilled/cheap labour	2.5991	1.6304	
Supplier and related industries			
• Supply industries	2.1712	1.7882	
• Complementary & supporting industries	3.0450	1.9324	

Note: [1] In a 7-point-scale (1=not important at all; 7=very important)

(Continued on the next page)

CONSTRUCT/INDICATOR	Mean	Standard Deviation	Construct specification
CORPORATE-LEVEL FACTORS [2]			Reflective-reflective hierarchical latent variable (Type I)
Subsidiary leadership			
• Decision making participation	5.0270	1.9654	
• Good political relationships	5.6937	1.2195	
• Managers' track record	5.0991	1.4267	
Subsidiary initiative			
• Beyond mandate	5.3874	1.1691	
• Legitimacy	4.9459	1.3872	
• Enhancement	5.7477	1.2825	
Subsidiary entrepreneurship			
• Proactiveness	5.0811	1.3957	
• HQs risk taking encouragement	4.2162	1.5100	
EXTERNAL EMBEDDEDNESS			Reflective-reflective hierarchical latent variable (Type I)
External breadth ties [3]			
• Local individuals knowledge	3.1712	1.9394	
• Local firms infrastructure	2.3333	1.5035	
• Academic Community	2.1171	1.5120	
External depth ties [4]			
• External Outsourcing	1.3964	0.8233	
• Strategic alliances	1.7477	1.1636	
INTERNAL EMBEDDEDNESS			Reflective-reflective hierarchical latent variable (Type I)
Internal breadth ties [5]			
• Inflows from HQs	4.3784	2.2241	
• Outflows to HQs	3.2703	1.9906	
• Peer Subsidiaries Interflows	2.6847	1.7476	
Internal depth ties [6]			
• MNC units experience	2.5856	1.4614	
• MNC joint collaboration	2.4234	1.3721	
SUBSIDIARY R&D-CONTRIBUTING ROLE [7]			Reflective first-order construct
• Basic research competences	2.0631	1.6364	
• Applied research competences	2.7297	2.0887	
• Research into new materials/specifications competences	3.5225	2.1861	
• Development of new products/designs/prototypes competences	2.7117	1.8944	
• Own-design manufacturing competences	3.3964	2.1544	
• Major improvements to machinery/equipment/ processes competences	2.7207	1.9361	

Note: [2] In a 7-point-scale (1=strongly disagree; 7=strongly agree)
[3] In a 7-point-scale (1=not important at all; 7=very important)
[4] In a 5-point-scale (1= used rarely; 5=used very often)
[5] In a 7-point-scale (1=not important at all; 7=very important)
[6] In a 5-point-scale (1= used rarely; 5=used very often)
[7] In a 7-point-scale (1=weak competence recognized; 7=very strong competence recognized)

Corporate-level factors

The corporate-level variable was constructed from nine questionnaire items specified as statements to which managers indicated agreement on a 7-point-scale (anchored as 1=strongly disagree, 7=strongly agree). This set of measures was assembled from multiple contributions in order to capture not only subsidiary choices but also headquarters perceived stance towards them. Initially, this variable was modelled as a single first-order factor; however, the number of items fell in the course of Factor Analysis in the PLS, suggesting the existence of underlying dimensions. Finally, three dimensions were found to load strongly on the main construct.

The first dimension of this scale included three items capturing subsidiary leadership based on Birkinshaw et al.'s (1998) measure. Specifically we use three questions relating to a subsidiary's history of strong, internationally respected leaders; the participation of the subsidiary's leaders on corporate decision making committees; and the leadership's efforts at fostering good political relationships with head office managers.

The second dimension comprised four items for assessing subsidiary initiative: the first item evaluated the degree of legitimacy conferred on the subsidiary managers' initiatives within the MNC (Roth & Morrison, 1992). The following two items captured the desire by subsidiary management to enhance local value-added and to develop their competences beyond the mandate assigned them (Birkinshaw, 1997). The last item rated the extent to which the subsidiary is an implementer of strategic directives issued by the parent office (Gupta & Govindarajan, 1991). This item was excluded during the PLS analysis because it loaded very weakly on the construct, leaving us finally with three items.

The third dimension embraces two items reflecting risk-taking encouragement from headquarters and subsidiary proactiveness, inspired

by the most extensively used operationalization of entrepreneurial orientation (Covin & Slevin, 1989; Miller & Friesen, 1982; Miller, 1983). Finally, this measure was specified as a reflective-reflective second-order construct.

Dual-embeddedness

Internal and external technical embeddedness were captured using ten indicators altogether. First, as regards the 'breadth' of subsidiary ties, respondents indicated the importance of interaction with different types of agent (either local actors or corporate counterparts) for the development of the subsidiary's R&D competences on a 7-point scale (ranging from 1=not important at all, to 7=very important). In the external embeddedness category, as Asmussen et al. (2009) suggest, we use the network links specific to the technical environment consisting of labour with industry-specific skills, local research institutions, and related industries using similar technologies, thereby providing synergies and technology spillovers (three items). In the internal embeddedness category the items cover knowledge sourcing linked to the corporate agents, that is to say, the focal subsidiary, the headquarters and the peer subsidiary units (three items) (Figueiredo, 2011).

Second, the strength of a subsidiary's network relationships was captured on a 5-point scale (where 1= used rarely, to 5=used very often) by asking respondents about their 'depth' of engagement in knowledge-based linkages, since these require high degrees of commitment, trust and reciprocity and constitute embodiments of embeddedness (Dacin, Ventresca, & Beal, 1999). In the case of external embeddedness, we included one item for outsourcing and another for alliances/cooperation linkages (Manolopoulos, Dimitratos, Young, & Lioukas, 2009); while for internal embeddedness, we refer to the mode in which knowledge is developed, either by leveraging the experience of other units or through joint collaborative efforts (two items) (Björkman, Barner-Rasmussen, & Li,

2004; Minbaeva, Pedersen, Björkman, Fey, & Park, 2003; Monteiro, Arvidsson, & Birkinshaw, 2008).

The measurement of the internal embeddedness construct mirrored that of external embeddedness. Both variables were specified as reflective second-order constructs, each loading strongly on two dimensions that fit the concepts of breadth (diversity of agents) and depth (commitment and trust) of the subsidiary's patterns of contacts with its partners as proposed by Andersson et al. (2002).

Subsidiary R&D-contributing roles

The subsidiary R&D-contributing role construct comprises six items measuring the level of competences in different R&D activities performed by the subsidiary and recognized by the entire MNC but from the subsidiary manager's perspective on a 7-point scale (where 1=weak competence recognized, 1=very strong competence recognized). Our aim here, in keeping with Birkinshaw & Hood (1998), is to focus on the subsidiary's charter and its underlying capabilities. The visible manifestation of the subsidiary's role in the MNC is its charter (Galunic & Eisenhardt, 1996), and in turn, the process of wielding a specific charter involves the explicit recognition by corporate management that these underlying competences are valued (Birkinshaw & Hood, 1998).

This variable, specified as a first-order construct, captures the subsidiary's recognized capabilities for its R&D competence-creating role. As such, it is an adaptation of the measure of a firm's technological capabilities as proposed by Iammarino, Padilla-Perez, & Von Tunzelmann (2008), but it focuses solely on the advanced category of capabilities as descriptors of a competence-creating role – i.e. cutting-edge research (basic research); applied research into new product generations; research into new materials and new specifications; development of new products, designs and prototypes; own-design manufacturing; and major improvements to machinery, equipment and processes.

Control variables

In order to control for effects other than those hypothesised, we used several control variables which we drew from the previous literature. First, we introduced 'subsidiary size' (measured as the number of employees in the focal subsidiary) to control for its influence on knowledge transfer (Foss & Pedersen, 2002) and mandate allocation (Bouquet & Birkinshaw, 2008).

Second, we controlled for 'subsidiary age' (computed as the number of years the subsidiary had been in operation), since older subsidiaries will have had more time to develop routines for transfer and for interacting with other partnerships (Håkansson & Snehota, 1995) and influencing strategic decisions (Yamin & Andersson, 2011).

Third, following Rugman & Verbeke's (2001; 2004) regionalization theory, to capture any potential influence of the location of the headquarters, we entered a dummy variable ('home region') for similar versus different locations with respect to the continent on which the subsidiary is located, in this case the EU (1=EU firms, 0=non EU firms).

Fourth, to ensure that 'entry mode' is not driving the results, we used a dummy variable as control for the formation of the subsidiary (1=greenfield investments and 0=otherwise), since acquired local affiliates substantially exceed greenfield affiliates in their R&D intensities, in their access to local knowledge-sharing networks (Belderbos, 2003), and in their knowledge transfer to peer subsidiaries (Björkman et al., 2004).

Fifth, earlier studies have found 'industry effects' for most of the variables studied in this paper. Particularly, technology transfer and diffusion (Gupta & Govindarajan, 2000) and global mandates (Frost et al., 2002) are more likely to emerge in high-tech industries. Based on two-digit NACE classification subsequently collapsed into OECD technology and knowledge-intensity industry classifications, we created a dummy

variable that takes the value of 1 if the subsidiary was qualified as high-tech or medium-high-tech, and 0 otherwise.

Finally, to guard against incorrect conclusions, we also estimated two non-hypothesized paths between 'country-level factors' and 'internal embeddedness' and between 'corporate-level factors' and 'external embeddedness'. Thus, in these specific relationships, the independent variables act as controls.

4.4.3. Data analysis technique

A partial least square (PLS) approach to structural equation modelling (Chin, 1995; Chin, 1998a; Chin, 1998b; Wold, 1982) was used to test the hypotheses, specifically we used SmartPLS 2.0 software (Ringle, Wende, & Will, 2005). For our analysis this technique is preferable for the following reasons.

First, structural equation modelling particularly fits this study since many if not most of the key concepts are not directly observable. Structural equation modelling combines the econometric perspective focusing on prediction and the psychometric perspective focusing on measuring latent, unobserved variables with multiple observed indicators (Chin, 1998a). This allows us to cope simultaneously with the issues of construct measurement and the structural relationships between the constructs (Venaik et al., 2005).

Second, dual embeddedness is still at an early stage of development, therefore the regression based approach of PLS is more appropriate than covariance-based models, since it is better suited to predictive research models and theory building, that is, exploratory studies (Chin, 2010) such as the one reported here.

Third, the mathematical algorithm underlying PLS also makes it suitable for this research, which is determined by a non-normal distribution and a

relatively small sample size. This is due to its iterative algorithm (Henseler, Ringle, & Sinkovics, 2009), which transforms non-normal data in accordance with the central limit theorem (Hair, Sarstedt, Ringle, & Mena, 2012), making PLS results robust to skewed data (Ringle, Götz, Wetzels, & Wilson, 2009; Wilden, Gudergan, Nielsen, & Lings, 2013). Indeed, PLS is referred to as a 'soft modelling' technique in the sense that it does not require restrictive assumptions of measurement (Sosik, Kahai, & Piovoso, 2009), data normality (Fornell & Larcker, 1981) or known distribution (Falk & Miller, 1992), and sample size (Chin & Newsted, 1999; Reinartz, Haenlein, & Henseler, 2009) prevalent to other methods.

Fourth, the research model contains both reflective and formative constructs, to which PLS is particularly suited. Specially, the formative second-order factors cannot be easily and efficiently run in other structural equation models (Diamantopoulos & Winklhofer, 2001; Jarvis et al., 2003).

Fifth, four of the five main constructs are second-order constructs measured though eleven dimensions and interwoven with a set of mediations. Such a complex model specification corroborates the suitability of PLS, given its robustness in dealing with complex models of limited sample size (Reinartz et al., 2009). Consequently, here we employed PLS because of its overall suitability to our modelling requirements.

The PLS estimates are reported in two stages following the recommendations of Chin (2001). In the first stage the measurement model is assessed by focusing on the psychometric properties of the scales under study[16]. As our measurement model also includes second-order latent variables, we follow Becker, Klein, & Wetzels' (2012) guidelines for reporting hierarchical latent variable results. Having

[16] In assessing the psychometric properties it is important to distinguish between formative and reflective scales as these rely on a different set of criteria (Diamantopoulos, Riefler, & Roth, 2008; MacKenzie, Podsakoff, & Jarvis, 2005).

established the appropriateness of the measures, the second stage provides evidence supporting the theoretical model as exemplified by the construct relationships. Then, the structural model is assessed in terms of its predictive power to judge the model's quality and hypothesis testing. Bootstrap percentile confidence intervals were constructed to assess the significance of the parameter estimates. This provides extra confidence that the results are not sample specific as it uses repeated random samples drawn from the data (Preacher & Hayes, 2004) and has the advantage of being completely distribution free (Chin, 2010). Accordingly, the number of bootstrap samples was set as being equal to 5000, with each bootstrap sample containing 111 observations as the original sample.

Psychometric properties of the first-order measurement model

As all the first-order latent variables are reflective, they were assessed with reference to the reliability and validity attributes of the item scales used. Analysis results are summarized in Table 4.2. First, individual item reliability proved to be optimal for most of the measurements, with item standardized loadings being equal to at least 0.707 (Carmines & Zeller, 1979). The only three loadings under the suggested optimal threshold: the 'key customers' (λ=0.5593**; $CI_{.99}$=[0.0106, 0.8754]), 'decision making participation' (λ=0.5572**; CI.99=[0.0179, 0.9182]), and 'external outsourcing' (λ=0.6376**; $CI_{.99}$=[0.1904, 0.8657]) items, were retained in the model, since they are over the minimum acceptable value of 0.55 suggested by Falk & Miller (1992). Indeed loads of 0.5 or 0.6 are considered acceptable for initial stages of research development (Chin, 1998b) or when the scales are adapted or applied across different contexts (Barclay, Higgins, & Thompson, 1995). Both instances apply to the research undertaken here. Further, we find all factor loadings to be significant at the 0.01 level.

Second, internal consistency reliability was examined through composite reliability (Werts, Linn, & Jöreskog, 1974), which fulfils the same task as

Crombach's alpha (Birkinshaw et al., 1998; Furrer, Tjemkes, & Henseler, 2012). However, composite reliability is more suitable for PLS because it does not assume that each indicator makes an equal contribution to the construct (Chin, 1998b). All the latent constructs exceeded the benchmark of 0.7 for exploratory research suggested by Nunnally (1978), which confers reliability to the measures (see Table 4.2).

Third, convergent validity demonstrates the unidimensionality of our constructs. The variance in the indicators accounted for, in terms of variance extracted (AVE), exceeds the 0.5 threshold (Fornell & Larcker, 1981), ensuring that each set of indicators represents one and the same underlying construct (Henseler et al., 2009). Finally, all constructs used in this study differ sufficiently from each other, i.e. fulfil discriminant validity. This requirement was inspected using Fornell & Larcker's (1981) criterion, which suggests that the AVE should be greater than the variance between the construct and other constructs in the model (i.e., the squared correlation between two constructs) (see Table 4.3).

Table 4.2. Validation of the first-order measurement model. Reliability and convergent validity

CONSTRUCT / INDICATOR (REFLECTIVE)	ITEM RELIABILITY	SIGNIFICANCE (bootstrapping)			CONSTRUCT RELIABILITY	CONVERGENT VALIDITY
	Loading	Standard error	t-value	Confidence Interval (99%)	Composite reliability	AVE
Level of competition					0.8091	0.6829
• Domestic rivalry	0.7144**	0.0951	7.5136	[0.3755, 0.8695]		
• Firm strategy	0.9249**	0.0275	33.6369	[0.8335, 0.9902]		
Demand market conditions					0.7618	0.6319
• Key customers	0.5593**	0.2012	2.7796	[0.0106, 0.8754]		
• New market niches	0.9752**	0.0709	13.7524	[0.4827, 0.9999]		
Factor conditions					0.8491	0.7381
• Raw material	0.8191**	0.0598	13.7054	[0.5739, 0.9121]		
• Skilled/cheap labour	0.8974**	0.0314	28.5809	[0.7969, 0.9793]		
Supplier and related industries					0.7687	0.6265
• Supply industries	0.7132**	0.1215	5.8691	[0.2097, 0.8949]		
• Complementary & supporting industries	0.8627**	0.0684	12.6209	[0.6277, 0.9972]		
Subsidiary entrepreneurship					0.8491	0.7384
• Proactiveness	0.8045**	0.0787	10.2248	[0.4660, 0.9198]		
• HQs risk taking encouragement	0.9109**	0.0352	25.8953	[0.7969, 0.9953]		
Subsidiary initiative					0.8188	0.6026
• Beyond mandate	0.7052**	0.2015	3.4998	[0.0412, 0.9655]		
• Legitimacy	0.7604**	0.1384	5.4935	[0.0990, 0.9592]		
• Enhancement	0.8556**	0.1253	6.8292	[0.1167, 0.9727]		
Subsidiary leadership					0.7532	0.5101
• Decision making participation	0.5572**	0.1996	2.792	[0.0179, 0.9182]		
• Good political relationships	0.7467**	0.1411	5.2936	[0.1945, 0.9784]		
• Managers' track record	0.8138**	0.1129	7.2075	[0.1880, 0.9629]		
External breadth ties					0.8745	0.6997
• Local individuals knowledge	0.7748**	0.0572	13.5368	[0.5888, 0.8870]		
• Local firms infrastructure	0.8573**	0.0365	23.4789	[0.7345, 0.9271]		
• Academic Community	0.8738**	0.0223	39.2476	[0.8049, 0.9235]		

(Continued on the next page)

CONSTRUCT / INDICATOR (REFLECTIVE)	ITEM RELIABILITY		SIGNIFICANCE (bootstrapping)		CONSTRUCT RELIABILITY	CONVERGENT VALIDITY
	Loading	Standard error	t-value	Confidence Interval (99%)	Composite reliability	AVE
External depth ties					0.784	0.6534
• External Outsourcing	0.6376**	0.1327	4.8031	[0.1904, 0.8657]		
• Strategic alliances	0.9488**	0.0299	31.7802	[0.8535, 0.9998]		
Internal breadth ties					0.8659	0.6837
• Inflows from HQs	0.7593**	0.0577	13.149	[0.5614, 0.8657]		
• Outflows to HQs	0.8905**	0.0184	48.3543	[0.8328, 0.9300]		
• Peer Subsidiaries Interflows	0.8255**	0.0417	19.7756	[0.6830, 0.9055]		
Internal depth ties					0.9347	0.8774
• MNC units experience	0.9368**	0.0185	50.6914	[0.8741, 0.9743]		
• MNC joint collaboration	0.9366**	0.0185	50.5943	[0.8726, 0.9752]		
Subsidiary R&D-contributing role					0.9063	0.6184
• Basic research	0.7918**	0.0399	19.8632	[0.6632, 0.8742]		
• Applied research	0.8785**	0.0232	37.8664	[0.8058, 0.9269]		
• Research into new materials/specifications	0.7372**	0.0626	11.7783	[0.5436, 0.8610]		
• Development of new products/designs/prototypes	0.7456**	0.0621	11.9969	[0.5493, 0.8717]		
• Own-design manufacturing	0.8260**	0.0341	24.228	[0.7246, 0.8971]		
• Major improvements to machinery/equipment/processes	0.7279**	0.0522	13.9314	[0.5685, 0.8384]		

Note: AVE=Average Variance Extracted; $^{**}p < 0.01$; $^{*}p < 0.05$ (based on a Student t(4999) distribution, two-tailed test).

Table 4.3. Validation of the first-order measurement model. Discriminant Validity

	1	2	3	4	5	6	7	8	9	10	11	12
1. Level of competition	**0.6829**											
2. Demand market conditions	0.0668	**0.6319**										
3. Subsidiary entrepreneurship	0.0036	0.0342	**0.7384**									
4. External breadth ties	0.2758	0.0551	0.0066	**0.6997**								
5. External depth ties	0.0283	0.0594	0.0217	0.0724	**0.6534**							
6. Factor conditions	0.1094	0.0132	0.0044	0.2131	0.0043	**0.7381**						
7. Subsidiary initiative	0.0039	0.0014	0.2364	0.0050	0.0074	0.0000	**0.6026**					
8. Internal breath ties	0.0595	0.0405	0.1053	0.0880	0.1111	0.0456	0.0197	**0.6837**				
9. Internal depth ties	0.0244	0.0480	0.1324	0.0165	0.1526	0.0643	0.0509	0.3149	**0.8774**			
10. Subsidiary leadership	0.0319	0.0325	0.3106	0.0166	0.0025	0.0015	0.3709	0.0567	0.0441	**0.5101**		
11. Subsidiary R&D-contributing role	0.2039	0.0555	0.0777	0.2474	0.1192	0.1391	0.0405	0.3804	0.2483	0.0555	**0.6184**	
12. Supplier & related industries	0.1845	0.1480	0.0008	0.2418	0.0585	0.1707	0.0052	0.0800	0.0656	0.0235	0.1401	**0.6265**

Note: Diagonal represents the average variance extracted; while below the diagonal the shared variance (squared correlations) is represented.

Psychometric properties of second-order measurement model

As the second-order latent variables in the model encompass both reflective and formative constructs, the two-stage approach, also known as the latent variable score method, was adopted (Ringle, Sarstedt, & Straub, 2012; Wetzels, Odekerken-Schroder, & van Oppen, 2009) to specify the hierarchical latent variables. In a first-stage, it estimates the latent variable scores of the first-order constructs without the second-order construct being present, and subsequently uses these first-stage construct scores as indicators for the higher order latent variable in a separate second-stage analysis (see e.g. Agarwal & Karahanna, 2000; Becker et al., 2012; Wilson & Henseler, 2007).

As with the first-order measurement model, the assessment of the reflective higher-order constructs should match the reliability and validity of the item measures (Table 4.4). Overall, 'corporate-level factors', 'external embeddedness' and 'internal embeddedness' have item loadings ranging from 0.70 to 0.90; composite reliabilities of 0.87, 0.77, and 0.88, respectively; and the average variance they extract are 0.69, 0.63, and 0.78. They clearly exceed the minimum requirements for adequate measurement models (0.70 for individual reliability and construct reliability, and 0.50 for average variance extracted). Moreover, comparison of these reliabilities with inter-construct correlations demonstrates adequate discriminant validity. This can be seen in Table 4.5, where the AVE for each construct is much larger than the squared correlation between two constructs.

Table 4.4. Validation of the second-order measurement model. Reliability and convergent validity

	ITEM RELIABILITY		SIGNIFICANCE (BOOTSTRAP)			CONSTRUCT RELIABILITY	CONVERGENT VALIDITY
CONSTRUCT / INDICATOR (FORMATIVE)	**VIF**	**Weights**	**Standard error**	**t-value**	**Confidence Interval (95%)**	**Composite reliability**	**AVE**
Country-level factors						n.a.	n.a.
• Level of competition	1.290	0.4705**	0.1306	3.6031	[0.1817, 0.6920]		
• Demand market conditions	1.195	0.2080	0.1314	1.5828	[-0.0570, 0.4588]		
• Factor conditions	1.256	0.3499*	0.1426	2.4529	[0.0493, 0.6119]		
• Supplier & relatied industries	1.520	0.3599*	0.1526	2.3585	[0.0583, 0.6642]		
CONSTRUCT / INDICATOR (REFLECTIVE)	**Loading**		**Standard error**	**t-value**	**Confidence Interval (99%)**	**Composite reliability**	**AVE**
Corporate-level factors						0.8718	0.6943
• Subsidiary entrepreneurship	0.8670**		0.0382	22.7146	[0.7401, 0.9655]		
• Subsidiary initiative	0.7838**		0.0768	10.2008	[0.4674, 0.8922]		
• Subsidiary leadership	0.8468**		0.0522	16.2335	[0.6362, 0.9260]		
External embeddedness						0.7695	0.6284
• External breadth ties	0.8788**		0.0477	18.4174	[0.7105, 0.9821]		
• External depth ties	0.6961**		0.1117	6.2345	[0.2710, 0.8714]		
Internal embeddedness						0.8761	0.7796
• Internal breadth ties	0.9024**		0.0226	39.991	[0.8265, 0.9470]		
• Internal depth ties	0.8630**		0.0324	26.6375	[0.7567, 0.9250]		
Subsidiary R&D-contributing role						0.9062	0.6182
• Basic research	0.7948**		0.0380	20.8891	[0.6774, 0.8744]		
• Applied research	0.8813**		0.0222	39.6466	[0.8158, 0.9308]		
• Research into new materials/specifications	0.7393**		0.0598	12.3679	[0.5521, 0.8672]		
• Development of new products/designs/prototypes	0.7424**		0.0637	11.6489	[0.5404, 0.8725]		
• Own-design manufacturing	0.8250**		0.0356	23.1466	[0.7099, 0.8987]		
• Major improvements to machinery/equipment/processes	0.7228**		0.0550	13.1406	[0.5481, 0.8384]		

Note: VIF=Variance Inflation Factor; AVE=Average Variance Extracted; $^{**}p < 0.01$; $^{*}p < 0.05$ (based on a Student t(4999) distribution, two-tailed test).

Table 4.5. Validation of the measurement second order model. Discriminant Validity

	1	2	3	4	5
1. Corporate-level factors	**0.6943**	0	0	0	0
2. Country-level factors	0.0084	**0.6284**	0	0	0
3. External embeddedness	0.0204	0.3502	**n.a.**	0	0
4. Internal embeddedness	0.1260	0.1292	0.1493	**0.7796**	0
5. Subsidiary R&D-contributing role	0.0854	0.2776	0.2945	0.4048	**0.6182**

Note: Diagonal represents the average variance extracted; while below the diagonal the shared variance (squared correlations) are represented.

For the formative second-order construct 'country-level factors', different quality criteria are required to assess the measurement properties. Loadings are misleading because the estimation does not take into account the intraset correlations for each block, and thus aspects such as internal reliability and convergent validity are not applicable to formative constructs (Bollen & Lennox, 1991). Psychometric properties are interpreted using weights and their statistical significance, which provide information about how each indicator contributes to the respective construct.

Additionally, we took the precaution to test for multicollinearity, given that it is an undesirable property in formative models (Diamantopoulos & Winklhofer, 2001) as it may inflate bootstrap standard errors and therefore trigger type II errors (Cenfetelli & Bassellier, 2009). An inspection of the variance inflation factor (VIF) using SPSS 20.0 for Windows does not raise any concerns about multicollinearity (see Table 4.4), as it is well below the cut-off value of 5 (Kleinbaum, Kupper, & Muller, 1988).

As for the values of the weights, for all the dimensions except that of 'demand market conditions', the contribution to the formative measure is significant at least at the 0.05 level. Thus, for 'demand market conditions' we also consider its absolute contribution to the construct (i.e. 'corporate-level factors'), which is given by the formative indicator's outer loading.

According to Hair et al. (2012), 'demand market conditions' should be interpreted as 'absolutely important', since while their outer weight is insignificant, their outer loading has a value above 0.5 (specifically 0.51), and in this situation, the indicator should be retained. Taken together, these results provide sufficient confidence that the measurement model used in this research is reliable and valid.

Common method bias assessment

Common method variance bias was evaluated ex post to check for biases not minimized by the survey design. We took the ad hoc statistical approach suggested by Podsakoff et al. (2003) and adapted for use with PLS by Liang, Saraf, Hu, & Xue (2007). Specifically, a latent 'method' factor was added to the structural model. This method factor included all the indicators of the principal constructs. Then, following Williams, Edwards, & Vandenberg (2003), we examined the statistical significance of factor loadings of the method factor and compared the variances of each observed indicator explained by its hypothesized construct and the method factor. As shown in Table 4.6, the indicators' loadings on the hypothesised constructs are all significant, whereas, with only one exception, all of their loadings on the method factor are non-significant. The variance in the indicators, explained by their hypothesised constructs (on average 0.6413), are substantially larger than those explained by the method factor (on average 0.0165). The above results show that the method did not contribute substantively to the variances in indicators and, therefore, common method bias was unlikely to be a serious concern for this study.

Table 4.6. Analysis of common method bias

CONSTRUCT / INDICATOR	Substantive factor loading	Variance explained by the substantive construct	Method factor loading	Variance explained by the method construct
Country-level factors				
• Level of competition	0.7033**	0.4946	0.0726	0.0041
• Demand market conditions	0.5787**	0.3349	-0.0245	0.0009
• Factor conditions	0.6668**	0.4446	-0.0010	0.0000
• Supplier and related industries	0.8506**	0.7235	-0.0565	0.0046
Corporate-level factors				
• Subsidiary entrepreneurship	0.7870**	0.6194	0.0633	0.0040
• Subsidiary initiative	0.8603**	0.7401	-0.0712	0.0052
• Subsidiary leadership	0.8642**	0.7468	0.0064	0.0000
External embeddedness				
• External breadth ties	0.7738**	0.5988	0.0904	0.0063
• External depth ties	0.8277**	0.6851	-0.1078	0.0108
Internal embeddedness				
• Internal breadth ties	0.8240**	0.6790	0.0875	0.0074
• Internal depth ties	0.9461**	0.8951	-0.0918	0.0085
Subsidiary R&D-contributing role				
• Basic research	0.4877 *	0.2379	0.3195	0.0968
• Applied research	0.8909**	0.7937	-0.0159	0.0002
• Research into new materials/specifications	0.5796 *	0.3359	0.1625	0.0245
• Development of new products/designs/prototypes	1.0552**	1.1134	-0.3234 *	0.0966
• Own-design manufacturing	0.9045**	0.8181	-0.0816	0.0068
• Major improvements to machinery/equipment/processes	0.8008**	0.6413	-0.0722	0.0040
AVERAGE		**0.6413**		**0.0165**

Note: ** p<0.01; * p<0.05 (based on a Student t(4999) distribution, two-tailed test).

Structural model evaluation

Structural model evaluation in PLS relies on measures indicating the model's predictive power (Tenenhaus, Esposito Vinzi, Chatelin, & Lauro, 2005)[17]. The central criterion in this respect is the coefficient of

[17] PLS lacks a global goodness-of-fit index (Hair, Sarstedt, Pieper, & Ringle, 2012). The goodness-of-fit index (GoF) proposed by Tenenhaus et al. (2004) as a means of validating a path model globally has recently been challenged by Henseler & Sarstedt (2012). The authors demonstrate that GoF cannot separate valid from invalid models and warn that applying GoF to model validation could lead researchers to make misleading decisions. By way of an alternative, they suggest that the application of GoF does make sense for group comparisons (i.e. varying the data while keeping the model constant). For more insights we recommend reading Henseler & Sarstedt (2012).

determination (R^2). Table 4.7 shows that the R^2 value for the three endogenous variables in the model greatly exceeds the minimum value of 0.1 recommended by Falk & Miller (1992). Furthermore, the theoretical model proposed explains more than 50% of the variance of the final endogenous variable predicted, i.e. 'subsidiary R&D-contributing role' (R^2=0.58), which can be rated as a 'moderate-substantial' predictive capacity according to Chin's (1998) benchmark. Also, the Stone-Geisser Q^2 statistic (Geisser, 1974; Stone, 1974) is higher than zero for the three endogenous constructs, that is to say 'external embeddedness' (Q^2=0.1703), 'internal embeddedness' (Q^2=0.1582) and 'subsidiary R&D-contributing role' (Q^2=0.3196), suggesting that the model has predictive relevance. Finally, structural path coefficients and, in particular, their significance and size are carefully evaluated.

In the case of the two categories of embeddedness introduced in the model as intermediate variables, we find that 'subsidiary R&D-contributing role' is directly and positively influenced by both 'internal embeddedness' (β=0.4148**; $CI_{.95}$=[0.2652, 0.5634]) and 'external embeddedness' (β=0.2340**; $CI_{.95}$=[0.0517, 0.4100), which in turn, are directly and positively influenced by the 'corporate-level factors' (β=0.3046**; $CI_{.95}$=[0.1415, 0.4602]) and 'country-level factors' (β=0.5836**; $CI_{.95}$=[0.4445, 0.7160]) respectively. It should be noted that while 'country-level factors' also hold a direct relationship with 'subsidiary R&D-contributing role' (β=0.2084*; $CI_{.95}$=[0.0510, 0.3805]), there is, however, no empirical evidence of a direct relationship between 'corporate-level factors' and 'subsidiary R&D-contributing role' (β=0.1038; $CI_{.95}$=[-0.0614, 0.2765]). The analysis also reveals that a significant relationship exists between the two embeddedness variables, that is to say, the 'internal embeddedness' is positively influenced by 'external embeddedness '(β=0.2258*; $CI_{.95}$=[0.0022, 0.4277]). These paths and the explained variance of the endogenous variables predicted are represented in Figure 4.2.

Table 4.7. Structural model assessment

PATHS	Path coefficient	Standard error	t-value (bootstrap)	Confidence Interval (95%)	R^2	Effect size f^2	Stone-Geisser Q^2
Effects on external embeddedness					0.3581		0.1703
• Country-level factors → External embeddedness	0.5836**	0.0700	8.3394	[0.4445, 0.7160]		0.5250	
Effects on internal embeddedness					0.2665		0.1582
• Corporate-level factors → Internal embeddedness	0.3046**	0.0811	3.7563	[0.1415, 0.4602]		0.1238	
• External embeddedness → Internal embeddedness	0.2258 *	0.1096	2.0609	[0.0022, 0.4277]		0.0425	
Effects on subsidiary R&D-contributing role					0.5826		0.3196
• Corporate-level factors → Subsidiary R&D cont. role	0.1038	0.0869	1.1935	[-0.0614, 0.2765]		0.0189	
• Country-level factors → Subsidiary R&D cont. role	0.2084 *	0.0839	2.4845	[0.0510, 0.3805]		0.0827	
• External embeddedness → Subsidiary R&D cont. role	0.2340 *	0.0914	2.5590	[0.0517, 0.4100]		0.0810	
• Internal embeddedness → Subsidiary R&D cont. role	0.4148**	0.0758	5.4762	[0.2652, 0.5634]		0.2968	
Control variables on subsidiary R&D-contributing role							
• Subsidiary age → Subsidiary R&D cont. role	0.1410	0.0773	1.8252	[-0.0128, 0.2878]		0.0431	
• Subsidiary size → Subsidiary R&D cont. role	0.0362	0.0580	0.6245	[-0.0858, 0.1489]		0.0024	
• Home region → Subsidiary R&D cont. role	0.0361	0.0628	0.5742	[-0.1568, 0.0885]		0.0029	
• Entry mode → Subsidiary R&D cont. role	0.0043	0.0674	0.0637	[-0.1292, 0.1348]		0.0000	
• Industry effects → Subsidiary R&D cont. role	0.1256	0.0634	1.8830	[-0.0050, 0.2462]		0.0357	
Control variables on embeddedness							
• Corporate-level factors → External embeddedness	0.0891	0.0728	1.2247	[-0.0581, 0.2273]		0.0100	
• Country-level factors → Internal embeddedness	0.1979	0.1046	1.8908	[-0.0001, 0.4089]		0.0132	

Note: $^{**}p < 0.01$; $^{*}p < 0.05$ (based on a Student t(4999) distribution, two-tailed test).
Note: Following Henseler et al. (2009) we specify f^2=(R^2 included-R^2 excluded)/(1-R^2 included); According to Cohen (1988), f^2 values of 0.02, 0.15, and 0.35 signify small, medium, and large effects, respectively.

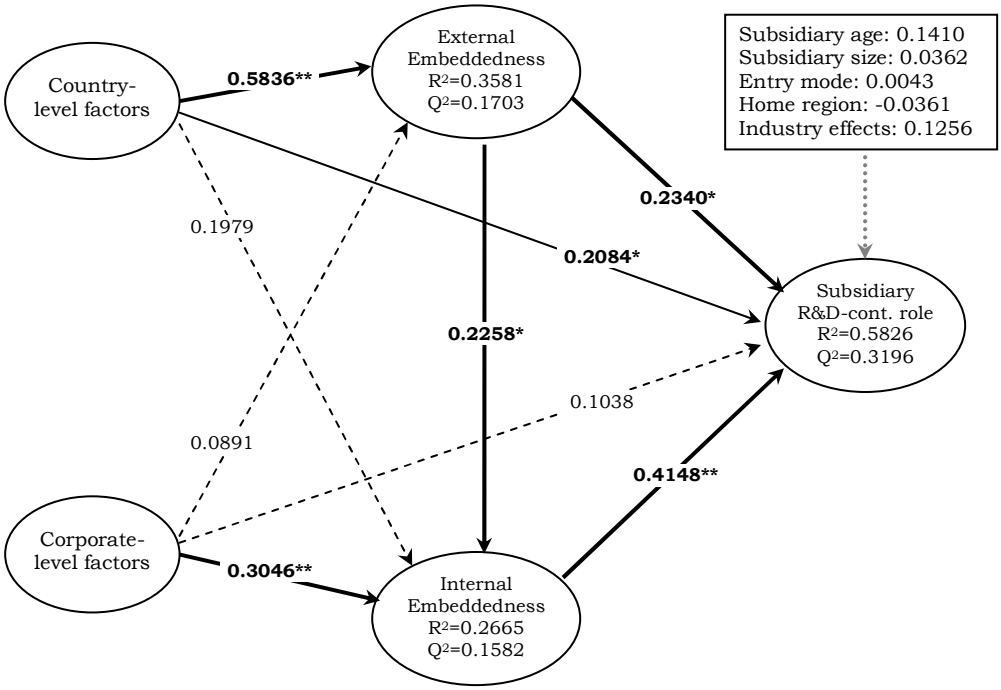
The control variables fall into two sets. The first set comprises the standard, subsidiary-specific variables that control for firm heterogeneity ('subsidiary age', 'subsidiary size', 'home region', 'entry mode' and 'industry effects'). Given the insignificant effects of these control variables we followed the principle of parsimony and excluded them from all further analyses. A similar procedure is adopted by other studies (see for e.g. Berghman, Matthyssens, Streukens, & Vandenbempt, 2013; Scott et al., 2010).

The second set is the more relevant from the network-base perspective, and comprises 'corporate-' and 'country-level factors' considered in cross-relationship with the opposite type of embeddedness, so that, we examined the effect of 'corporate-level factors' on 'external embeddedness' (β=0.0891; $CI_{.95}$=[-0.0581, 0.2273]) and 'country-level factors' on 'internal embeddedness' (β=0.1979; $CI_{.95}$=[-0.0001, 0.4089]). In both cases, no significant effect was found. Nevertheless, given that the confidence interval of the second control is very close to zero, we retained it in the model and scrutinized its relative impact by means of changes in the R^2 (Cohen, 1988). This measure corroborates the weak size effect (f^2=0.013) of 'country-level factors' as a control variable. In the light of these findings, to fully understand the pattern of dual embeddedness in the R&D subsidiary roles, a formal mediation test has to be conducted.

For the sake of caution, an additional analysis, reversing the line of causality between 'external embeddedness' and 'internal embeddedness', was undertaken. Although research on network embeddedness has largely established the causality direction as specified in our model, the reverse impact between these variables has never explicitly been shown. Hence, we checked the possibility that the relationship might flow in the opposite direction, i.e. from 'internal embeddedness' towards 'external embeddedness' (the results from this analysis are provided in Appendix 4.B - model 2). Apart from the predictable variation in the variance explained by these variables and the small changes in the paths throughout the model, the shift in path direction between 'external

embeddedness' and 'internal embeddedness' resulted in a non-significant path. This verification corroborates the adequacy of the line of causality as depicted in our model.

Figure 4.2. Path values and variance explained



Note: $^{**}p < 0.01$; $^{*}p < 0.05$ (based on a Student t(4999) distribution, two-tailed test).

H1: Country-level factors → External embeddedness → Subsidiary R&D-contributing role

H2: Corporate-level factors → Internal embeddedness → Subsidiary R&D-contributing role

H3: Corporate-level factors → External embeddedness → Internal embeddedness → Subsidiary R&D-contributing role

Post hoc assessment of mediating effects

Mediation analyses are most often guided by the procedures outlined by Baron and Kenny (1986). However, the statistical literature has disputed

some of their suggestions, criticizing the low statistical power provided in many situations (for a discussion see Iacobucci, Saldanha, & Deng, 2007; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Preacher & Hayes, 2008; Zhao, Lynch, & Chen, 2010), especially the risk of erroneously concluding the existence of a mediation effect (Type I error) (Holmbeck, 2002)[18]. Consequently, we used bias-corrected bootstrap for testing mediating effects[19], since it performs better than Baron & Kenny (1986) and Sobel (1982) in small to moderate samples in terms of both its statistical power and Type I error rate (MacKinnon et al., 2002; MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2008; Williams & MacKinnon, 2008; Zhao et al., 2010).

Further, the theoretical model proposed involves multiple mediation hypotheses and requires testing indirect effects either in parallel or linked serially in a cause sequence. For this reason, we applied Hayes' (2012) PROCESS macro in SPSS 20 for testing *serial multiple mediator models* (Hayes, Preacher, & Myers, 2011), not only to decide whether or not an indirect effect exists, but also to tease apart individual mediating effects often attributable to several potential mediators that might overlap in content (see Preacher & Hayes, 2008; West & Aiken, 1997). This method enables us to compare and contrast the size of the indirect effects of multiple mediators. Moreover, it makes it possible to include more than one independent variable, each of which can be tested in a complementary model, and to control simultaneously the non-hypothesized effects of 'corporate-' and 'country-level factors'. In each model, we chose one of the independent variables (either the 'corporate-

[18] By looking only at the significance of the coefficients and controlling for a substantial decrease in the direct effect after entering the mediator variable - as is done in Baron & Kenny's (1986) method, the results may lead to the erroneous conclusion that there is a mediation effect (Type I error) (Holmbeck, 2002). It is therefore critical to examine not only the significance of the coefficients but also the absolute size of the indirect effects (Preacher & Hayes, 2004). Although the procedure developed by Sobel (1982) provides a more direct test of the indirect effect, the assumptions of normal sampling distribution of product of coefficients necessary for this test is only present in large samples and hinders its application in this research.

[19] The bias corrected bootstrap will generate a confidence interval for each mediator. If the interval for a mediator does not contain zero, then the indirect effect of this mediator is significantly different from zero.

level factors' or 'country-level factors') as the primary independent variable to be examined, and treated the other as covariates for that test (c.f. Sun, 2010).

4.5. RESULTS

The main argument of this paper is that the impact of the classical factors on the configuration of strategic R&D roles, i.e. 'corporate-level factors' and 'country-level factors', is mediated at one and the same time by the 'internal' and 'external embeddedness'. In this sense, Table 4.8 shows the results of the post hoc assessment of these mediating effects.

First, a model is specified with the 'corporate-level factors' as the independent variable (Model 1 in Table 4.8) and the 'country-level factors' treated as a covariate. As can be seen, 'corporate-level factors' have a significant total effect on 'subsidiary R&D-contributing role' (β=0.2469**, $CI_{.95}$=[0.0914, 0.4024]). When the mediators (i.e. 'external embeddedness' and 'internal embeddedness') are introduced, the 'corporate-level factors' no longer have a significant direct effect on 'subsidiary R&D-contributing role' (β=0.0841, $CI_{.95}$=[-0.0544, 0.2226]). Further, the total indirect effect is different from zero (β=0.1628; $CI_{.95}$=[0.0758, 0.2839]). An examination of the specific indirect effects indicates that 'internal embeddedness' is the only significant mediator (β=0.1339; $CI_{.95}$=[0.0602, 0.2417]). Still, it may be of interest to examine whether these indirect effects differ significantly. The pairwise contrast of the indirect effects reveals that 'internal embeddedness' is a significantly greater mediator than the other two. The difference between them is -0.1141 and -0.1250. The other two indirect effects through 'external embeddedness' cannot be distinguished in terms of magnitude (the confidence interval of the contrast contains zeros, indicating that the two indirect effects are of a similar magnitude). Therefore, we can affirm that 'internal embeddedness' fully mediates the impact of 'corporate-level' factors on 'subsidiary R&D-contributing role', so H1 is supported.

Second, we examine the model that has 'country-level factors' as the independent variable and 'corporate-level factors' as a covariate (Model 2 in Table 4.8). In line with these results, country-level factors do have a significant total effect on 'subsidiary R&D-contributing role' (β=0.5069, $CI_{.95}$=[0.3514, 0.6624]) and the total indirect effects are also significant (β=0.2723, $CI_{.95}$=[0.1574, 0.4130]). When the mediators (i.e. 'external embeddedness' and 'internal embeddedness') are introduced, the effect of 'country-level factors' directly on 'subsidiary R&D-contributing role' becomes significantly smaller in size relative to the total effect (β=0.2346, $CI_{.95}$=[0.0715, 0.3977]), but it remains significant at the 95% confidence interval. An examination of the specific indirect effects shows that both indirect effects, through 'external embeddedness' and through 'external-internal embeddedness' in a double-step path, act as mediators, since their 95% confidence interval does not contain zero. In contrast, the specific indirect effect through 'internal embeddedness' does not act as a mediator. The three-way pair wise contrast between them indicates that the indirect effects do not differ significantly, despite the fact that the paths through 'external embeddedness' are significantly different from zero and although the paths through 'internal embeddedness' are not. '*Such apparent paradoxes can occur when one of the specific indirect effects involved in the contrast is not sufficiently far from zero*' (Preacher & Hayes, 2008), such as 'internal embeddedness' in this study.

Table 4.8. Summary of the results from the post hoc assessment of mediating effects

MODEL 1: CORPORATE-LEVEL FACTORS AS INDEPENDENT VARIABLE								
Total effect of IV on DV			Direct effect of IV on DV			Indirect effect of IV on DV		
Coefficient	T-value	Bootstraping BC 95% CI	Coefficient	T-value	Bootstraping BC 95% CI	Mediators	Point estimate	Bootstraping BC 95% CI
0.2469**	3.1466	[0.0914, 0.4024]	0.0841	1.2042	[-0.0544, 0.2226]	Total indirect effect	0.1628	[0.0758, 0.2839]
						External embeddedness	0.0199	[-0.0052, 0.0626]
						External & Internal embeddedness	0.0090	[-0.0026, 0.0427]
						Internal embeddedness	0.1339	[0.0602, 0.2417]
						Contrast size effects		
						External vs. External&Internal	0.0109	[-0.0067, 0.0551]
						External vs. Internal	-0.1141	[-0.2200, -0.0325]
						External&Intenral vs. Internal	-0.1250	[-0.2314, -0.0476]

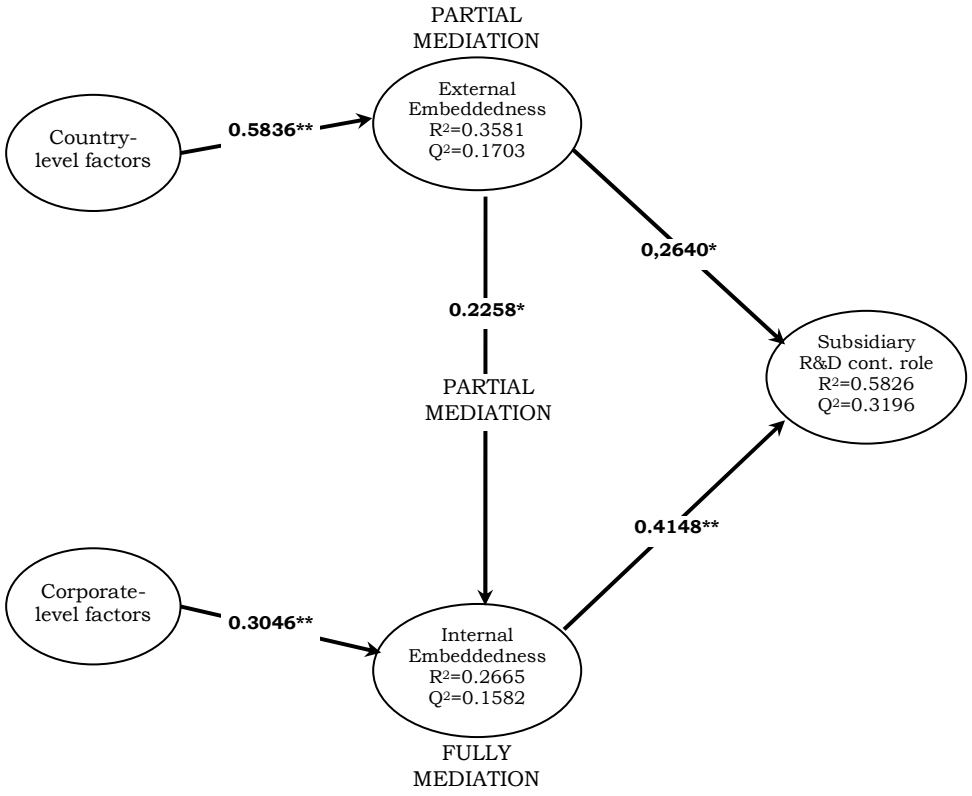
MODEL 2: COUNTRY-LEVEL FACTORS AS INDEPENDENT VARIABLE								
Total effect of IV on DV			Direct effect of IV on DV			Indirect effect of IV on DV		
Coefficient	T-value	Bootstraping BC 95% CI	Coefficient	T-value	Bootstraping BC 95% CI	Mediators	Point estimate	Bootstraping BC 95% CI
0.5069**	6.4611	[0.3514, 0.6624]	0.2346**	2.8516	[0.0715, 0.3977]	Total indirect effect	0.2723	[0.1574, 0.4130]
						External embeddedness	0.1304	[0.0226, 0.2630]
						External & Internal embeddedness	0.0589	[0.0115, 0.1356]
						Internal embeddedness	0.0831	[-0.0002, 0.1808]
						Contrast size effects		
						External vs. Internal.	0.0715	[-0.0639, 0.2156]
						External&Internal vs. Internal	0.0473	[-0.1030, 0.2180]
						External vs. External&Intenral	-0.0242	[-0.1426, 0.1135]

Note: BC=Bias Corrected; CI=Confidence Interval; 5,000 bootstrap samples; $^{**}p < 0.01$; $^{*}p < 0.05$ (based on a Student t(4999) distribution, two-tailed test).
'External' represents the path: Country-level factors → External embeddedness → Subsidiary R&D-contributing role.
'Internal' represents the path: Country-level factors → Internal embeddedness → Subsidiary R&D-contributing role.
'External&External' represents the path: Country-level factors → External embeddedness→ Internal embeddedness → Subsidiary R&D-contrib. role.

Turning therefore to our hypotheses, on the one hand, 'external embeddedness' mediates the influence of country-level factors on the 'subsidiary R&D-contributing role', while on the other hand, 'country-level factors' also impact the 'subsidiary R&D-contributing role' via a double-step mediation comprising 'external embeddedness' causally affecting 'internal embeddedness'. This partially supports H2 and H3, since both mediated and direct effects coexist and point at the same direction, which means that partial mediations but not full mediations exist between 'country-level factors' and 'subsidiary R&D-contributing roles'.

Finally, a particular feature of these findings is that they can be shown to be robust after controlling for the effects of 'corporate-level factors' on 'external embeddedness' and 'country-level factors' on 'internal embeddedness', two indirect effects that were not hypothesised. These results reduce the risk of wrong conclusions being drawn as a consequence of parameter bias due to omitted variables (Judd & Kenny, 1981). Figure 4.3 outlines the significant mediating effects of the formal mediation test.

Figure 4.3. Results of the formal mediation test: significant mediating effects



Note: $^{**}p < 0.01$; $^{*}p < 0.05$ (based on a Student t(4999) distribution, two-tailed test).

H1: Country-level factors → External embeddedness → Subsidiary R&D-contributing role (PARTIAL MEDIATION)

H2: Corporate-level factors → Internal embeddedness → Subsidiary R&D-contributing role (FULLY MEDIATION)

H3: Corporate-level factors → External embeddedness → Internal embeddedness → Subsidiary R&D cont. role (PARTIAL MEDIATION)

4.6. DISCUSSION

By adopting a network-based view, this study offers a number of fresh insights into the drivers of the configuration of subsidiary R&D roles. In particular, we have found evidence of underlying factors of the subsidiary

R&D-contributing role in the development of the technological base of the whole MNC, which forms part of the competitive advantage of the firm. Our findings are consistent with other studies that have identified country- and corporate-level factors to be the main drivers of strategic R&D roles, albeit not quite in the manner that these prior contributions would have led us to expect.

Our results suggest, first, that the better the condition of the location in which a subsidiary is sited, the better the contribution it can make to technology generation within the MNC. However, this beneficial effect exists because local embeddedness establishes the bases for sharing, learning and generating knowledge beyond the boundaries of the firm. As such, a subsidiary's external embeddedness channels the influence of country-level factors on its R&D-contributing role. This means that a better local environment does not necessarily result in the assignment of greater R&D mandates, unless the subsidiaries themselves engage in technological exploration by strengthening linkages with local agents. This finding supplements our understanding of how local contexts impact subsidiary roles and adds further our knowledge of the factors that the literature recognises under the rubric of 'location advantages' (see e.g. Benito et al., 2003; Dunning, 2000).

Second, corporate-level factors appear to be strongly associated with internal embeddedness, which in turn, serves to boost the recognition of competence-creating mandates among a firm's subsidiaries. However, our results show that no clear relationship exists between corporate-level factors and a subsidiary's contributing role, except through the channels of internal embeddedness. This finding is contrary to predictions in a number of prior studies conducted from a resource-based view (e.g. Birkinshaw, 1996; Roth & Morrison, 1992) and to supplementary theories of subsidiary evolution (e.g. Birkinshaw & Hood, 1998; Cantwell & Mudambi, 2005; Dörrenbächer & Gammelgaard, 2006). Our interpretation of these differences is that these prior studies, undertaken from an atomistic view of MNC subsidiary units, appear to have neglected

internal embeddedness as the means by which corporate-level factors might impact a subsidiary's contributing role. This would seem to demonstrate that traditional approaches are misleading when explaining differences in the various R&D roles of the units of an MNC, since one of the main sources of such differences is the manner in which, and the extent to which, subsidiaries become embedded in the internal and external network linkages for accumulating and sharing knowledge.

Third, because much of the influence of external embeddedness on a subsidiary's R&D-contributing role is conducted through the channels of internal embeddedness, our study confirms the need to consider the impact of dual network embeddedness in determining the role played by subsidiaries as R&D contributors. In contrast to previous studies that identify above all the importance of external embeddedness for a subsidiary's role as a centre of excellence (Andersson & Forsgren, 2000), our study finds that internal embeddedness presents a more markedly positive 'size effect' (Cohen, 1988) on a subsidiary's acknowledged competences. In fact, the greater the effect of external embeddedness on a subsidiary's R&D-contributing role, the stronger is the mediating effect of internal embeddedness.

A possible explanation might be found in the attention-based view (Bouquet & Birkinshaw, 2008). Thus, the greater impact of internal embeddedness may be derived not solely from technological inputs stemming from the corporate context, but also from the underlying organizing principles, systems, and processes that allow the subsidiary to innovate (Almeida & Phene, 2004). Ciabuschi et al. (2011) demonstrate that internal embeddedness attracts headquarters involvement in subsidiary activities and that this can lead to an increased level of competences at the focal subsidiary. An alternative explanation might lie in the resource-dependency theory (Mudambi & Pedersen, 2007). Thus, the subsidiary builds critical linkages with key external actors so as to learn and assimilate knowledge from the host country environment, and wilfully uses corporate linkages in order to control and transfer value-

adding resources, especially knowledge, on which the rest of the MNC can draw (Birkinshaw et al., 2005) and which they could not otherwise access (Dörrenbächer & Gammelgaard, 2010). In this situation, a subsidiary's internal embeddedness ensures the dissemination of technological capabilities back to the parent company, so as to manipulate dependencies and exert influence over the allocation of mandates.

A more exhaustive examination of the relationship between the external and internal embeddedness in our model provides further evidence of interest. In line with the findings of the additional analysis in which the line of causality between external and internal embeddedness was reversed, we note the absence of any significant effect of internal embeddedness on external embeddedness. A plausible explanation for this is that the two operate differently in relation to their impact on a subsidiary's R&D role. For instance, linkages to the MNC may result in redundant competences, since these ties are framed within the same social structure (Almeida & Phene, 2004); in contrast, linkages to entities within the host country might provide knowledge of a more novel, less duplicative nature, relative to the current practices of the MNC (Cantwell & Mudambi, 2005; Yamin & Andersson, 2011). Our results suggest that the line of causality runs from external embeddedness to internal embeddedness because the former requires some degree of internal embeddedness in order to impact fully on the level of competences for which the subsidiary is recognized among the MNC as a whole. This process is of obvious important, as it should help to shed light on how knowledge obtained through external embeddedness can be disseminated to the rest of the firm, and thus increase the subsidiary's contribution to the MNC's overall competitive advantage. Our results also reveal a positive sign in this line of causality, which means that a subsidiary's R&D-contributing role is affected by the growth of embeddedness in both the local environment and in the corporate network. And, here, our model is able to depict the kind of relationships that can occur between them.

This conclusion runs contrary to the predictions of some studies undertaken from the network-based view, which describe the existence of a trade-off between internal and external network embeddedness. They assume that a subsidiary's external embeddedness is positively associated with its competence development but also with its context specificity, a factor that hinders the possibility of transferring knowledge to other corporate units (Andersson et al., 2002). Additionally, they claim a subsidiary has to face institutional pressures from both the host and the home countries, so that the gap between the two institutions is, on occasions, difficult to bridge (Forsgren et al., 2005), which creates a dilemma similar to that found in the tension characterising the integration-responsiveness framework (Meyer et al., 2011). For example, Adenfelt & Lagerström (2006) reported difficulties in handling the dual roles of knowledge development and sharing, which results in a role concerned primarily with the latter at the expense of developing new knowledge, reflecting the respective cost and time requirements of the two activities. This is also discussed conceptually by Forsgren et al. (2000).

Our findings go someway to refuting these previous claims as we provide empirical evidence of the subsidiary's capacity to build on both knowledge networks, at least as far as its competence-creating mandates are concerned. However, these findings can perhaps be reconciled with the previous literature if we consider that the ability to handle dual embeddedness is dependent on a subsidiary's prior stock of knowledge and the role it plays in the corporation. Hence, we would expect subsidiaries presenting an inverse relationship between their internal and external embeddedness not to perform an R&D-contributing role. This line of thinking is also prevalent in the view of the firm as a network of differentiated roles and responsibilities (Ghoshal & Bartlett, 1990).

In this sense, it is a well established postulate of the network-based view, that a subsidiary's contributing role is associated with the sourcing of knowledge abroad, leveraged by the subsidiary's business relationships with its external partners (Andersson et al., 2002; Andersson, 2003).

However, our results reveal the relevance of internal embeddedness to a subsidiary's R&D-contributing role. It is our claim that internal network embeddedness is fundamental to the perceived importance of these competences in the eyes of the parent office, ensuring explicit recognition is obtained from corporate headquarters. If a subsidiary's capabilities are not valued, charter allocation is unlikely and, therefore, it will not be granted a role in which it can contribute to strategy development (Birkinshaw & Hood, 1998). Our findings corroborate that for the second part of the process to be fulfilled, a subsidiary must exploit its connectivity within the MNC network. After accessing external local knowledge, a subsidiary must be able to transfer this knowledge internally within the firm so as to acquire recognition and to be deemed important. This conclusion is consistent with the argument that a high degree of intra-organizational knowledge exchange between the focal subsidiary and the other units of the MNC is likely to boost a subsidiary's visibility within the MNC (Bouquet & Birkinshaw, 2008), attract headquarters attention (Ambos et al., 2010) and increase the subsidiary's influence over the head office's decision-making in its own favour (Mudambi & Navarra, 2004). As such, subsidiaries that fulfil R&D-contributing roles are not only externally embedded, operating as independent actors in their local environment in which they have successfully established relationships, but they are also internally embedded, having integrated themselves into the MNC's network insofar as subsidiaries are dependent on the strategic allocation of resources and mandates within the MNC. Thus, on the basis of our findings, internal and external embeddedness cannot be seen as 'competing' forces; on the contrary, the presence of both forces is imperative, a condition that is attributable to the mediating effects they have on each other.

4.7. CONCLUSIONS

The main contribution of this paper has been to present a multiple mediating model that sheds light of the origin, underlying factors and

causal mechanisms that endow an MNC subsidiary with an R&D-contributing role. Although many typologies have been proposed suggesting that subsidiaries vary greatly in the R&D strategic role they adopt, there is no definitive evidence of the origins of such variations (Brinkinshaw et al., 1998). Hence, we have explored how the MNC's internal corporate context, the host country's external context together with dual embeddedness interact to produce the conditions for heterogeneous subsidiary R&D roles. By bringing together previous insights in the literature examining subsidiary roles and networks, here we have gone one step further and uncovered various mediations that determine the strength of internal and external influences. The present study has shown that (1) internal embeddedness fully mediates the impact of corporate-level factors on subsidiary R&D-contributing roles; (2) external embeddedness partially mediates the impact of country-level factors on subsidiary R&D-contributing roles; and, (3) dual embeddedness (defined as a three-path mediation in which external embeddedness precedes internal embeddedness) also mediates in a sequential manner the relationship between the country-level factors and the subsidiary's R&D-contributing role.

Thus, our results indicate that favourable conditions in the internal and external context may not necessarily result in the enhancement of a subsidiary's R&D-contributing role, unless dual embeddedness is well established. Hence, the achievement of a competence-creating mandate does not follow directly from the strategic importance or the dynamism of corporate- and country-level factors as has traditionally been claimed in the literature. However, these factors do matter in the process, inasmuch as they affect the development of competences in network relationships that, in turn, influence whether a subsidiary can contribute to the development of MNC competences. Here, we should stress the critical role played by internal embeddedness as a channel for transferring knowledge to the rest of the multinational, attracting the attention of headquarters and, thus, having an influence on the allocation of mandates. In the case of the conditions of the internal context we have shown the existence of a

significant relationship only when the effect is mediated through engagement in intra-corporate relationships. Furthermore, the potential impact on a subsidiary's R&D-contributing role of each of the contextual and relational dimensions analysed herein cannot be fully comprehended until we have fully accounted for the effect mediated through the channels of internal embeddedness. These findings have an obvious theoretical relevance as well as both significant methodological and managerial implications.

4.7.1. Theoretical Implications

We make several contributions to an understanding of the differences in the R&D roles of subsidiaries located in the same country or within the same MNC across countries. Specifically, our research model draws attention to three weaknesses in the pertinent literature.

First, this paper contributes to the literature examining the drivers of subsidiary's R&D roles by introducing the effects of network linkages. Research on R&D roles has traditionally looked for the origin of the heterogeneous roles played by subsidiaries among the features of the internal corporate and the external host country contexts (Bartlett & Ghoshal, 1990; Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; Kuemmerle, 1997; 1999; Pearce, 1992; von Zedtwitz & Gassmann, 2002). However, the empirical evidence presented in this paper has emphasised the importance of knowledge-sharing relationships as a strategic source of the technological capabilities for competence-creating mandated subsidiaries (Andersson et al., 2001; Andersson et al., 2002; 2007). The omission of network effects may explain why a number of previous studies focusing solely on contextual factors (for example, Benito et al., 2003; Foss & Pedersen, 2002; Frost et al., 2002) failed to identify a clear relationship between them and their part in the development of a subsidiary's technological competences. Thus, a more comprehensive understanding needs to include the network-based view.

Second, very little research has been reported in the business network literature examining the antecedents of the differences between subsidiaries in terms of their embeddedness (Santangelo, 2012). Although both an MNC's internal factors and the broader environmental factors have been proposed for establishing the foundations for building knowledge-sharing relationships (e.g. Andersson et al., 2005; Giroud & Scott-Kennel, 2009; Holm et al., 2005; Jindra, Giroud, & Scott-Kennel, 2009; Nell, Andersson, & Schlegelmilch, 2010), seemingly few models deal explicitly with their joint effect on subsidiary R&D roles. By contrast, here we have combined the traditional literature on subsidiary R&D roles and recent research on embeddedness in explaining the drivers of a subsidiary's R&D-contributing role, demonstrating that the two perspectives may in fact be much closer to each other than has usually been thought. This is a novel theoretical approach to explaining the phenomenon more fully.

Finally, this paper contributes the debate considering how external embeddedness affects subsidiary R&D roles. Some researchers argue that externally embedded subsidiaries can provide access to a variety of competencies and thus perform an advanced R&D-contributing role (Andersson & Forsgren, 2000; Andersson et al., 2001; 2002; Frost et al., 2002), whilst others suggest that externally embedded subsidiaries are more concerned with developing their own competencies, at the expense of transferring them to other MNC units (Andersson et al., 2005; Andersson et al., 2007; Mudambi & Navarra, 2004). It is our contention that these arguments in fact neglect the multiple mediating effects of internal embeddedness. As such, this study represents an empirical attempt at directly extending and deploying the notion of internal embeddedness as the 'missing link' between the contradictory stances taken to date (in this regards see the second essay in chapter three).

4.7.2. Methodological implications

Analyses of the antecedents of embeddedness typically focus on environmental characteristics, albeit in a somewhat rudimentary, limited way (a notable exception is Nell & Andersson, 2012), and are often at odds with the network-based view (Nell & Andersson, 2012). This study, by specifying the environmental context through a formative construct of the main elements of Porter's (1990) diamond model, corrects for the network-based view and captures the diamond network model propounded by Rugman & Verbeke (1993). By so doing, this paper incorporates Asmussen et al.'s (2009) logic of unbalanced diamonds in its measurement of the environment. In other words, individual host-country environments may be strong in some dimensions and weak in others. We argue that the diversity of national diamonds confronted by multinational firms across countries is better represented by formative constructs for two reasons: (1) As posited by Venaik, Midgley, & Devinney (2004; 2005), country-level factors are too heterogeneous to believe that they might be highly correlated as is required from a reflective viewpoint. For example, an item designed to measure the importance of market customers will not necessarily correlate with one designed to measure the availability of supply industries. (2) Modelling country-level factors via reflective items reflects Porter's single diamond model characterized by a self-reinforcing system of diamond components at the domestic-national level. However, MNCs, by virtue of their network of specialized, interdependent subsidiaries (Bartlett & Ghoshal, 1989) can build overall competitiveness not only at the national level, but also at regional and even global levels, and as such reinforcing dynamics occur across borders (Asmussen et al., 2009; Rugman & Verbeke, 1993). Hence, using a reflective construct may overestimate the reinforcing nature of single diamond elements and neglect the nature of an MNC's network activities. This is a novel approach that should serve to guide researchers in the specification of environmental constructs.

4.7.3. Practical Implications

The empirical results of this paper have implications for practitioners. Our analysis alerts subsidiary managers to the fact that, although local embeddedness can be conceived as a facilitator of learning and competence development, and has been traditionally associated with competence-creating mandates, engagement in the internal MNC network is equally important in the development of subsidiary R&D roles. The reason for this is that internal network linkages are the channel via which such competences are made available to the rest of the MNC, which in turn influences the internal strategic context for making decisions, especially, headquarters decision regarding the assignment of subsidiary mandates. Likewise, with regard to the importance of foreign subsidiaries as sources of competence for the MNC as a whole, our results warn MNC headquarters about the contingent importance of the management of networks. Although the role of each subsidiary has traditionally been seen to be a function, in large part, of its local environment, the potential of environmental factors as a source of competitiveness lies in the subsidiaries engagement in the host country's system of innovation through a certain degree of embeddedness. Thus, from a managerial perspective, a high-priority activity at top management levels is not only identifying suitable competitive environments in which to locate, but also determining the real possibilities for establishing long-lasting and profitable technological relationships for developing competence in the host country. This knowledge of a subsidiary's local networks may also support MNC headquarters in their task of monitoring and controlling the subsidiary units.

8. LIMITATIONS AND FUTURE RESEARCH

The preceding analysis has limitations, which, however, could lead to further research. The first, and most immediately apparent, of these concerns is the specificity of the sample setting. The results reported are

derived from a sample of Spanish subsidiaries, which may have constraints regarding the generalizability of these findings to other foreign subsidiaries. Likewise, the country-level factors discussed here refer uniquely to the Spanish environment. Yet, this research is explorative in nature and future confirmatory research would need to analyse broader samples in a variety of settings.

Second, the study has been conducted using a cross-sectional method, so we are unable to demonstrate causality conclusively or to rule out reverse causality altogether. At this exploratory stage, a longitudinal analysis would have needlessly complicated the analysis; yet, clearly, in the future this would constitute an exciting avenue of research.

Third, the analysis considers the subsidiary's contributing role in sole relation to R&D and does not examine marketing, human resources or any other value chain activities that might contribute to firm-specific advantage. Investigating other functions would also mean that other aspects, most notably other types of linkage in the subsidiary network, would have to be taken into consideration (see e.g. Asmussen et al., 2009). Therefore, future research should include a subsidiary's other functional activities as well as its business relationships with its counterparts.

Finally, for reasons of conceptual and analytical stringency, we have limited our measurement of subsidiary embeddedness to a relatively small number of relationship types showing a high degree of commitment, trust and reciprocity (e.g. alliances, outsourcing, collaboration). Future research would need to widen its analysis of the type of linkages scrutinized. In this sense, extra care should be taken in defining the boundaries of the network under investigation, taking into account that defining such research boundaries is somewhat artificial but nevertheless necessary from an analytical point of view (Nell & Andersson, 2012).

However, despite the aforementioned limitations, this study provides some initial insights as to why the subsidiaries of different corporations located in the same environment, and subsidiaries from the same corporation located in different environments, display a diverse range of competencies and make different contributions to a firm's specific-advantage.

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APPENDIX 4.A. Constructs and measures

CONSTRUCT/INDICATOR	Respondents assessed the strength of the following aspects in the business environment in which their subsidiary competes
COUNTRY LEVEL FACTORS	
Level of competition	
• Domestic rivalry	• High intensity of domestic rivalry
• Firm strategy	• High intensity in differentiation competitive strategy
Demand market conditions	
• Key customers	• Sophisticated and demanding customers
• New market niches	• Potential new market niches for innovative products
Factor conditions	
• Raw material	• Availability of raw material
• Skilled/cheap labour	• Availability of skilled/cheap labour
Supplier and related industries	
• Supply industries	• Quality of supply industries
• Complementary & supporting industries	• Existence of complementary & supporting industries
CORPORATE LEVEL FACTORS	**Respondents indicated to what extent the following statements adjust to their subsidiary.**
Subsidiary entrepreneurship	
• Proactiveness	• Managers consistently engage in new ventures even if they are uncertain.
• HQs risk taking encouragement	• There is encouragement for calculated risk
Subsidiary initiative	
• Beyond mandate	• The subsidiary has developed competences beyond the mandate assigned by headquarters.
• Legitimacy	• Managerial initiatives and dissent are viewed as legitimate
• Enhancement	• Managers have initiative to enhance local value-added activities.
• Obeying orders (item dropped)	• The subsidiary only executes the decisions taken in other units of the group
Subsidiary leadership	
• Decision making participation	• Subsidiary managers actively participate in corporate decision making committees
• Good political relationships	• Subsidiary senior managers have fostered good political relations with their counterparts and bosses in head office and sister affiliates
• Managers' track record	• The subsidiary has a history of strong, internally respected leaders

EXTERNAL EMBEDDEDNESS	**Respondents indicated to what extent the following aspects have contributed to achieve the differential capabilities of their subsidiary in performing R&D activities.**
External breadth ties	
• Local individuals knowledge	• Technological inputs derived from the personnel's knowledge and know-how generated from their prior working experience.
• Local firms infrastructure	• Technological inputs derived from joint research activities with local firms.
• Academic community	• Technological inputs derived from joint projects with the local academic community (Universities, research centres, etc.)
External depth ties	
• External outsourcing	• Technology sources derived from an effective use of a strong Spanish technological capability (e.g., outsourcing, acquisition) in areas of science particularly relevant to our industry.
• Strategic alliances	• Technology sources derived from joint collaborative efforts with Spanish actors involving different types and degrees of research and development, and joint problem-solving with high degrees of trust and complexity

INTERNAL EMBEDDEDNESS	**Respondents indicated to what extent the following aspects have contributed to achieve the differential capabilities of their subsidiary in performing R&D activities.**
Internal breadth ties	
• Inflows from HQs	• Vertical knowledge inflows related to new products and new services from the HQs (top-down flows)
• Outflows to HQs	• Vertical knowledge outflows related to new products and new services to the HQs (bottom-up flows)
• Peer Subsidiaries Interflows	• Horizontal knowledge flows related to new products and new services among peer subsidiaries (peer flows)
Internal depth ties	
• MNC units experience	• Knowledge absorption from the experience of other MNC units to create new product models and new production systems
• MNC joint collaboration	• Knowledge sharing with other units based on collaborative research, development and design of new products, processes, components based on new technology

SUBSIDIARY CONTRIBUTORY R&D ROLE	**Vis-à-vis the same business unit in the parent's country of origin, respondents indicate the level of competences performed by the subsidiary that are recognized by the entire MNC.**
• Basic research	• Cutting-edge research (basic research)
• Applied research	• Applied research into new product generations
• Research into new materials/specifications	• Research into new materials and new specifications
• Development of new products/designs/prototypes	• Development of new products, designs and prototypes
• Own-design manufacturing	• Own-design manufacturing
• Major improvements to machinery/equipment/ processes	• Major improvements to machinery, equipment and processes

APPENDIX 4.B. ADDITIONAL ANALYSIS (Reverse causality between external embeddedness and internal embeddedness)

PATHS	MODEL 1				MODEL 2			
	Path coefficient	SIGNIFICANCE (bootstrapping)		R^2	Path coefficient	SIGNIFICANCE (bootstrapping)		R^2
		t-value	CI (95%)			t-value	CI (95%)	
Effects on external embeddedness				0.3581				0.3913
• Country level factors → External embeddedness	0.5836**	8.3394	[0.4445, 0.7160]		0.5339**	6.2037	[0.3553, 0.6914]	
Effects on internal embeddedness				0.2665				0.2339
• Corporate level factors → Internal embeddedness	0.3046**	3.7563	[0.1415, 0.4602]		0.3249**	4.2010	[0.1727, 0.4727]	
• **External embeddedness → Internal embeddedness**	**0.2258 ***	**2.0609**	**[0.0022, 0.4277]**		---	---	---	
• **Internal embeddedness → External embeddedness**	**---**	**---**	**---**		**0.1764**	**1.7901**	**[-0.0259, 0.3591]**	
Effects on subsidiary R&D contributory role				0.5826				0.5827
• Corporate level factors → Subsidiary R&D cont. role	0.1038	1.1935	[-0.0614, 0.2765]		0.1026	1.1806	[-0.0698, 0.2704]	
• Country level factors → Subsidiary R&D cont. role	0.2084 *	2.4845	[0.0510, 0.3805]		0.2050 *	2.4412	[0.0511, 0.3826]	
• External embeddedness → Subsidiary R&D cont. role	0.2340 *	2.5590	[0.0517, 0.4100]		0.2361 *	2.5697	[0.0528, 0.4119]	
• Internal embeddedness → Subsidiary R&D cont. role	0.4148**	5.4762	[0.2652, 0.5634]		0.4174**	5.6195	[0.2646, 0.5627]	
Control variables on subsidiary R&D contributory role								
• Subsidiary age → Subsidiary R&D cont. role	0.1410	1.8252	[-0.0128, 0.2878]		0.1398	1.7946	[-0.0157, 0.2901]	
• Subsidiary size → Subsidiary R&D cont. role	0.0362	0.6245	[-0.0858, 0.1489]		0.0369	0.6604	[-0.0740, 0.1443]	
• Home region → Subsidiary R&D cont. role	0.0361	0.5742	[-0.1568, 0.0885]		-0.0340	0.5351	[-0.1566, 0.0914]	
• Entry mode → Subsidiary R&D cont. role	0.0043	0.0637	[-0.1292, 0.1348]		0.0030	0.0448	[-0.1302, 0.1322]	
• Industry effects → Subsidiary R&D cont. role	0.1256	1.8830	[-0.0050, 0.2462]		0.1243	1.9217	[-0.0043, 0.2481]	
Control variables on embeddedness								
• Corporate level factors → External embeddedness	0.0891	1.2247	[-0.0581, 0.2273]		0.0298	0.3874	[-0.1224, 0.1807]	
• Country level factors → Internal embeddedness	0.1979	1.8908	[-0.0001, 0.4089]		0.3299**	4.2485	[0.1841, 0.4874]	

Note: CI=Confidence Interval; $^{**}p < 0.01$; $^{*}p < 0.05$ (based on a Student t(4999) distribution, two-tailed test).

CHAPTER 5. CONCLUSIONS

5.1. CONCLUDING REMARKS

This dissertation begins by echoing beliefs as to how the integration of subsidiaries into international networks is altering the scholarly conception of the MNC, forcing us to see subsidiaries as differentiated nodes embedded in a great variety of contexts (Bartlett & Ghoshal, 1990; Forsgren, Johanson, & Sharma, 2000; Nohria & Ghoshal, 1997). This paradigm shift in the international business field highlights the potential of the MNC to tap into diverse knowledge bases and to incorporate them so as to create new competences (Almeida & Phene, 2004; Meyer, Mudambi, & Narula, 2011). In completing this mission, some subsidiaries achieve competence-creating mandates whereby they become responsible for leveraging and integrating specific bodies of knowledge on a global basis (Cantwell & Mudambi, 2005; Mudambi & Swift, 2011), which becomes essential for securing the long-term success and the sustained competitive advantage of the whole MNC.

Accordingly, foreign-owned subsidiaries are increasingly being acknowledged as sources of knowledge and innovative capabilities for the entire MNC. This claim has been bolstered by the emergence of subsidiary R&D units with advanced capabilities in science and technology (Blomkvist, Kappen, & Zander, 2010), and by evidence that subsidiaries are also becoming more technologically specialized and differentiated from each other over time (Birkinshaw, Hood, & Jonsson, 1998; Frost, 2001; Nobel & Birkinshaw, 1998). Notwithstanding the intuitive appeal of this argument, there is no conclusive evidence as to the origin of this variation in subsidiary R&D roles and in the subsidiary-level contribution to MNC operations. In this respect, the academic debate has typically focused on local environment features as a source of differentiation, that is, on the location advantages for innovation, as well as, on the influence of knowledge-seeking, as opposed to market-seeking, motives at the corporate group level (for a discussion see Cantwell & Mudambi, 2005).

However, these factors do not clearly reflect the reality of the present-day networked MNC.

Therefore, with the overall aim of adding to the extant literature on subsidiaries' R&D roles, and of furthering our understanding of the proactive use of dual-embeddedness in the location in which subsidiaries operate, this dissertation takes the form of three essays that can be integrated to form a unique line of argument, where the first provides an update of the traditional location advantages for FDI in R&D, the second explores the effects of a subsidiary's dual network embeddedness on the evolution of its R&D role, and the third takes the results obtained in the first two essays and analyses their joint effect on the R&D-contributing role of subsidiaries.

Thus, the three essays that make up this dissertation are sequenced in such a way that they cover the entire phenomenon, with each new essay taking the findings of the previous study as its starting point. Thus, gradually, the essays are able to piece together the full picture.

The first essay addresses the general question: 'How important are the different location advantages for a subsidiary's R&D-contributing role?'. The second essay examines the question: 'How do internal and external knowledge embeddedness act together in determining subsidiary R&D roles over time?'. And the third essay asks: 'Does the R&D-contributing role of subsidiaries stem from munificent internal and external environments or from the interaction with agents in these contexts?' Specific answers to these questions, accompanied by detailed findings, implications, limitations and future research lines, are provided in their respective chapters (an overview is also provided here in Table 5.1). Therefore, here we seek to give some thought to the general contributions made by this thesis by addressing the sensitive question: "Has this dissertation really made a valuable contribution?". In this regard, Shaver (2013) outlines a series of concerns related to the typical pitfalls in

advancing in the analysis of a particular area of research[20]. Thus in attempting to respond to this question, we take his four reflections as our starting point for assessing the findings of this dissertation: (1) an excessive concern for maximizing explanatory power; (2) an excessive concern for methodology; (3) an excessive concern for measurement; (4) and an excessive concern for the sample setting.

5.2. AN EXCESSIVE CONCERN FOR MAXIMIZING EXPLANATORY POWER

The excessive concern for maximizing explanatory power – what Shaver (2013) calls the 'R^2 game' – refers to the disproportionate focus on completing current explanations, at the expense of not questioning what is already known and failing to refine extant relationships. This R^2 game usually leads to small incremental steps being taken rather than the making of any substantive contributions. According to Shaver, chasing R^2 by the constant addition of explanations is a never-ending task, with returns that are continuously diminishing. Here, by contrast, this dissertation has sought to challenge received wisdom regarding the factors involved in the configuration of strategic R&D roles (which have traditionally been analysed in isolation) and to redirect the focus of research to underlying network effects, particularly those arising as a consequence of simultaneous engagement in internal and external networks. We show that conventional country-level factors and corporate-level factors on their own are unable to account for the heterogeneity in foreign-owned R&D units, both statically and over time. Our findings suggest that the concept of dual network embeddedness is the third explanatory factor, related in turn to the unequal access to knowledge resources in both internal and external contexts. This analysis is, we believe, the first to present a detailed picture of dual embeddedness in

[20] Although the critique is conducted in relation to entry modes, Shaver's (2013) commentary analysis is applicable to any field of international business research.

relation to subsidiary R&D roles. As such, our findings fulfil the requirements outlined for avoiding the R^2 game: thus, instead of increasing the explanatory power by adding unnecessary artefacts, this dissertation has been more interested in detecting what leads to the specific explanatory power, since abstraction and simplifications can be considered merits as opposed to defects, as long as the model serves its descriptive or predictive purposes. To this end, we first develop a general model using an inductive approach to theory building, which is subsequently used in conducting the follow-up predictive analysis. It should be acknowledged that avoiding the R^2 game is easier when a research field is beginning to grow and has not yet reached maturity such as the one described in this study.

5.3. AN EXCESSIVE CONCERN FOR METHODOLOGY

Given that every qualitative or quantitative method is built on a set of assumptions, Shaver (2013) warns that an excessive concern for proposing a new method (that is, trading one set of assumptions for another set of equivalent assumptions) is clearly not taking the field any further forward. In the context of the present dissertation, the empirical embeddedness literature shows a marked bias in favour of quantitative studies to the detriment of in-depth attempts at understanding the phenomena under study (Michailova & Mustaffa, 2012), while most of the findings regarding subsidiaries' R&D roles are based upon case studies of specific R&D units, with the attendant problems of generalizability and sample selection (Frost, 2001). Therefore, in both research streams mixed method studies, that is, those combining quantitative and qualitative methods, are under-represented (Creswell & Plano Clark, 2007; Johnson, Onwuegbuzie, & Turner, 2007; Tashakkori & Creswell, 2007). Yet, the use of qualitative and quantitative methods should not be exclusive; rather they should be allowed to overlap and complement each other. Mixed methods allow researchers to leverage the best of each approach, while overcoming the

drawbacks of the other; indeed, the weaknesses of one method are often the strengths of the other (Molina-Azorin, 2012). Here, for example, drawing on methods from both research paradigms has provided a greater understanding of the location and development of subsidiary R&D roles from the double network approach. Indeed, Boyd, Gove, & Hitt (2005) advocate that qualitative and quantitative research complement each other and, in tandem, quality research of both types can move the field forward more rapidly.

Specifically, we have used an exploratory mixed method design (Creswell & Plano Clark, 2007), which seeks first to explore a phenomenon or research question through qualitative techniques, and then to use this exploratory analysis to conduct a quantitative analysis. The qualitative stage corresponds to the first and the second essays, which were conducted via the case-study approach. Here the purpose was to further understanding of the country context and of the dual embeddedness phenomenon by adopting an inductive approach, since this allows us to address more fully the complexity of the problem, the nature of the context and the behaviour of the agents involved and the relations between them (Gummesson, 2006). The results of this preliminary qualitative research could then be drawn upon to conduct the following subsequent quantitative stage, either by helping to clarify the research context or by identifying the most appropriate measures for use in the quantitative study. This second stage corresponds to the third essay which employed the partial least square (PLS) approach to structural equation modelling. Because dual embeddedness is still at an early stage of development, this quantitative method is well suited to predictive research models and theory development, that is, exploratory studies (Chin, 2010)

Table 5.1. Overview of the conclusions presented in the dissertation

Title of the essay	Main finding	Main implications for practice	Limitations	Future research lines
First essay: The role of the environment in the location of R&D activities in the subsidiaries of foreign multinationals.	Spanish environment does not appear to be exceptional in terms of either its demand-side or supply-side factors, when it comes to attracting foreign direct investment in R&D and innovation, and it runs the risk of becoming 'stuck in the middle'	Policies should focus on embedding and engaging the subsidiaries already present in the country in the local innovation system, with the aim of facilitating their evolution towards competence-creating mandates.	The focus on competence-creating subsidiaries may limit the application of the results and recommendations to units with less active roles in R&D. The focus on the traditional determinants of the location of foreign direct investment in innovation neglect to some extent the underlying network effects, which emerge as catalysts for FDI in R&D.	Analysing the effect of local network embeddedness, in conjunction with the other locations factors, on subsidiary R&D activities.
Second essay: Knowledge sharing and subsidiary R&D mandate development: A matter of dual embeddedness.	Evolving towards a competence-creating mandate is characterised by the simultaneous growth of embeddedness in both internal and external networks; otherwise, a subsidiary may gravitate away from upgrading its R&D role.	For subsidiary managers, the model highlights an important strategy by which they can purposely set about upgrading their R&D role within the MNC. For MNC headquarters, if internal and external embeddedness are properly managed, these network linkages facilitate their task of seeking advantages originating in the global spread of the firm.	Neither the optimal balance between external and internal embeddedness, over-embeddedness or network redundancy are explored. The sample setting is quite specific. Limited attention is paid to the impact of top management teams on shaping embeddedness. The potential of headquarters to maintain their own network linkages with the subsidiary's local environment are not reflected.	Analysing in greater depth the specific nuances of dual embeddedness. Undertaking quantitative studies with a broader sample and technological settings. Examining dual embeddedness from the perspective of the upper-echelons of management. Incorporating headquarters embeddedness in the subsidiaries' local networks.
Third essay: Disentangling the mediating effect of dual embeddedness on the subsidiary's R&D-contributing role.	The model brings to the fore internal and external embeddedness as mediators in the relationship between corporate- and country-level factors with the R&D-contributing role of subsidiaries.	For subsidiary managers, the results draw attention to the importance of internal embeddedness as a channel via which they can manipulate dependencies and influence headquarters' mandate assignments. For MNC headquarters, a high-priority should be not only identifying suitable environments for location, but also the real potential for establishing long-lasting and profitable relationships.	The specificity of the sample setting may limit generalizability. The cross-sectional data cannot conclusively demonstrate causality. The analysis considers subsidiary R&D, leaving unexplored marketing, human resources and any other value chain activities that might contribute to firm-specific advantages. The measurement of embeddedness examines a limited set of representative network relationships (e.g. alliances, outsourcing, and collaboration).	Analysing broader samples in a variety of settings. Undertaking longitudinal studies. Investigating other functional areas such as marketing, human resources and other value chain activities beyond R&D. Enlarging and widening the type of linkages scrutinized.

The main reason underpinning the selection of this mixed methodological design was that of complementarity, that is, clarifying, enhancing, or illustrating the results obtained with one method with the results obtained from another (for a review see Molina-Azorin, 2012; Molina-Azorin, Lopez-Gamero, Pereira-Moliner, Pertusa-Ortega, & Tari-Guillo, 2012). In this way we have sought to fill the methodological voids at the centre of the research streams underpinning this dissertation, i.e. an in-depth understanding of dual embeddedness and the verification of subsidiary R&D roles. In this regard, it might be argued that each essay only adopts a single methodological approach. Yet, it should not be forgotten that the three essays reported in this dissertation are sequenced and designed to cover the entire phenomenon and, as such, they can be integrated to form a unique line of argument, which combines qualitative and quantitative methods. The study also responds to recent calls for the use of mixed methods in management and organizational studies (Aguinis et al., 2010; Currall & Towler, 2003; Edmondson & Mcmanus, 2007). In this field, a mixed methods study that develops theory and/or a reliable measurement instrument may be considered a pioneering work and also contribute to the advancement of strategy research (Molina-Azorin, 2012).

5.4. AN EXCESSIVE CONCERN FOR MEASUREMENT

As regards the excessive concern for measurement, Shaver (2012) warns that constant improvements in measurement yield decreasing marginal returns. This is particularly true of the double-network perspective adopted here, since many if not most of the key concepts are not directly observable. In addition, research on dual-network embeddedness is an emerging field of research, which leaves plenty of scope for multiple definitions and measures of the same construct that can result in different and often contrary findings. In this sense, there is a real danger of diversity, variation and pluralistic tendencies developing and increasing at the expense of precision and of further knowledge (Michailova & Mustaffa, 2012). State-of-the-art studies of dual

embeddedness call for more work that attempts to draw together the current measures scattered about the literature rather than creating new measures. For example, the first and third essays herein raise concerns about the way in which investigators have operationalized the host-country environment. Despite the fact that the subsidiary's host country provides the background in which embeddedness can thrive, environmental factors are usually presented from an atomistic view, which ignores the MNC's privileged position for tapping into resources and capabilities from multiple local contexts and for integrating them to create competitive advantages. Echoing Nell & Andersson (2012), this is not only conceptually inconsistent but also critical for understanding the variation in subsidiary relational embeddedness. We advocate modelling the environmental context through a formative construct to reflect the diamond network model proposed by Rugman & Verbeke (1993). This is not a measure purposely tailored for the essay, rather it is a response to the concerns of several authors regarding the need to put the measurement of environmental factors on a more coherent and conceptual footing (Asmussen, Pedersen, & Dhanaraj, 2009; Nell & Andersson, 2012; Venaik, Midgley, & Devinney, 2005). Therefore, in terms of Shaver's (2013) criterion, here measurement refines understanding rather than specifically leading to an incremental advance in the literature.

5.5. AN EXCESSIVE CONCERN FOR THE SAMPLE SETTING

Although there is much to be said for testing well-known theories in different countries, this approach does not often advance our understanding of those theories (Shaver, 2013). However, in the particular case of a growing research field, such as dual embeddedness, extending current theories to examine network linkages in locations and industries that have not hitherto been analysed offers certain opportunities for research. To date, subsidiary network embeddedness has been examined in a rather limited number of geographical contexts:

restricted to North-west Europe and North America, which tend to dominate the leadership of innovation. Recent research on non-traditional locations has mainly flourished in emerging economies (Santangelo, 2012), leaving intermediate or moderate innovating countries largely unexplored (some exceptions are Manolopoulos, 2010; Santangelo, 2009; 2012). Therefore, our analysis, conducted in the Spanish context, examines various characteristics that to date have received little attention.

Moreover, the relocation of labour-intensive activities from countries of this type to the newly emerging economies, as well as the agglomeration of technology intensive sectors in leading-edge countries, is serving to increase international competition for FDI in R&D (Santangelo, 2009) and, more importantly, is threatening the growth of intermediate countries. In such a context, a clear understanding of the factors affecting the R&D roles of subsidiaries is especially relevant in order to improve Spain's competitiveness and for helping subsidiaries to resist relocation. Our results suggest that policies need to focus on embedding and engaging the subsidiaries already present in the country in the local innovation system, with the aim of facilitating their evolution towards higher value-adding activities and competence-creating mandates. However, this is not the sole contribution of this dissertation, since we do not simply apply an existing model developed in other locations to the Spanish context. Rather we go further and elaborate a new model, derived inductively, to analyse the network factors related to differences in the R&D roles of subsidiaries. Consequently, the insights offered by this dissertation need to be assessed in terms of their potential to advance our overall understanding, and not simply as regards what they tell us about the specific geographical context in which they were obtained. This study is one of the first to place dual network relationships and the contexts in which they occur at the centre of the examination of subsidiary R&D roles, not only in the Spanish economy but also in leading-edge and emerging countries. Obviously, future research needs to be undertaken

with a broader sample and a more heterogeneous technological setting so as to be able to correct and generalise the insights described here.

Ultimately, the objective of this final concluding section has been to restate and defend the contributions of this dissertation. Without neglecting the various problems and weaknesses reported in the respective essays, this final critical review has enabled us to identify many of the distinctive features that provide evidence of progress having been made in the field of inquiry. If this self-critical thinking has contributed to the discussion of the findings obtained and encourages further research in the future, then the goal of this dissertation has been fulfilled.

5.6. REFERENCES

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ANNEX | PEER-REVIEWED OUTCOMES OF THE Ph.D. DISSERTATION

PEER-REVIEWED OUTCOMES OF THE Ph.D. DISSERTATION

Following the requirements of the Section 3, Article 36 of the regulation governing the Ph.D. programs under the RD 99/2011 (approved by the Governing Board of the University of Barcelona on 16th of March, 2012 and amended on 9th of May, 2012), below are summarized the peer-reviewed outcomes of this Ph.D. dissertation.

THESIS PROPOSAL

Awards

Title of the award: Best PhD research proposal award 2012
Title of the proposal: A double-network perspective on the evolution in subsidiary R&D role: A matter of dual embeddedness
Seminar: III Taller doctoral sobre estrategia de empresa de ACEDE
Venue: Valencia **Year:** 2012

FIRST ESSAY: The role of the environment in the location of R&D activities in the subsidiaries of foreign multinationals

Journal papers

Title: El papel del entorno en la localización de actividades de I+D en las filiales de las multinacionales extranjeras
Authors: Miravitlles-Matamoros, P.; Guitart-Tarrés, L.; Achcaoucaou, F.; Núñez-Carballosa, A.
Source: Revista Europea de Dirección y Economía de la Empresa
Volume: 21 **Issue:** 3 **Pages:** 169-181 **Published:** 2012
Indexed in: CIRC, Latindex

Title: The role of the environment in the location of R&D and innovation activities in subsidiaries of foreign multinationals
Authors: Miravitlles, P.; Guitart-Tarrés, L.; Achcaoucaou, F.; Núñez-Carballosa, A.
Source: Innovation-Management Policy & Practice
Volume: 15 **Issue:** 2 **Pages:** 174-187 **Published:** 2013
Indexed in: Journal Citation Reports/Social Sciences Edition

Title: Localización de la inversión extranjera en innovación: España frente a las economías emergentes
Authors: Miravitlles-Matamoros, P.; Núñez-Carballosa, A.; Achcaoucaou, F; Guitart-Tarrés, L; Cruz-Cazares, C.
Source: Economía Industrial
Volume: 387 **Issue:** 1 **Pages:** 135-145 **Published:** 2013
Indexed in: CarhusPlus, CIRC

Books

Title: Factores de atracción y retención de los centros de I+D e innovación de las multinacionales extranjeras en España
Authors: Miravitlles, P.; Guitart Tarrés, L.; Achaoucaou, F.; Núñez, A.
Editorial: Fundación Española para la Ciencia y la Tecnología (FECYT).
Country: Spain **Published:** 2010
ISBN: 978-84-693-7935-6

Title: Factores de localización de Centros de I+D en los países emergentes y análisis de las ventajas competitivas de España
Authors: Miravitlles, P.; Guitart, L.; Núñez, A.; Achcaoucaou, F.; Cruz, C.
Editorial: Fundación Española para la Ciencia y la Tecnología (FECYT).
Country: Spain **Published:** 2012
ISBN: 720-12-049-4.

International conferences

Title: Attraction factors for the R&D and innovations by foreign multinationals in Spain
Authors: Miravitlles Matamoros, P.; Guitart Tarrés, L; Achcaoucaou; Núñez Carballosa, A.
Conference: 6th Iberian International Business Conference
Venue: Barcelona **Year:** 2010

SECOND ESSAY: Knowledge sharing and subsidiary R&D mandate development: A mater of dual embeddedness

Journal papers in second round revision

Title: Knowledge sharing and subsidiary R&D mandate development: A matter of dual embeddedness
Authors: Achcaoucaou, F.; Miravitlles, P.; León-Darder, F.
Source: International Business Review
Indexed in: Journal Citation Reports/Social Sciences Edition

Books chapters

Title: A double-network perspective on the evolution in subsidiary R&D role: A matter of dual embeddedness
Authors: Achcaoucaou, F.; Miravitlles, P.
Book title: Soft Computing in Management and Business Economics
Editors: A.M. Gil-Lafuente, J. Gil-Lafuente, J.M. Merigó-Lindahl
Pages: 97-108
Editorial: Springer Heidelberg **Country:** New York **Published:** **2012**
ISBN: 978-3-642-30450-7

National conferences

Title: Evolución de la I+D de las filiales de multinacionales extranjeras: un estudio cualitativo y exploratorio
Authors: Achcaoucaou, F.; Miravitlles, P.
Conference: XX Congreso Nacional de ACEDE.
Venue: Granada **Year:** 2010

Title: Evolution of subsidiary R&D role from the double-network view. A theoretical approach of dual embeddedness.
Authors: Achcaoucaou, F.; Miravitlles, P.
Conference: XXII Congreso Nacional de ACEDE.
Venue: Cádiz **Year:** 2012

International conferences

Title: Dinámica y evolución de los roles de I+D de las filiales de MNCs Extranjeras: Un estudio de casos
Authors: Achcaoucaou, F.; Miravitlles, P.
Conference: XXV Annual conference of the European Academy of Management and Business Economies
Venue: València **Year:** 2011

Title: A double-network perspective on the evolution in subsidiary R&D role: A matter of dual embeddedness
Authors: Achcaoucaou, F.; Miravitlles, P.
Conference: XXVI Annual conference of the European Academy of Management and Business Economies
Venue: Barcelona **Year:** 2012

Title: Knowledge sharing and subsidiary R&D mandate development: A matter of dual embeddedness
Authors: Achcaoucaou, F.; Miravitlles, P.; León-Darder, F.
Conference: 2013 Academy of International Business Conference
Venue: Turkey **Year:** 2013 (Accepted as competitive paper)

THIRD ESSAY: Disentangling the mediating effect of dual embeddedness on subsidiary R&D-contributing role

National conferences

Title: Disentangling the mediating effect of dual embeddedness on subsidiary R&D-contributing role
Authors: Achcaoucaou, F.; Miravitlles, P.; León-Darder, F.
Conference: XXIII Congreso Nacional de ACEDE
Venue: Malaga **Year:** 2013 (accepted as competitive paper)