Paper to be presented at the

DRUID Society Conference 2014, CBS, Copenhagen, June 16-18

MNC SUBUNITS? ALLIANCE PORTFOLIO AND INNOVATION: DISENTANGLING THE MULTIPLE EFFECT OF CULTURAL DISTANCE

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Abstract

The present study investigates how the composition of a MNC subunit?s portfolio of strategic alliances impacts on its innovative performance, in terms of both scale and quality. Specifically, we claim that, the more the portfolio is composed by exploratory/upstream (rather than exploitative/downstream) alliances, and the more the partners are culturally distant from the MNC subunit, the higher the impact upon the innovative performance. Furthermore, we distinguish the multiple role of cultural distance, by considering differences not only between partners and the focal MNC subunit, but also between partners and the focal MNC subunit?s parent company, and discuss their benefits. However, we state that when the alliance portfolio partners become too distant from both the host and the home country, excessive coordination and integration costs emerge, which may in turn overcome the benefits of diversity and hamper the subunit?s innovative performance. Our empirical analysis relies on 233 alliance portfolios established by 53 MNC biotech subunits from 1981 to 2011. Preliminary econometric estimates confirm our hypotheses, and reveal that MNC subunits? innovativeness benefits from portfolios of strategic alliances that are composed mainly by upstream agreements, and entail partners that are culturally distant from its parent.

Jelcodes:F23,M

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ABSTRACT

The present study investigates how the composition of a MNC subunit's portfolio of strategic alliances impacts on its innovative performance, in terms of both scale and quality. Specifically, we claim that, the more the portfolio is composed by exploratory/upstream (rather than exploitative/downstream) alliances, and the more the partners are culturally distant from the MNC subunit, the higher the impact upon the innovative performance. Furthermore, we distinguish the multiple role of cultural distance, by considering differences not only between partners and the focal MNC subunit, but also between partners and the focal MNC subunit's parent company, and discuss their benefits. However, we state that when the alliance portfolio partners become too distant from both the host and the home country, excessive coordination and integration costs emerge, which may in turn overcome the benefits of diversity and hamper the subunit's innovative performance. Our empirical analysis relies on 233 alliance portfolios established by 53 MNC biotech subunits from 1981 to 2011. Preliminary econometric estimates confirm our hypotheses, and reveal that MNC subunits' innovativeness benefits from portfolios of strategic alliances that are composed mainly by upstream agreements, and entail partners that are culturally distant from its parent.

Keywords: alliance, cultural distance, innovation, subunits, biotech

INTRODUCTION

Since the mid-1980s, attention has increasingly focused on the emergence of internal and external networks for innovation in MNCs. There has been a growing awareness among scholars that MNCs use their multinational networks to augment their competitive advantages and/or create new advantages (Berry, 2014; Cantwell, 1989; Cantwell, Dunning & Lundan, 2010). From this standpoint, MNC subunits interact with external local networks, and at the same time draw upon cross-border knowledge exchange in international internal and external networks (Cantwell & Piscitello, 2013; Nohria & Ghoshal, 1994; Piscitello, 2011). Increasingly, MNC subunits have been mandated by their parent company to conduct locally distinctive competence-creating efforts in addition to the more traditional competence-exploiting activities (Cantwell & Mudambi, 2005). These processes are likely to benefit from a higher variety of knowledge sources, as MNC subunits develop combinative capabilities (Kogut & Zander, 1992) that allow them to discover new connections or applications which suggest some potential new directions for the firm.

We focus here on strategic alliances that MNC subunits often undertake, both upstream and downstream, as exploration and exploitation collaborations have been shown to enable them to reach beyond their boundaries for access to knowledge and other resources (Zaheer & Hernandez, 2011). In particular, we are interested in the characteristics of the MNC subunit’s partner portfolio that may influence the former’s innovativeness. We claim that, the more the portfolio is composed by exploratory (rather than exploitative) alliances, as the case of upstream agreements, and the more the partners are culturally distant from the MNC subunit, the higher the impact upon the subunit’s innovative performance. In fact, the degree of differentiation of the knowledge bases of the MNC subunit and the alliance partners (that is likely to lead to new lines of development) is also likely to be inversely related to the cultural proximity between the alliance partners and the subunit. When the distance between countries increases, their knowledge bases are more likely to differ and to provide greater opportunities for the new technological creation in MNC subunits. Indeed, new knowledge is generally created through the discovery and implementation of new combinations of prior knowledge, i.e. firms relate local departures into new fields of specialization to their established competence base, both to enhance local competence-creating development through relevant new parent company knowledge inputs as the subunit's agenda adapts, and to provide value to the MNC group by selectively feeding back at least some of the new knowledge combinations or novel applications that have the potential for further uses in other parts of the MNC[i]. In addition, we disentangle the multiple effect of cultural distance, by assessing the impact exerted also by differences between the alliance partners and the MNC parent company. In fact, the latter tends to represent the "original knowledge base or 'technological core' of the MNC" (Zaheer & Hernandez, 2011: 110), being thus a fundamental benchmark when considering how allying with partners culturally distant from its parent company may allow the subunit to source novel and non-redundant knowledge. Hence, we state that subunits benefit, in terms of innovative performance, also when create mainly upstream alliances and collaborate with firms located in countries culturally distant from their parent. However, we claim that this holds only until a certain threshold; in fact, when the alliance portfolio partners become too distant both from the host and the home country, knowledge bases become too different and they cannot cross fertilize each other, and coordination costs become too high, thus overcoming the benefits of diversity and hampering the subunit's innovative performance.

Our empirical analysis rely upon a sample of 233 portfolios of strategic alliances established by 53 foreign MNC subunits operating in the biotechnology industry from 1981 to 2011. Results show that the innovative performance of the subunit increase (both in terms of scale and quality) when the portfolio of strategic alliances is composed by upstream alliances and collaborate with partners that are culturally distant from the subunit's parent company. Conversely, no effect arises when the upstream alliances are matched with a high cultural distance between the partner and the host country of the subunit. Finally, the joint effect of a portfolio composed by upstream alliances and by partners that are culturally distant from both the home and the host country of the subunit is negative in terms of both innovation scale and quality.

The remainder of the paper is organized as follows. In Section 2, we present the conceptual framework and develop the hypotheses. Then, in Sections 3 and 4, we describe the research methodology and the results, respectively. Finally, in Section 5, we conclude by discussing the main implications of the study, its limitations, and the venues for future research.

2. CONCEPTUAL FRAMEWORK AND HYPOTHESES

Strategic Alliances as a Source of Innovative Activity of MNC Subunits

In the actual scenario, highly characterized by knowledge specialization and dispersion, organizations tend to be more and more focalized on specific capabilities (Stuart & Podolny, 1996). Making strategic alliances is conceived as an important mean to access to heterogeneous knowledge (e.g., Mowery, Oxley & Silverman, 1996; Larsson, Bengtsson, Henriksson & Sparks, 1998; Owen-Smith & Powell, 2004). This strategy is strictly in line with the tendency of firms to open their organizational boundaries in the attempt to find those competencies needed to innovate and sustain their competitive advantage (Chesbrough, 2003). Indeed, innovation is only partially dependent on firms' internal resources, thus leading them to establish global and local networks of collaborations to acquire knowledge, technologies, and assets from third parties (Rothaermel & Boeker, 2008). Hence, firms ally to jointly produce value that could not otherwise be produced by either partner independently (Zajac & Olsen, 1993). Strategic alliances have recently assumed a prominent role also as regards to MNCs subunits, whose increasing autonomy and more proactive function within the MNCs' strategies (Cantwell & Piscitello, 2013) have lead scholars to deepen our understanding of how their capabilities may evolve by acquiring and integrating external resources (e.g., Collison & Wang, 2012). Namely, alliances allow MNCs to reach beyond their boundaries for access to knowledge and other resources (Zaheer & Hernandez, 2011). Such attention has been especially devoted to the innovative capabilities of subunits (e.g., Almeida, 1996; Almeida & Phene, 2004; Phene & Almeida, 2008), which are fundamental to generate novel technologies and solutions, thus enhancing the innovativeness and competitiveness of the whole MNC (e.g., Rugman & Verbeke, 2001; Kotabe, Dunlap-Hinkler, Parente & Mishra, 2007). External sources may be related to local knowledge and capabilities as well as to the openness of the local context where the subunit is located and to the access to potential wider reservoirs of knowledge (Cantwell & Piscitello, 2013; Kafouros, Buckley & Clegg, 2012). Within this context, we rely on the literature on alliance and innovation that has generally stressed the importance of upstream collaborations, as R&D agreements, which are seen as opportunities to quickly access complementary capabilities, generate R&D scale economies, and reduce costs and development time (e.g., Mowery et al., 1996; Hoang & Rothaermel, 2005; Cassiman

& Veugelers, 2006; Sampson, 2007; Diestre & Rajagopalan, 2012). In turn, these types of collaborations are more explorative in nature, being aimed at generating novel technological solutions by integrating firm's internal knowledge with the novel external knowledge of partners, as opposed to downstream relationships, which are instead more focused on exploiting firm's existing technologies (Rothaermel & Deeds, 2004; Lavie & Rosenkopf, 2006).

The Paradox of Cultural Distance

Extant work presents mixed evidence on the role of national cultural differences between the focal firm and its partners, as that creates opportunities for accessing unique networks of resources and capabilities, but at the same time also impose barriers and costs to efficient resource exchange (Lavie & Miller, 2008). Thus, the literature presents a paradox by suggesting that distance exerts both positive and negative effects on performance. On the one hand, distance is valuable because it allows firms to reach out to sources of unique, diverse, and non-redundant knowledge (Kogut, 1983; Rosenkopf & Almeida, 2003). On the other hand, distance imposes well-known costs of control, coordination, and travel, as well as being associated with the difficulties of adapting to different cultural and institutional environments (Zaheer, 1995). More recently, scholars have shown how distance increases the difficulty of transferring tacit knowledge (Bell & Zaheer, 2007; Jensen & Szulanski, 2004)—which is especially important to MNCs engaged in technology-related activities. Given this paradox of distance, it becomes important to explain the conditions under which distance within the technologically oriented firm's geographic scope exerts positive or negative effects on firm performance. Accordingly, here we discuss the effect of collaborating with culturally distant partners by jointly considering the content of the alliances, distinguishing between upstream and downstream agreements. In addition, we consider the multiple role of cultural distance, by considering the differences between partners and the subunit, and also between partners and the subunit's parent company.

Cultural Distance Between the Subunit and Partners

The role of cultural distance is likely to be particularly relevant when MNC subunits do perform exploratory activity, i.e. when they build up new competencies that they did not inherit or receive from their parent company. In fact, the capacity of MNC subunits to undertake competence-creating activities depends on the breadth of relevant knowledge that is accessible to an MNC subunit in its knowledge search efforts (Cantwell & Mudambi, 2005). Thus, the subunit learn more from partners with dissimilar cultural backgrounds, as that increase the potential access to wider, sometimes even unexpected and unforeseeable opportunities, resources, competencies and knowledge (Kogut, 1983; Rosenkopf & Almeida, 2003). Accordingly, our first hypothesis is as follows:

Hypotheses 1. A subunit's portfolio of strategic alliances impacts positively upon the subsidiary's innovative performance, in terms of both scale and quality, the more it is constituted by upstream alliances, and the more culturally distant from the MNC subunit are strategic partners.

Cultural Distance Between the Parent and Partners

Moreover, even when partners are proximate to the MNC subunit, they may be distant from the MNC parent company. As the latter represents the original knowledge base or "technological core" of the MNC (Bianchi & Di Minin, 2011; Zaheer & Hernandez, 2011), the more distant the partners from that, the more diverse is the knowledge bases, and the more likely it is that new domains of applications or new combinations will be found by the subunit (Christensen, 1997; Cyert & March, 1963). Hence, our second hypothesis is as follows:

Hypotheses 2. A subunit's portfolio of strategic alliances affects positively the subsidiary's innovative performance, in terms of both scale and quality, the more it is constituted by upstream alliances, and the more culturally distant from the MNC parent company are strategic partners.

The Multiple Role of Cultural Distance

When considering partners that are distant from both the host and the home country, cultural distance may lead to a trade-off (see also Zaheer & Hernandez, 2011, for the paradox of geographical distance in alliance portfolio). In fact, while allying with culturally distant partners may allow MNC subunits to enrich their resource pools and recognize novel value creation and development opportunities (e.g., Kale, Singh & Perlmutter, 2000; Nielsen, 2007), especially useful when mainly engaged in upstream relationships (e.g., Lavie & Rosenkopf, 2006; Sampson, 2007; Capaldo & Messeni Petruzzelli, 2014), when partners are culturally distant from both the host country (where the subunit is located) and the parent's home country, excessive coordination and integration costs may emerge. Namely, the high complexity in managing these relationships may in turn overcome the benefits of diversity.

The rationale underlying this reasoning is that differences in language, communication patterns, opinions, attitudes, beliefs, and geographic distance are exacerbated, thus enhancing the difficulties of transferring knowledge across organizational boundaries (e.g., Phene, Fladmoe-Lindquist & Marsh, 2006; Thuc Anh, Baughn, Minh Hang & Neupert, 2006; Jiang, Tao & Santoro, 2010; Zaheer & Hernandez, 2011). This poses for the subunits the challenges to adapt and interact with different approaches and routines originated within international contexts with whom they have no relationships, being these distant from both the host and home countries. Hence, subunits are exposed to the risk of incorporating too much diversity, as reflected by specific national innovation systems, industrial patterns, and regulatory frameworks (Cantwell, 1989; Bartholomew, 1997), which may hamper partners' mutual understanding (Lavie & Miller, 2008). Furthermore, this difficulties tend to be enhanced by the fact that subunits ally mainly to collaborate in R&D activities, which involve complex and tacit knowledge (Coff, 2003; Hagedoorn, 2003), thus making a certain degree of common norms and routines as fundamental to "interpret and give meaning to actions without making all these difficult interpretations explicit" (Knoben & Oerlemans, 2006: 76). In addition, R&D activities are uncertain and subject to appropriability hazards (e.g., Dasgupta & Stiglitz, 1980; Pisano, 1990), and hence influenced by risk taking approaches, which significantly differ across culturally distant organizations (Hofstede, 1980, 2001). In turn, this affects organizations' innovative behaviors and orientations (Frost, Birkinshaw & Ensign, 2002), thus making collaborations between subunits and partners distant from both the host and home country as extremely difficult, since involving organizations expected to differently perceive opportunities and threats (Barkema & Vermeulen, 1997). Accordingly, our third hypothesis is the following:

Hypotheses 3. A subunit's portfolio of strategic alliances affects less positively the subsidiary's innovative performance, in terms of both scale and quality, when it is constituted by upstream alliances, and partners are culturally distant both from the host and the home country.

METHODS

Research Setting and Data

The research setting is represented by the biotechnology industry, whose inception may be traced back to 1953, when Watson and Crick discovered the double helix model of DNA, and to 1976, when the US company Genentech commercialized the first biotechnology product (Rothaermel, 2000). The choice of this specific industry for testing our hypotheses is justified by a number of reasons. First, the development and commercialization of biotechnology solutions are largely characterized by interfirm collaborations (e.g., Hagedoorn, 1993; Stuart, Ozdemir & Ding, 2007; Rothaermel & Boeker, 2008; Diestre & Rajagopalan, 2012; Zidorn & Wagner, 2012), due to the necessity to integrate multiple and heterogeneous competencies (Sorensen & Stuart, 2000). Second, these collaborations often involve actors located in distant and different geographical areas (e.g., Bartholomew, 1997; Phene et al., 2006), hence making cultural distance between partners an important issue. Finally, patents represent an effective mechanism to protect novel technological products (e.g., Albert, Avery, Narin & McAllister, 1991; Shan & Song, 1997; Hoang & Rothaermel, 2010; Messeni Petruzzelli, Rotolo & Albino, 2012), thus making our proxies of innovation scale and quality as suitable.

The sample is represented by 53 biotech worldwide foreign subunits, both public and private, included in the BioScan database, which have established at least one strategic agreement from their foundation to 2011. For each firm, we considered all the collaborations they have been involved in, and then grouped firm's collaborations per year, hence using a portfolio level of analysis (for each firm in each year). The final sample consists of 233 observations. Then, in order to measure innovativeness of MNC subunits, we collected patent data from the U.S. Patent and Trademark Office (USPTO) database. We focused our attention upon the US, since it represents the largest market for biotechnology (Ernst & Young, 2013). Finally, we collected alliance, subunit, and partner data from multiple sources, including BioScan, SEC filings for publicly traded firms, press releases, and corporate websites. Table 1 displays the distribution of observations across the subunits' host and home countries. Most of alliances refer to subunits located in the U.S. (63.95%), followed by Belgium (14.59%) and Canada (5.15%). Conversely, the main home country is Japan (28.33%), followed by the U.S. (17.60%).

- Insert Table 1 about here -

Variables

Dependent variables. Following Phene & Almeida (2008), we measured subunits' innovativeness in terms of both scale and quantity by analyzing their patent portfolio and the citations received by the same portfolio, respectively. Specifically, we measured *Innovation Scale* as the cumulated number of patents applied for by the subunit two years after the alliance. However, we also consider, as a robustness check, a shorter (+1) and a longer (+3) period of time, which enables us to provide also a more dynamic perspective of the alliances consequences in terms of subunits' innovativeness. *Innovation Quality* is instead measured as the total number of (forward) citations received by these patents within the same temporal window (i.e. +2, using +1 and +3 as robustness check). The use of patents and forward citations to assess innovative performance has been largely employed in the literature, being these able to estimate firms' innovative effort (e.g., Hagedoorn & Schakenraad 1994; Ahuja, 2000; Almeida & Phene, 2004) and its technical and economic relevance (e.g., Trajtenberg, 1990; Hall, Jaffe & Trajtenberg, 2005; Gambardella, Harhoff & Verspagen, 2008), respectively.

Independent variables. As suggested by Koza & Lewin (2000), we identified the nature of an alliance on the basis of its content, as described by alliance announcements. In particular, we considered upstream alliances, as those aimed at generating knowledge through R&D agreements, and downstream alliances, as those involving joint marketing and service, OEM/VAR (Original Equipment Manufacturers and Value-Add Resellers), licensing, production, or supply. Then, we measured the upstream nature of subunits' alliance portfolio (*Upstream Alliance*) through a continuous measure, as suggested by Lavie & Rosenkopf (2006), and by Lavie, Kang & Rosenkopf (2011). Specifically, following Koza & Lewin (2000), we codified with 1 the upstream alliances, with 0 the downstream alliances and with 0.5 the hybrid alliances. The final proxy was computed as the average value of this indicator for each firm in each year. Values range from 0 to 1, being high values associated to a predominance of upstream alliances.

As regards to the cultural distance, we used the index proposed by Kogut & Singh (1998), based on the four cultural dimensions[ii] suggested by Hofstede (1980), which has been largely adopted by previous studies to proxy cultural differences between firms involved in international strategic alliances (e.g., Barkema & Vermuelen, 1997; Tsang & Yip, 2007; Lavie & Miller, 2008). Namely, the cultural distance between the focal MNC subunit and each partner is measured as:

$$CD\, subunit - partner_j = \sum_{i=1}^{4} \frac{(I_{i,j} - I_{i,s})^2 / V_i}{4}$$

where $CD\, subunit - partner_j$ is the cultural distance between the subunit's host country and the home country of the j_{th} partner; I_{ij} is the score for the i_{th} cultural dimension and the j_{th} partner's country; V_i is the variance of the i_{th} cultural dimension; and s indicates the subunit's country. Similarly, the cultural distance between the subunit's parent home country and its partner is measured as

$$CD\, parent - partner_j = \sum_{i=1}^{4} \frac{(I_{i,j} - I_{i,p})^2 / V_i}{4}$$

where p indicates the MNC subunit parent's country. The scores for each country on the four dimensions were obtained from the website http://www.geert-hofstede.com/hofstede_dimensions.php. Finally, both *CD subunit-partner* and *CD parent-partner* are calculated at the alliance portfolio level by measuring the average values per year.

Control variables. We included several control variables to account for other potential effects influencing subunits' innovativeness. For each subunit, we introduced the following variable: *Subunit Size*, as the number of their employees (e.g., Rothaermel & Deeds, 2004); *Subunit Age*, as the difference between the subunit's year of foundation and the alliance portfolio's year (e.g., Sorensen & Stuart, 2000); *Subunit Technological Capital*, as the number of all patents that the subunit filed with the USPTO until to the alliance portfolio's year (e.g., Nooteboom, Vanhaverbeke, Duysters, Gilsing & van den Oord, 2007); *Subunit Business Diversification*, as the number of subunit's different SIC codes (e.g., Hitt, Hoskisson, & Kim, 1997); *Subunit Alliance Experience*, as the number of subunit's prior alliances until the alliance portfolio year (e.g., Hoang & Rothaermel, 2005); Then, we accounted for alliance specific relational attributes. First, we included *Technological Distance*, measured as suggested by previous studies (e.g., Ahuja & Katila, 2001; Rosenkopf & Almeida, 2003; Diestre & Rajagopalan, 2012). In particular, we identified all USPTO patents and related technological classes filed by each subunit and its partner until the alliance year. Hence, we created a count of the number of patent classes in which both firms had overlapping patenting activities, and we computed the technological distance as the difference between 10 and this count. Second, we controlled for intra-group ties through the variable *Intra Group*, as a dummy variable taking value one if the subunit and its partner belong to the same MNC, zero otherwise (e.g., de Faria, Lima & Santos, 2010). Both *Technological Distance* and *Intra Group* are averaged at the alliance portfolio year. Moreover, as for the subunit, we included the variable *Partners' Technological Capital* by calculating the average value of patents owned by the various partners included in each subunit's alliance portfolio per year. Finally, we used *Subunit's Industry Dummies*, as reflected by the main SIC code, to capture specific sectorial trends.

Methodology

Both the dependent variables used in this study are count, integer, and non-negative, thus making the negative binomial approach as the most suitable (Gourieroux, Monfort & Trognon, 1984; Hausman, Hall & Griliches, 1984). In fact, the Poisson model, assumes an equal value between standard deviation and mean, which is however violated by our variables, as highlighted by the coefficient of variations, equal to 3.26 and 3.45 for *Innovation Scale* and *Innovation Quality*, respectively. We conducted the analysis via the NBREG procedure in STATA. Table 2 reports the correlation matrix and descriptive statistics of our dependent and explicative variables. Since some correlation coefficients are close to 0.5, we computed the maximum variance inflation factor (VIF). As the relevant values do not exceed the critical threshold of 10 (Kleinbaum, Lawrence, Muller & Nizam, 1998), being the maximum value equal to 1.39 for *Subunit Technological Capital* and the average value equal to 1.36, we can rule out any multicollinearity concern.

- Insert Table 2 about here -

RESULTS

Tables 3a and 3b reports the results of our econometric analysis applied to *Innovation Scale* and *Innovation Quality*, respectively. Columns (1) display the results and the incident-rate ratios (IRR) of the base model, without any moderating effect. Upstream alliances do not seem to provide any effect *per se*, since the coefficients of the variable are significant neither for *Innovation Scale* nor for *Innovation Quality*. As regards the cultural distance measures, *CD subunit-partner* displays a negative and significant ($p<0.01$) effect for both dependent variables, meaning that alliances with a partner whose country is culturally distant from the subunit's host country decrease noticeably the subunit's innovation performance. A partner culturally distant from the subunit's host country is more likely, indeed, to be subject to misunderstandings of local social norms, institutions and values, which in turn imply increased transaction costs, operational difficulties, managerial complexity, inter-organizational conflicts and monitoring and control costs (Egelhoff, 1982; Schneider & DeMeyer,1991; Luo & Peng, 1999; Tihanyi, Griffith & Russel, 2005). Conversely, the cultural distance between subunit's parent and partner's countries displays only a weak positive effect ($p<0.10$) on *Innovation Quality*. Positive effects may result from creativity benefits (e.g., Shane, Venkataraman & MacMillan, 1995) and from the integration of newly acquired skills with existing resources, giving birth to new synergies and complementarities and, hence, to new unique competitive advantages (Morosini, Shane & Singh, 1998), especially when the subunit is located in advanced R&D environments (Birkinshaw, 1997; Hakanson & Nobel, 2001). As regards the controls, it seems that younger companies have a higher innovation performance in terms of both innovation scale and quality ($p<0.01$), probably due to a lower marginal effect of alliances for old and consolidated companies with respect to start-ups. At the same time, larger firms seems to perform better in terms of innovation quality ($p<0.05$), probably because they can afford to embark on larger scale projects with a higher quality content. Conversely, the variable *Subunit Technological Capital* displays a strong and positive effect ($p<0.001$) only for *Innovation Scale*, probably due to a path-dependence effect associated to previous patenting activity, which is likely to increase the ability to produce new patents, on the one hand, but also to generate a lock-in effect, on the other hand, which prevents firms from diversifying their innovation activity and increasing its quality content. The subunit business diversification displays a weak positive effect only on innovation quality ($p<0.10$), meaning that a diversified firm is likely to be subject to more innovation stimulus. Conversely, technological distance shows a negative and significant effect on both measures of innovation performance ($p<0.001$), thus revealing that the quantity and quality of innovation are hampered when the subunit and its partner rely on different technological classes, as shown by previous literature (e.g., Mowery et al., 1996; Ahuja, 2000). Finally, results show that when the subunit and the partner belong to the same group, alliance generates a lower amount of patents, being the coefficient in Table 3a negative and significant (p<0.05).

Columns (2), (3) and (4) of Tables 3a and 3b aim at testing hypotheses 1 and 2 by introducing the interaction between *Upstream Alliances* and *CD subunit-partner* (columns (2)), the interaction between *Upstream Alliances* and *CD parent-partner* (columns 3), and both interactions simultaneously (columns 4). Columns (2) show a positive but not significant coefficient of the interaction term for both innovation quantity and quality. Hence, hypothesis 1 is not verified. Conversely, hypothesis 2 is fully confirmed, since the interaction between *Upstream Alliances* and *CD parent-partner* displays a positive and significant coefficient for both *Innovation Scale* and *Innovation Quality* (p<0.01), as shown by columns (3) and (4). Column (5) introduces the interaction between the two cultural distances, in order to assess their joint impact on innovation quantity and quality, regardless of the type of alliance (i.e. upstream or downstream) considered. The coefficients are positive but not significant in both Tables 3a and 3b, meaning that it is not the joint presence of the two cultural distances *per se* that affect the innovation performance, but their combination with the type of alliance. Finally, columns (6) shows that hypothesis 3 is fully confirmed, since the interaction between *Upstream Alliances* and the two measures of cultural distances has a negative effect on both *Innovation Scale* (p<0.01) and *Innovation Quality* (p<0.05).

- Insert Tables 3a and 3b about here -

Hypotheses 2 and 3 are fully confirmed also when considering a shorter (+1) and longer (+3) time span for our dependent variables. Indeed, as it is shown by columns (3), (4) and (6) of Tables 4a, 4b, 5a, and 5b, both the positive coefficient of the interaction between *Upstream Alliances* and *CD parent-partner* and the negative coefficient of the interaction among *Upstream Alliances* and the two measures of cultural distance are significant.

- Insert Tables 4a, 4b, 5a and 5b about here -

In Figures 1 and 2 we plotted the relationships between the characteristics of subunits' alliance portfolio, as reflected by upstream alliances and partners culturally distant from their home country, and their innovative performance in terms of both scale and quality. The graphical representations are consistent with our second hypotheses, hence confirming the positive interacting effect between *Upstream Alliance* and *CD parent-partner*. Finally, to gain more insights into the third hypothesis, we decomposed the interaction terms and conducted simple slope analysis (Ai & Norton, 2003; Aiken & West, 1991; Hoetker, 2007) for high vs. low levels of *CD subunit-partner* (i.e. mean ± one st.dev.), as shown in Figures 3 and 4. Also in these cases, the graphs supported our prediction.

- Insert Figures 1, 2, 3, and 4 about here -

DISCUSSION AND CONCLUSIONS

In the present study, we have analyzed the impact exerted by the composition of a MNC subunit's portfolio of strategic alliances on its innovative performance, in terms of both scale and quality. Specifically, we have focalized our attention upon the type of alliances, distinguishing between upstream and downstream agreements, and partners cultural differences. With this regards, being the subunits embedded in a complex networks of relationships with their headquarter (e.g., Birkinshaw, 1997), we considered the multiple role of cultural distance, as reflected by differences between both partners and the subunit, and partners and its parent. Our analysis shows that subunits benefit more from establishing upstream alliances and collaborating with firms culturally different from its home country. This, in fact, allows the subunit to acquire unique, diverse, and non-redundant knowledge (Kogut, 1983; Rosenkopf & Almeida, 2003), which are in turn fundamental especially when conducting explorative activities, as the case of upstream collaborations (Lavie & Rosenkopf, 2006). Nevertheless, when partners are culturally distant from both the home and host country the benefits of diversity tend to decrease, since excessive coordination and integration costs may emerge (Thuc Anh et al., 2006). In addition, these difficulties tend to be exacerbated by the fact that the subunit mainly allies to collaborate in R&D activities, as upstream relationships, which involve complex and tacit knowledge (Coff, 2003), and are subject to uncertainty (Dasgupta & Stiglitz, 1980), hence making a certain cultural closeness as necessary to allow the subunit to fully exploit the innovative gains of its alliance portfolio.

Implications for Theory

Our study contributes to research on international business, by shedding new light on a number of issues. First, following the approach proposed by Zaheer & Hernandez (2011), we extend the line of inquire that jointly consider the effect MNC subunits internal and external networks on their innovative performance. Second, we contribute to solve the paradox of cultural distance (e.g., Rosenkopf & Almeida, 2003; Bell & Zaheer, 2007), by distinguishing between cultural differences from both the subunits' host and home country, and revealing the contingent role played by alliances' type, as reflected by upstream agreements. Finally, we respond to a recent call to analyze the differences in terms of innovative performance across MNC subunits (Collison & Wang, 2012), by focusing on how they leverage the strategic portfolio of alliances.

Our research informs studies on alliances in a threefold manner. First, we contribute to the recent stream of research focusing at the alliance portfolio level (Wessmer, 2008). Second, we shed new light on the impact of cultural distance on alliance partners interaction and knowledge outcomes, which have been less explored, producing vague and inconsistent results (Meier, 2011). Third, we discuss the innovative implications of alliances, whose understanding, despite investigated (e.g., Laursen & Salter, 2006; Sampson, 2007; Phelps, 2010), remain incomplete, thus calling for further investigation (see Zaheer & Hernandez, 2011; Lahiri & Narayanan, 2013). Moreover, we analyze multiple level performance, as scale and quality, thus adding further insights into firms' innovative behavior.

Finally, our study contributes to the research on balancing exploration and exploitation (e.g., March, 1991; Gupta, Smith & Shalley, 2006; Lavie, Stettner & Tushman, 2010), especially referring to the domain separation approach (Lavie & Rosenkopf, 2006; Hess & Rothaermel, 2011; Lavie, et al. 2011; Messeni Petruzzelli, 2013). In particular, we first introduce a further structural domain characterizing alliance, as represented by the cultural differences between partners, which have been proved to significantly influence firms' innovative and cooperative behavior (e.g., Shane et al., 1995). Thus, we respond to a recent call for a more deeper investigation into the relationship between cross-national peculiarities and exploration/exploitation (Lavie et al., 2010). Then, we distinguish this specific domain into two distinct sub-domains, as indicated by the cultural distance between the subunit and its partner and between the subunit's parent and the partner. Accordingly, we reveal that the benefits of the domain separation approach are contingent upon both the specific domains under investigation and their relative level of analysis.

Managerial Implications

Our study informs managers and corporate executive operating in subunits of MNCs on the costs and benefits of establishing upstream alliances and collaborating with culturally different partners. Specifically, our findings reveal the necessity to find a trade-off between selecting partners that are located in countries culturally distant from their home or host geographical area. In fact, while dealing with the two different cultural distances separately highlights the merits going along with partners' diversity, when jointly considered the costs of such an excessive diversity outweigh its benefits, thus calling for a choice. Furthermore, results point out the major innovative advantages for subunits emerge when their alliances' portfolio is mainly constituted by upstream collaborations and partners culturally far more from their home than host country. Thereby, the best option, in terms of innovative performance, seems to collaborate for R&D projects, having partners that are culturally close to the subunits' host country, while culturally distant from their parent's one.

Limitations and Future Research

Our study presents a number of limitations that may however represent opportunities for further research. First, to assess subunits' innovative performance we rely upon patent-based information, which, despite their extensive adoption, present a number of concerns (e.g. Gittelman, 2008), hence calling for other proxies. Second, we investigate the interplay between partners' cultural distance and the upstream nature of alliances on subunits' innovative performance. Nevertheless, other determinants of partners' diversity may be considered, as technological, industrial, and organizational, taking into account also their complementary or substitutive effects, as well as the distance relative to both subunits and their headquarters. Third, we focus our attention upon how subunits create new value by leveraging strategic alliances. Scholars may however extend this perspective by investigating appropriability issues. Finally, we focus our research on a specific industry, as the biotechnology. Other studies may extend the generalizability of our findings by including other high technology sectors.

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TABLES

Table 1: Distribution of observations (No.) by subunits' host and home countries

Host Country	**No.**	**%**
Australia	5	2.15
Belgium	34	14.59
Canada	12	5.15
Finland	1	0.43
Germany	7	3.00
Ireland	2	0.86
Israel	5	2.15
Netherlands	1	0.43
Switzerland	8	3.43
UK	9	3.86
US	149	63.95
Total	**233**	**100.00**

Home Country	**No.**	**%**
Australia	2	0.86
Belgium	4	1.72
Canada	1	0.43
Denmark	3	1.29
France	25	10.73
Germany	18	7.73
Israel	1	0.43
Italy	2	0.86
Japan	66	28.33
Mexico	1	0.43
Netherlands	6	2.58
Switzerland	30	12.88
UK	32	13.73
UK/Netherlands	1	0.43
US	41	17.60
Total	**233**	**100.00**

Table 2: Correlation matrix and descriptive statistics

	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)
1) Innovation Scale	1.000												
2) Innovation Quality	0.782	1.000											
3) Upstream Alliance	0.016	0.019	1.000										
4) CD subunit-partner	-0.139	-0.146	-0.025	1.000									
5) CD parent-partner	-0.038	-0.052	0.082	-0.054	1.000								
6) Subunit Size	0.182	0.186	-0.122	-0.065	-0.166	1.000							
7) Subunit Age	-0.062	-0.070	-0.186	0.170	0.045	0.296	1.000						
8) Subunit Technological Capital	0.426	0.322	0.060	-0.049	-0.092	0.400	0.134	1.000					
9) Subunit Business Diversification	0.373	0.361	0.100	-0.228	0.141	0.276	-0.072	0.473	1.000				
10) Subunit Alliance Experience	0.110	0.041	-0.076	0.153	-0.049	0.218	0.045	0.427	0.113	1.000			
11) Technological Distance	-0.339	-0.245	-0.096	0.179	-0.084	-0.195	-0.128	-0.355	-0.375	-0.095	1.000		
12) Intra Group	-0.007	0.007	-0.053	0.105	-0.183	-0.075	-0.107	0.033	0.001	-0.062	0.020	1.000	
13) Partners' Technological Capital	0.005	0.012	0.113	-0.049	0.055	-0.095	-0.040	-0.028	0.032	-0.046	-0.198	0.276	1.000
Observations	233	233	233	233	233	233	233	233	233	233	233	233	233
Mean	16.991	3.056	0.352	0.650	1.289	0.016	25.030	0.123	1.957	8.433	8.932	0.032	0.054
Std. Dev.	55.428	10.550	0.378	0.864	1.161	0.681	27.568	1.236	0.968	10.635	1.270	0.164	0.975
Min	0.000	0.000	0.000	0.000	0.000	-0.445	0.000	-0.407	1.000	0.000	5.000	0.000	-0.337
Max	623.000	110.000	1.000	3.706	5.280	2.449	136.000	6.821	5.000	45.000	10.000	1.000	5.621

Table 3a: Results of the negative binomial models; dependent variable = Innovation Scale (+2 years)

Explicative variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR
Upstream Alliance	0.118	1.125	0.131	1.140	-0.548	0.578	-0.521	0.594	0.209	1.233	-0.484	0.616
	(0.25)		(0.28)		(-1.09)		(-1.06)		(0.44)		(-1.03)	
CD subunit-partner	-0.397**	0.672**	-0.415**	0.660**	-0.356**	0.701**	-0.371*	0.690*	-0.512**	0.600**	-0.502**	0.605**
	(-3.02)		(-2.98)		(-2.58)		(-2.43)		(-3.04)		(-2.94)	
CD parent-partner	0.121	1.129	0.136	1.146	0.072	1.074	0.084	1.088	0.102	1.107	0.040	1.041
	(0.84)		(0.93)		(0.52)		(0.60)		(0.68)		(0.31)	
Subunit Size	0.512	1.669	0.525	1.691	0.404	1.497	0.412	1.510	0.435	1.545	0.225	1.253
	(1.33)		(1.33)		(1.15)		(1.14)		(1.09)		(0.64)	
Subunit Age	-0.028**	0.972**	-0.029***	0.971***	-0.029***	0.971***	-0.030***	0.971***	-0.031***	0.970***	-0.034***	0.967***
	(-3.26)		(-3.35)		(-3.63)		(-3.70)		(-3.59)		(-4.52)	
Subunit Technological Capital	0.834***	2.303***	0.798**	2.221**	0.896***	2.450***	0.851***	2.342***	0.881***	2.413***	0.907***	2.476***
	(3.36)		(3.09)		(3.72)		(3.38)		(3.50)		(3.51)	
Subunit Business Diversification	0.292	1.340	0.280	1.323	0.268	1.307	0.262	1.300	0.261	1.298	0.224	1.251
	(1.43)		(1.37)		(1.41)		(1.38)		(1.25)		(1.19)	
Subunit Alliance Experience	0.011	1.011	0.013	1.013	0.019	1.019	0.021	1.021	0.013	1.013	0.023	1.023
	(0.81)		(0.90)		(1.35)		(1.47)		(0.89)		(1.60)	
Technological Distance	-0.675***	0.509***	-0.673***	0.510***	-0.660***	0.517***	-0.652***	0.521***	-0.673***	0.510***	-0.613***	0.542***
	(-5.17)		(-5.21)		(-5.18)		(-5.15)		(-5.15)		(-4.81)	
Intra Group	-1.855*	0.157*	-1.824*	0.161*	-1.371	0.254	-1.321	0.2668	-1.966**	0.140**	-1.368	0.255
	(-2.52)		(-2.49)		(-1.49)		(-1.46)		(-2.64)		(-1.49)	
Partners' Technological Capital	-0.057	0.945	-0.049	0.953	-0.075	0.927	-0.068	0.934	-0.044	0.957	-0.017	0.983
	(-0.41)		(-0.35)		(-0.51)		(-0.46)		(-0.32)		(-0.10)	
Upstream Alliance*CD subunit -partner			0.314	1.369			0.388	1.474			1.125**	3.081**
			(0.81)				(0.89)				(2.09)	
Upstream Alliance*CD parent-partner					0.964**	2.623**	0.984**	2.674**			0.950***	2.587***
					(3.05)		(3.05)				(3.53)	
CD subunit-partner*CD parent-partner									0.165	1.180	0.136	1.145
									(1.41)		(1.16)	
Upstream Alliance*CD subunit-partner*CD parent-partner											-0.780**	0.458**
											(-2.73)	
Constant	5.735***	309.454***	5.743***	312.078***	5.751***	314.442***	5.678***	292.288***	6.061***	429.014***	5.739***	310.855***
	(3.96)		(3.96)		(3.95)		(3.88)		(4.02)		(3.80)	
N. of observations	233		233		233		233		233		233	
chi-square	2850.735***		2677.783***		2186.892***		2686.167***		3139.692***		2691.055***	
Log pseudolikelihood	-505.350		-505.198		-502.411		-502.189		-504.880		-500.081	

† 0.10 * 0.05 ** 0.01 *** 0.001. Z-statistics between brackets

Table 3b: Results of the negative binomial models; dependent variable = Innovation Quality (+2 years)

Explicative variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR
Upstream Alliance	0.347	1.415	0.452	1.571	-0.691	0.501	-0.569	0.566	0.364	1.439	-0.555	0.574
	(0.65)		(0.93)		(-1.12)		(-0.98)		(0.67)		(-1.02)	
CD subunit-partner	-0.647**	0.524**	-0.707**	0.493**	-0.626**	0.535**	-0.676**	0.509**	-0.795**	0.451**	-0.733*	0.480*
	(-2.77)		(-2.91)		(-2.68)		(-2.79)		(-2.68)		(-2.39)	
CD parent-partner	0.285†	1.330†	0.290†	1.336†	0.207	1.230	0.204	1.226	0.300†	1.349†	0.243	1.276
	(1.78)		(1.80)		(1.31)		(1.28)		(1.89)		(1.59)	
Subunit Size	1.775*	5.902*	1.815*	6.141*	1.454*	4.281*	1.459*	4.302*	1.774*	5.894*	1.367*	3.922*
	(2.52)		(2.54)		(2.20)		(2.20)		(2.49)		(2.08)	
Subunit Age	-0.037***	0.963***	-0.039***	0.962***	-0.036***	0.964***	-0.037***	0.963***	-0.040***	0.961***	-0.039***	0.962***
	(-3.58)		(-3.66)		(-3.67)		(-3.68)		(-3.77)		(-3.72)	
Subunit Technological Capital	0.068	1.070	0.025	1.025	0.175	1.191	0.141	1.152	0.063	1.065	0.144	1.155
	(0.25)		(0.09)		(0.66)		(0.54)		(0.23)		(0.55)	
Subunit Business Diversification	0.420†	1.522†	0.401†	1.494†	0.388†	1.474†	0.376	1.457	0.376	1.457	0.372	1.451
	(1.73)		(1.67)		(1.70)		(1.64)		(1.55)		(1.61)	
Subunit Alliance Experience	0.023	1.023	0.025	1.026	0.026	1.027	0.028	1.029	0.026	1.027	0.032	1.033
	(1.20)		(1.28)		(1.40)		(1.48)		(1.32)		(1.64)	
Technological Distance	-0.684***	0.505***	-0.680***	0.507***	-0.684***	0.505***	-0.678***	0.508***	-0.674***	0.510***	-0.663***	0.515***
	(-4.99)		(-5.00)		(-5.11)		(-5.14)		(-4.94)		(-5.09)	
Intra Group	-2.233	0.107	-2.079	0.125	-2.215	0.109	-2.040	0.130	-2.267	0.104	-1.909	0.148
	(-1.54)		(-1.49)		(-1.53)		(-1.45)		(-1.56)		(-1.30)	
Partners' Technological Capital	-0.360	0.698	-0.351	0.704	-0.262	0.770	-0.259	0.772	-0.332	0.718	-0.237	0.789
	(-1.42)		(-1.39)		(-1.02)		(-1.02)		(-1.32)		(-0.90)	
Upstream Alliance*CD subunit -partner			0.456	1.578			0.539	1.714			0.993	2.698
			(0.80)				(0.89)				(1.48)	
Upstream Alliance*CD parent-partner					1.100**	3.005**	1.131**	3.097**			0.991**	2.695**
					(2.83)		(2.82)				(3.17)	
CD subunit-partner*CD parent-partner									0.176	1.192	0.139	1.149
									(0.99)		(0.73)	
Upstream Alliance*CD subunit-partner*CD parent-partner											-0.661*	0.517*
											(-1.99)	
Constant	3.381*	29.388*	3.409*	30.232*	3.586*	36.098*	3.592*	36.306*	3.642*	38.170*	3.463*	31.919*
	(1.98)		(1.99)		(2.02)		(2.02)		(2.10)		(1.96)	
N. of observations	233		233		233		233		233		233	
chi-square	1914.114***		2036.231***		2695.394***		1692.385***		2301.463***		2468.740***	
Log pseudolikelihood	-277.753		-277.623		-275.400		-275.243		-277.516		-274.670	

† 0.10 * 0.05 ** 0.01 *** 0.001. Z-statistics between brackets

APPENDIX

Table 4a: Results of the negative binomial models; dependent variable = Innovation Scale (+1 years)

Explicative variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR
Upstream Alliance	-0.049	0.952	-0.018	0.983	-0.768	0.464	-0.719	0.487	-0.023	0.448	-0.688	0.503
	(-0.11)		(-0.04)		(-1.48)		(-1.43)		(-0.05)		(-1.41)	
CD subunit-partner	-0.385*	0.681*	-0.400*	0.670*	-0.351*	0.704*	-0.368*	0.692*	-0.431*	0.650*	-0.437*	0.646*
	(-2.43)		(-2.44)		(-2.11)		(-2.05)		(-2.21)		(-2.23)	
CD parent-partner	0.131	1.140	0.141	1.151	0.084	1.088	0.092	1.096	0.124	1.132	0.057	1.059
	(0.97)		(1.01)		(0.61)		(0.64)		(0.89)		(0.44)	
Subunit Size	0.681	1.977	0.689	1.992	0.554	1.740	0.553	1.738	0.651	1.918	0.369	1.446
	(1.48)		(1.46)		(1.37)		(1.33)		(1.38)		(0.97)	
Subunit Age	-0.032***	0.969***	-0.032***	0.968	-0.031***	0.969***	-0.032***	0.969***	-0.033***	0.9678***	-0.035***	0.965***
	(-3.82)		(-3.86)		(-3.97)		(-4.01)		(-3.85)		(-4.53)	
Subunit Technological Capital	0.835***	2.304***	0.803***	2.232	0.888***	2.431***	0.848***	2.335***	0.854***	2.348***	0.881***	2.413***
	(3.77)		(3.38)		(3.99)		(3.59)		(3.67)		(3.57)	
Subunit Business Diversification	0.292	1.339	0.285	1.329	0.279	1.321	0.275	1.317	0.278	1.321	0.253	1.288
	(1.33)		(1.30)		(1.37)		(1.35)		(1.25)		(1.30)	
Subunit Alliance Experience	-0.003	0.997	-0.002	0.998	0.006	1.006	0.007	1.007	-0.003	0.997	0.009	1.009
	(-0.21)		(-0.14)		(0.40)		(0.50)		(-0.19)		(0.66)	
Technological Distance	-0.703***	0.495***	-0.699***	0.497	-0.677***	0.508***	-0.668***	0.513***	-0.703***	0.495***	-0.627***	0.534***
	(-5.33)		(-5.36)		(-5.13)		(-5.08)		(-5.34)		(-4.78)	
Intra Group	-4.400*	0.012*	-4.208*	0.015*	-4.418*	0.012*	-4.165*	0.016*	-4.461*	0.012*	-3.828*	0.022*
	(-2.52)		(-2.48)		(-2.57)		(-2.51)		(-2.51)		(-2.44)	
Partners' Technological Capital	-0.523*	0.593*	-0.527*	0.591*	-0.459*	0.632*	-0.467*	0.627*	-0.513*	0.599*	-0.449†	0.638†
	(-2.29)		(-2.31)		(-2.02)		(-2.09)		(-2.23)		(-1.93)	
Upstream Alliance*CD subunit -partner			0.248	1.282			0.347	1.415			1.251*	3.493*
			(0.55)				(0.63)				(2.10)	
Upstream Alliance*CD parent-partner					0.922**	2.513**	0.944**	2.570**			0.914***	2.495***
					(2.87)		(2.83)				(3.35)	
CD subunit-partner*CD parent-partner									0.060	1.062	0.039	1.040
									(0.49)		(0.34)	
Upstream Alliance*CD subunit-partner*CD parent-partner											-0.908**	0.403**
											(-3.22)	
Constant	5.629***	278.500***	5.595***	268.951***	5.581***	265.325***	5.476***	238.916***	5.777***	322.686***	5.259***	192.261***
	(3.69)		(3.68)		(3.47)		(3.41)		(3.73)		(3.32)	
N. of observations	246		246		246		246		246		246	
chi-square	1962.255***		1837.453***		1711.256***		2307.650***		1963.663***		1857.047***	
Log pseudolikelihood	-423.404		-423.328		-420.984		-420.853		-423.343		-418.769	

† 0.10 * 0.05 ** 0.01 *** 0.001. Z-statistics between brackets

Table 4b: Results of the negative binomial models; dependent variable = Innovation Quality (+1 years)

Explicative variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR
Upstream Alliance	-0.412	0.662	-0.231	0.794	-1.941*	0.144*	-1.807*	0.164*	-0.407	0.666	-1.584*	0.205*
	(-0.65)		(-0.41)		(-2.57)		(-2.54)		(-0.63)		(-2.31)	
CD subunit-partner	-0.841*	0.431*	-0.939*	0.391*	-0.791*	0.453*	-0.841*	0.431*	-1.145**	0.318**	-0.908*	0.403*
	(-2.54)		(-2.45)		(-2.50)		(-2.42)		(-2.78)		(-2.42)	
CD parent-partner	0.303†	1.354†	0.307†	1.360†	0.093	1.098	0.082	1.085	0.366*	1.442*	0.190	1.209
	(1.70)		(1.74)		(0.47)		(0.41)		(2.24)		(1.10)	
Subunit Size	1.602†	4.962†	1.664†	5.281†	1.297	3.660	1.317	3.732	1.620†	5.055v	1.229	3.416
	(1.76)		(1.84)		(1.57)		(1.59)		(1.81)		(1.52)	
Subunit Age	-0.045**	0.956**	-0.047**	0.954**	-0.050***	0.951***	-0.051**	0.950**	-0.050***	0.951***	-0.055***	0.946***
	(-3.12)		(-3.25)		(-3.35)		(-3.23)		(-3.53)		(-3.37)	
Subunit Technological Capital	0.220	1.246	0.183	1.201	0.399†	1.491†	0.381	1.464	0.217	1.243	0.411†	1.508†
	(1.03)		(0.82)		(1.72)		(1.62)		(0.99)		(1.74)	
Subunit Business Diversification	0.392	1.480	0.361	1.434	0.310	1.363	0.294	1.342	0.327	1.387	0.262	1.300
	(1.23)		(1.17)		(1.10)		(1.04)		(1.08)		(0.96)	
Subunit Alliance Experience	-0.047†	0.954†	-0.043	0.958	-0.037	0.964	-0.034	0.967	-0.044	0.957	-0.030	0.971
	(-1.73)		(-1.45)		(-1.40)		(-1.19)		(-1.52)		(-1.06)	
Technological Distance	-0.603***	0.547***	-0.596***	0.551***	-0.591***	0.554***	-0.583***	0.558	-0.611***	0.543***	-0.561***	0.571***
	(-3.48)		(-3.56)		(-3.40)		(-3.46)		(-3.46)		(-3.39)	
Intra Group	-2.005	0.135	-1.782	0.168	-2.798†	0.061†	-2.657†	0.070†	-2.009	0.134	-2.563	0.077
	(-1.52)		(-1.44)		(-1.66)		(-1.65)		(-1.45)		(-1.44)	
Partners' Technological Capital	-0.221	0.802	-0.226	0.798	-0.056	0.945	-0.065	0.937	-0.177	0.838	-0.052	0.949
	(-0.78)		(-0.82)		(-0.17)		(-0.20)		(-0.63)		(-0.16)	
Upstream Alliance*CD subunit -partner			0.536	1.709			0.353	1.423			1.202	3.325
			(0.73)				(0.52)				(1.52)	
Upstream Alliance*CD parent-partner					1.917***	6.804***	1.914***	6.779			1.541***	4.670***
					(3.74)		(3.73)				(4.06)	
CD subunit-partner*CD parent-partner									0.287†	1.332†	0.298†	1.347†
									(1.69)		(1.77)	
Upstream Alliance*CD subunit-partner*CD parent-partner											-1.157***	0.314***
											(-3.12)	
Constant	1.557	4.746	1.621	5.058	2.040	7.688	2.068	7.907	2.097	8.145	1.860	6.424
	(0.79)		(0.82)		(1.04)		(1.05)		(1.02)		(0.96)	
N. of observations	246		246		246		246		246		246	
chi-square	1806.577***		1860.467***		2739.546***		2776.919***		2569.276***		2154.122***	
Log pseudolikelihood	-161.619		-161.509		-156.799		-156.753		-161.284		-155.813	

† 0.10 * 0.05 ** 0.01 *** 0.001. Z-statistics between brackets

Table 5a: Results of the negative binomial models; dependent variable = Innovation Scale (+3 years)

Explicative variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Coeff.	**IRR**	**Coeff.**	**IRR**	**Coeff.**	**IRR**	**Coeff.**	**IRR**	**Coeff.**	**IRR**	**Coeff.**	**IRR**
Upstream Alliance	0.558	1.748	0.556	1.743	0.024	1.025	0.029	1.029	0.624	1.866	0.047	1.048
	(1.25)		(1.24)		(0.05)		(0.06)		(1.38)		(0.10)	
CD subunit-partner	-0.446**	0.640**	-0.452**	0.636**	-0.400*	0.670*	-0.403*	0.668*	-0.533**	0.587**	-0.521**	0.594**
	(-3.09)		(-3.02)		(-2.54)		(-2.46)		(-3.18)		(-2.74)	
CD parent-partner	0.144	1.155	0.153	1.165	0.116	1.123	0.123	1.131	0.122	1.129	0.046	1.047
	(0.93)		(0.99)		(0.80)		(0.85)		(0.75)		(0.34)	
Subunit Size	0.620	1.858	0.624	1.866	0.532	1.702	0.534	1.705	0.557	1.746	0.307	1.360
	(1.47)		(1.46)		(1.35)		(1.34)		(1.29)		(0.81)	
Subunit Age	-0.023*	0.977*	-0.023*	0.977*	-0.023*	0.977*	-0.024*	0.977*	-0.025*	0.975*	-0.029***	0.972***
	(-2.27)		(-2.30)		(-2.51)		(-2.53)		(-2.41)		(-3.32)	
Subunit Technological Capital	0.961**	2.614**	0.937**	2.552**	1.019**	2.770**	0.993**	2.699**	0.996**	2.707**	1.063**	2.896**
	(2.92)		(2.69)		(3.04)		(2.83)		(3.06)		(3.06)	
Subunit Business Diversification	0.258	1.294	0.252	1.287	0.240	1.271	0.238	1.268	0.232	1.262	0.189	1.208
	(1.20)		(1.18)		(1.17)		(1.15)		(1.06)		(0.94)	
Subunit Alliance Experience	0.018	1.018	0.019	1.019	0.024†	1.024†	0.024†	1.025†	0.018	1.019	0.025†	1.025†
	(1.46)		(1.50)		(1.80)		(1.86)		(1.49)		(1.94)	
Technological Distance	-0.715***	0.489***	-0.711***	0.491***	-0.704***	0.494***	-0.699***	0.497***	-0.711***	0.491***	-0.650***	0.522***
	(-5.29)		(-5.26)		(-5.27)		(-5.17)		(-5.27)		(-4.73)	
Intra Group	-1.141	0.320	-1.113	0.329	-0.939	0.391	-0.911	0.402	-1.158	0.314	-0.835	0.434
	(-1.60)		(-1.56)		(-1.40)		(-1.37)		(-1.54)		(-1.22)	
Partners' Technological Capital	-0.122	0.886	-0.119	0.887	-0.123	0.884	-0.122	0.885	-0.118	0.888	-0.082	0.921
	(-0.97)		(-0.95)		(-1.00)		(-0.99)		(-0.93)		(-0.58)	
Upstream Alliance*CD subunit -partner			0.156	1.169			0.173	1.189			1.029†	2.797†
			(0.40)				(0.42)				(1.86)	
Upstream Alliance*CD parent-partner					0.802**	2.229**	0.805**	2.237**			0.831**	2.295**
					(2.68)		(2.65)				(3.09)	
CD subunit-partner*CD parent-partner									0.112	1.118	0.073	1.075
									(0.99)		(0.66)	
Upstream Alliance*CD subunit-partner*CD parent-partner											-0.840**	0.432**
											(-2.79)	
Constant	6.458***	637.966***	6.442***	627.755***	6.500***	664.859***	6.443***	628.155***	6.737***	842.801***	6.498***	663.984***
	(4.31)		(4.30)		(4.39)		(4.31)		(4.35)		(4.25)	
N. of observations	222		222		222		222		222		222	
chi-square	1980.508***		1946.890***		1994.386***		2001.966***		1896.780***		2819.388***	
Log pseudolikelihood	-539.022		-538.982		-537.004		-536.956		-538.782		-534.764	

† 0.10 * 0.05 ** 0.01 *** 0.001. Z-statistics between brackets

Table 5b: Results of the negative binomial models; dependent variable = Innovation Quality (+3 years)

Explicative variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR	Coeff.	IRR
Upstream Alliance	0.666	1.946	0.674	1.963	0.169	0.720	0.176	1.193	0.761	2.141	0.260	1.296
	(1.21)		(1.24)		(0.28)		(0.30)		(1.35)		(0.45)	
CD subunit-partner	-0.609**	0.544**	-0.620*	0.538*	-0.555*	0.574*	-0.558*	0.572*	-0.782**	0.457**	-0.726*	0.484*
	(-2.65)		(-2.52)		(-2.25)		(-2.17)		(-2.91)		(-2.29)	
CD parent-partner	0.278	1.320	0.286	1.331	0.237	1.267	0.240	1.271	0.267	1.306	0.209	1.232
	(1.54)		(1.55)		(1.37)		(1.35)		(1.50)		(1.28)	
Subunit Size	1.807**	6.093**	1.825*	6.205*	1.651*	5.211*	1.657*	5.242*	1.723*	5.601*	1.333*	3.794*
	(2.59)		(2.57)		(2.46)		(2.43)		(2.44)		(2.14)	
Subunit Age	-0.036**	0.965**	-0.036**	0.965**	-0.035***	0.966***	-0.035***	0.965***	-0.038***	0.963***	-0.038***	0.963***
	(-3.27)		(-3.26)		(-3.33)		(-3.31)		(-3.48)		(-3.78)	
Subunit Technological Capital	0.421	1.523	0.396	1.486	0.484	1.622	0.474	1.606	0.456	1.578	0.587	1.799
	(0.88)		(0.78)		(0.96)		(0.89)		(0.95)		(1.07)	
Subunit Business Diversification	0.297	1.346	0.293	1.341	0.278	1.321	0.277	1.320	0.264	1.302	0.245	1.278
	(1.13)		(1.12)		(1.06)		(1.06)		(0.99)		(0.94)	
Subunit Alliance Experience	0.020	1.021	0.021	1.021	0.022	1.023	0.023	1.023	0.022	1.022	0.024	1.024
	(1.17)		(1.17)		(1.21)		(1.20)		(1.22)		(1.23)	
Technological Distance	-0.797***	0.451***	-0.794***	0.452***	-0.788***	0.455***	-0.787***	0.455***	-0.783***	0.457***	-0.749***	0.473***
	(-5.18)		(-5.16)		(-5.13)		(-5.08)		(-5.12)		(-4.83)	
Intra Group	-3.439†	0.032†	-3.352†	0.035†	-3.306†	0.037†	-3.269†	0.038†	-3.597*	0.027*	-3.144†	0.043†
	(-1.93)		(-1.87)		(-1.92)		(-1.88)		(-1.99)		(-1.86)	
Partners' Technological Capital	-0.389	0.678	-0.389	0.678	-0.345	0.708	-0.346	0.708	-0.350	0.705	-0.291	0.748
	(-1.42)		(-1.42)		(-1.26)		(-1.26)		(-1.28)		(-1.02)	
Upstream Alliance*CD subunit -partner			0.137	1.147			0.061	1.063			0.960	2.612
			(0.28)				(0.12)				(1.54)	
Upstream Alliance*CD parent-partner					0.599†	1.821†	0.597†	1.817†			0.591†	1.806†
					(1.68)		(1.67)				(1.87)	
CD subunit-partner*CD parent-partner									0.206	1.229	0.177	1.193
									(1.51)		(1.25)	
Upstream Alliance*CD subunit-partner*CD parent-partner											-0.839**	0.432**
											(-2.65)	
Constant	6.330***	560.927***	6.314***	552.367***	6.361***	578.827***	6.348***	571.123***	6.651***	773.854***	6.316***	553.107***
	(3.65)		(3.64)		(3.60)		(3.58)		(3.72)		(3.49)	
N. of observations	222		222		222		222		222		222	
chi-square	2742.577***		1934.639***		1266.232***		1258.225***		1873.311***		1594.408***	
Log pseudolikelihood	-345.870		-345.854		-345.197		-345.194		-345.458		-343.741	

† 0.10 * 0.05 ** 0.01 *** 0.001. Z-statistics between brackets

FIGURES

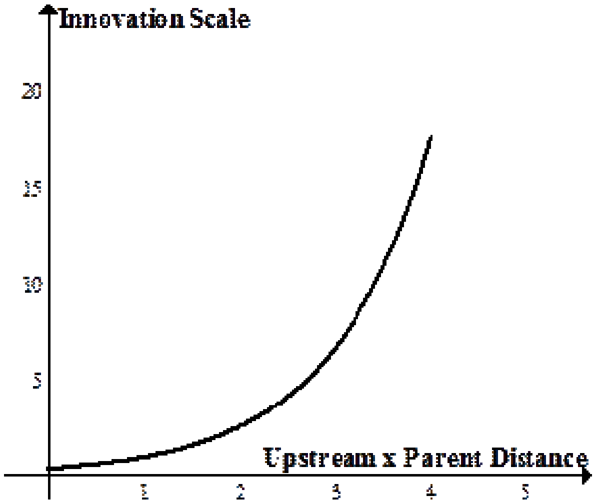

Figure 1. Upstream alliance, subunit cultural distance, and innovation scale

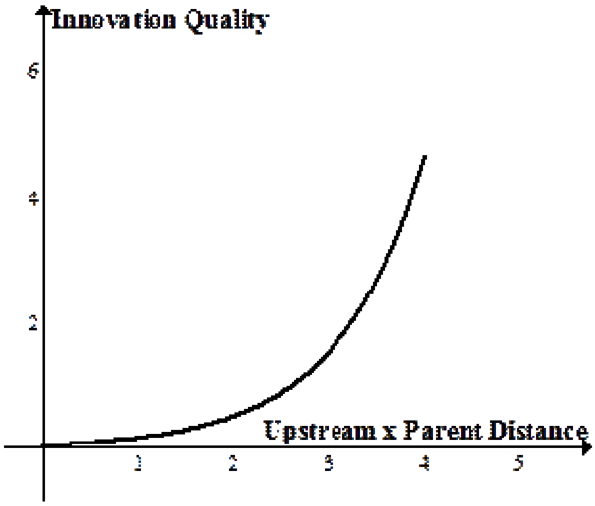

Figure 2. Upstream alliance, subunit cultural distance, and innovation quality

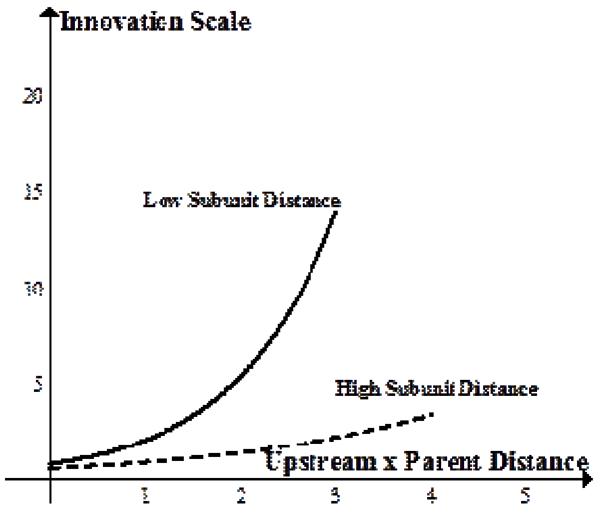

Figure 3. Upstream alliance, subunit and parent cultural distance, and innovation scale

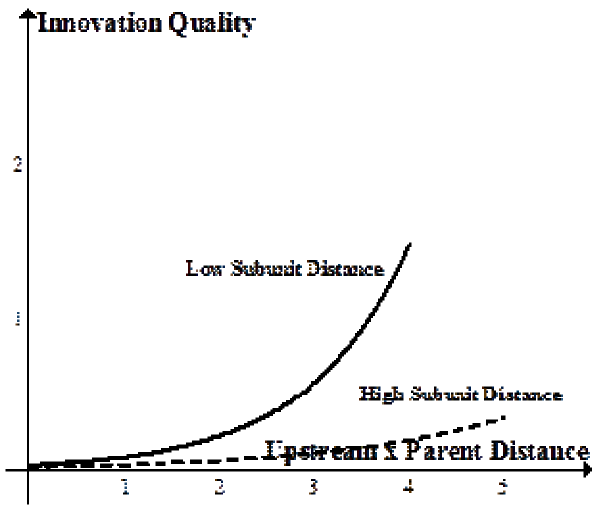

Figure 4. Upstream alliance, subunit and parent cultural distance, and innovation quality

[i] For most large MNCs, the most important knowledge base continues to be embodied in the parent company and the home country (Patel and Pavitt, 1991; Patel and Vega, 1999; Bianchi and DiMinin 2011; and Belderbos et al, 2013).

[ii] Power distance, uncertainty avoidance, masculinity/femininity, and individualism.