Munich Personal RePEc Archive

# The dual role of external corporate venturing in technological exploration

Vanhaverbeke, Wim and Li, Ying and Van de Vrande, Vareska

Hasselt University, Technical School of Business, RSM - Erasmus University

2009

Online at https://mpra.ub.uni-muenchen.de/26488/
MPRA Paper No. 26488, posted 08 Nov 2010 10:49 UTC

# The dual role of external corporate venturing in technological exploration

**Wim Vanhaverbeke**
Department BEW, Hasselt University, Belgium
Vlerick Leuven Gent Management School, Belgium
ESADE Business School, Spain

**Ying Li**
Technical University of Denmark
DTU Executive School of Business
DK-2800 Kgs. Lyngby, Denmark

**Vareska van de Vrande**
Rotterdam School of Management – Erasmus University, the Netherlands
Ecole Polytechnique Fédérale de Lausanne, Switzerland

## Abstract

*Firms tend toward local search when they continue to build on own technological knowledge. Therefore, technological exploration has usually been associated with some form of boundary spanning activities. In line with previous research this study focuses on organizational or external boundary-spanning exploration, but in contrast to previous studies, it distinguishes between explorative learning from partners and from non-partners. Partners are considered as organizations with whom a focal firm has some kind of external venturing relations, i.e. technological alliances, corporate venturing capital, or M&As. Central in the study is the* dual role *of these external corporate venturing relations and their effect on the two types of exploration. In explorative learning from partners, the external venturing relationships function as pipes to exchange information between the partners. In explorative learning from non-partners, partners may play a role as prisms. That is, they inform the focal firm about technological opportunities beyond its current network. The results of the empirical analysis confirm the dual role of the partners in advancing the two types of explorative learning. The results furthermore indicate that intermediate levels of technological distance between a focal firm and its partners foster explorative learning from partners, while low levels of technological distance enhances explorative learning from non-partners.*

*Corresponding author*
Wim Vanhaverbeke
Department BEW, Hasselt University
Agoralaan - Bldg D
3590 Diepenbeek – Belgium
wim.vanhaverbeke@uhasselt.be
Mobile : +32478332440

# The dual role of external corporate venturing in technological exploration


**Abstract**

*Firms tend toward local search when they continue to build on own technological knowledge. Therefore, technological exploration has usually been associated with some form of boundary spanning activities. In line with previous research this study focuses on organizational or external boundary-spanning exploration, but in contrast to previous studies, it distinguishes between explorative learning from partners and from non-partners. Partners are considered as organizations with whom a focal firm has some kind of external venturing relations, i.e. technological alliances, corporate venturing capital, or M&As. Central in the study is the* dual role *of these external corporate venturing relations and their effect on the two types of exploration. In explorative learning from partners, the external venturing relationships function as pipes to exchange information between the partners. In explorative learning from non-partners, partners may play a role as prisms. That is, they inform the focal firm about technological opportunities beyond its current network. The results of the empirical analysis confirm the dual role of the partners in advancing the two types of explorative learning. The results furthermore indicate that intermediate levels of technological distance between a focal firm and its partners foster explorative learning from partners, while low levels of technological distance enhances explorative learning from non-partners.*


## 1 Introduction

The importance of gaining knowledge from external sources to explore new technological and market opportunities has long been recognized in studies of innovation management, strategic alliances and corporate venturing (e.g., Rosenkopf and Nerkar, 2001; Lavie and Rosenkopf, 2006; Schildt *et al*., 2005; Keil *et al*., 2008). Companies increasingly use external corporate venturing to learn from knowledge sources beyond the boundary of the firm (Rosenkopf and Nerkar, 2001). External corporate venturing, including corporate venture capital (CVC) investments (Dushnitsky and Lenox, 2005; Keil *et al*., 2008), alliances (Gulati, 1998), and mergers and acquisitions (M&A) (Ahuja and Katila, 2001; Puranam and Srikanth, 2007) has been found to be positively related to the innovation performance of firms and has become a noteworthy vehicle for exploration (Schildt *et al*., 2005; Lavie and Rosenkopf, 2006; Lin *et al*., 2007). Exploration refers to the variation-seeking, risk-taking and experimentation-oriented learning of unfamiliar knowledge (March, 1991). At the firm level, exploration usually implies learning of new knowledge that does not reside within the firm. It has been suggested in the extant literature that by forming external venturing relationships with other organizations, an innovating firm can gain access to novel knowledge sources and explore new technological opportunities from its venturing partners (Chesbrough, 2003; Rosenkopf and Nerkar, 2001; Schildt *et al*., 2005; Keil *et al*., 2008).

However, innovating firms can not only explore new technologies from its corporate venturing partners, but it can also explore new technologies from organizations with whom they have had no prior venturing relationships. The former is indeed facilitated and governed *directly* by the venturing partnerships, while the latter could also be influenced by a firm's external corporate venturing partnerships in *an indirect way*. When an innovating firm explores from organizations with whom it has no external venturing relations, the existing corporate venturing partnerships may nevertheless have impact on the exploratory learning of the innovating firm by acting, for instance, as an information pipe, a reputation reference, or a complementary knowledge source (Podolny, 2001; Gulati, 1998). Although prior studies have greatly contributed to our understanding of the relationship between external corporate venturing and exploration, they have mostly focused on a firm's exploratory learning *from* its venturing partners. We call this "explorative learning from partners" or "ELP". There has been little insight in how external corporate venturing may affect the exploratory learning *beyond* these venturing partnerships in reaching out to firms and organizations with whom an innovating company had or has no direct venturing relations. We will call this explorative learning from non-partners" or "ELN". In other words, the extant literature has analyzed in detail the role of external corporate venturing partners with regard to external sources of knowledge, but we know little about how external corporate venturing partnerships could play a role in exploring technological knowledge embedded in other organizations with which the innovating firm has *no* venturing relationships.

It is also unclear how external corporate venturing partnerships could affect ELP and ELN *differently*. Nevertheless, it is important to investigate this dual role of a firm's external corporate venturing on explorative learning for several reasons. First, since firms are socially embedded within various social connections in an increasingly open innovation context, non- partnering organizations could be an equally important external source for exploration as venturing partners (Chesbrough, 2003, 2006; Rigby and Zook, 2002). Second, a firm's external corporate venturing is highly relevant to its ELN because the venturing partnerships can serve for the innovating firm as a radar to detect new technological opportunities. They act as a prism (Podolny, 2001) to identify the relevance and complementarity of new technologies, and as a reputation mechanism to legitimize ELN. Finally, the quantity and quality of a firm's existing venturing relationships might alter the incentives and constrain the resources for ELN. Hence, the purpose of this paper is to investigate the effects of external corporate venturing, including corporate venture capital (CVC), alliances and mergers and acquisitions (M&A), on both types of explorative learning – exploration from partners and non-partners. Besides the direct benefit of having access to external venturing partners' technologies an innovating firm may also benefit from its partners' knowledge and reputation to explore new external knowledge sources beyond its partners.

This study makes several contributions to the corporate venturing and inter-organizational learning literature. First, to our knowledge, this paper is among the first to conceptually distinguish explorative learning *from* partners (ELP) and explorative learning from *non*-partners (ELN). Second, it empirically investigates the potentially different effects of external venturing on a firm's ELP and ELN. The results of this study will extend our understanding on external corporate venturing and innovation. Third, it also theoretically explores and empirically tests the relationships between the levels of integration in the venturing governance modes and EFP and EBP. Finally, we also take into account the possible influence of technological distance (Nooteboom, 2000a) on the exploratory learning in combination with the effects of external corporate venturing. Consequently, the results of this study provide new insights for the literature on inter-organizational learning in general and for the prevailing stream of research on exploration in particular.

This paper is organized as follows. First, we introduce the concept of exploration and exploitation and explain the difference between explorative learning from partners and non-partners. We also illustrate how most studies in the literature on exploration have limited their focus on the inter-organizational learning *between* venturing partners. The role of the partners in facilitating explorative learning from non-partners has been largely neglected. Third, we provide a theoretical background for external corporate venturing and develop hypotheses on the relationships between corporation venturing and explorative learning from partners and non-partners. Next, we present the data and estimation methods to test the hypotheses. Finally, we discuss the results and draw some conclusions from our research, followed by suggestions for future research.

## 2 Theory and hypotheses

### *2.1 The dual role of external corporate venturing partnerships in technological exploration*

The notions of exploration and exploitation have been widely used in studies on organizational learning, strategic renewal and technological innovation. March (1991) described the two concepts as follows: 'exploration includes things captured by terms such as search, variation, risk taking, experimentation, flexibility, discovery, and innovation. Exploitation refers to such things as refinement, choice, production, efficiency, selection, implementation, and execution (March, 1991, p. 71). Exploration is variation-seeking, risk-taking and experimentation oriented. Exploitation is variety-reducing and efficiency oriented (March, 1991). In this paper, we focus on *exploration* and, in line with Rosenkopf and Nerkar (2001), we start from the observation that in order to move beyond local search exploration requires organizational boundary spanning. These authors claim that technological exploration in firms requires learning from other organizations. We refine the concept of external boundary spanning exploration by distinguishing *two types of external sources from whom the* *innovating firm can learn.* Companies can go beyond local search by sourcing new technology from its external corporate venturing partners. However, companies can also learn from companies with whom it had no venturing relations before. In making this distinction between partners and non-partners, we create a new typology of boundary spanning exploration which will be instrumental in understanding the *dual role of external corporate venturing partners in explaining technological exploration*.

Previous research has shown that firms with stronger reliance on their own prior developments have a stronger innovation performance, but they risk that their technological competencies become less relevant as newly emerging technologies are not detected in time. Firms can further build and exploit existing technological competencies through internal R&D. However, researchers also argued that this internal orientation leads to the development of competency traps (Levitt and March, 1988; Levinthal and March, 1993) and core rigidities (Leonard-Barton, 1992, 1995). Firms have to acquire technological knowledge from external partners and the gains related to the internal development of technology are not sustainable unless the organization can assimilate and integrate knowledge that is developed externally (Rosenkopf and Nerkar, 2001; Sidhu *et al.*, 2004). Exploration is usually recognized as activities that search for unfamiliar, distant and remote knowledge (Ahuja and Lampert, 2001; Rosenkopf and Nerkar, 2001; Benner and Tushman, 2002; Katila and Ahuja, 2002; Nerkar, 2003). The underlying logic is that a firm's reuse of internal knowledge aims at refining, improving and exploiting existing technological knowledge, while searching and acquiring new knowledge outside of the firm is regarded as tentative, unfamiliar, uncertain and exploratory (Katila and Ahuja, 2002; Rosenkopf and Nerkar, 2001). Knowledge sourcing from other firms is crucial for exploration as innovations are considered the result of a recombination of component elements (Schumpeter, 1934; Henderson and Clark, 1990; Kogut and Zander, 1992). Firms can find and assimilate new technological knowledge from other companies because firms differ from each other in many ways, such as market orientation, manufacturing facilities, distribution channels, skills developed in application technology and market launches of new products, technological capabilities and so forth (Dosi, 1988). Differences in firms' knowledge bases is a crucial condition for learning and for producing Schumpeterian 'novel combinations' (Nelson and Winter, 1982). A few studies on corporate venturing and strategic alliances consider exploitation as the reuse and refinement of a firm's existing knowledge base, while exploration is considered as a learning process to integrate new technologies from a firm's venturing partners (Benner and Tushman, 2002; Schildt *et al.*, 2005; Lavie and Rosenkopf, 2006). These venturing partnerships may have different governance modes, including corporate venture capital investment, strategic alliances, joint ventures, and mergers and acquisitions (Keil et al., 2008; Van de Vrande et al., 2009). Although the role of venturing partners in technological exploration has been acknowledged in the existing literature, scholars have only investigated how an innovating firm can learn *from* its partners, but they overlooked the possibility that a firm may utilize the same external venturing relationships to explore new technologies *beyond* the existing venturing partnerships.

We draw on the extant literature about technological innovations to define two types of exploration—explorative learning from partners (ELP) and from non-partners (ELN). Both types of exploration are related to organizational boundary spanning learning (Sorenson and Stuart, 2000; Rosenkopf and Nerkar, 2001). Explorative learning from partners (ELP) results from the fact that innovating firms learn directly from their external corporate venturing relationships. That is, firms can explore new technologies or competencies by establishing corporate venturing relationships that determine how the transfer or co-creation of the technology will be managed and organized. A pharmaceutical company might for instance establish an R&D agreement with a biotechnology start-up to learn about the specific knowledge of the latter in a particular application of functional genomics. In this case, we expect that the new technology developed in the pharmaceutical company will be partly based on the technology of the start-up company. Explorative learning from non-partners (ELN), however, is another type of boundary spanning exploration. ELN is an explorative learning process in which the innovating company is not learning directly from its external corporate venturing relationships, but the company is exploring new technological areas relying on existing technological knowledge of other organizations with whom it has no venturing partnerships. A firm can learn from non-partners in different ways: scientific publications (McMillan *et al.*, 2000), patent releases, contact with consultants and intermediaries (Howells, 2006), product introductions in the market, conferences, exhibitions, benchmarking with competitors (Wiersema and Bowen, 2008; Hunt and Morgan, 1997), mobility of personnel, etc. are just a few ways how exploration in a firm can be based on knowledge of organizations with whom the innovating company has not established any formal collaboration.

In explorative learning from partners an innovating firm is learning from its venturing partners directly. Their technological competences or knowledge base is the primary reason why the focal firm engages in technology alliances, invests in a portfolio firm as a corporate investor or acquires companies with interesting technologies. The venturing relations can thus be considered as 'pipes' through which the knowledge interactions between partners is shaped and facilitated (Podolny, 2001). This role of venturing relations has been extensively explained in the literature.

On the other hand, companies can avoid local search by exploring from organizations with which they have had no prior external corporate venturing relationships. This can be referred to as 'explorative learning from non-partners (ELN). The extant literature has noticed the importance of this type of learning (Beckman *et al.*, 2004; Lavie and Rosenkopf, 2006), but has overlooked the role of the external corporate venturing partners in facilitating this type of explorative learning (Schildt, *et al.*, 2005; Keil *et al*. 2008).

For instance, Schildt *et al*. (2005, 501) intentionally excluded patents that do not refer to the patents of a venture partner but to other organizations because "they are not considered as constituting *interorganizational learning"*. We argue that there are many reasons to believe that it is important to link a firm's existing external venturing relationships to its explorative learning from non-partners. In other words, how can technology partners play a role in a firm's explorative learning *beyond* its existing network of venturing partners? First, an innovating firm is embedded in a broader social network of firms with which it is directly or indirectly connected via the venturing partnerships (Granovetter, 1985). The social embeddedness of firms provides an innovating firm not only with access to the knowledge base of its venturing partners to which it's directly connected, but also the possibility to reach out to the knowledge base of other firms which are known by or connected to the focal firm's venturing partners (Davis, 1991; Burt, 1992). In other words, the external venturing partnerships may increase the likelihood of knowledge spillover from other firms to the focal firm (Meyer, 2004; Chang and Xu, 2008). The external corporate venturing relationships can be regarded as the channels to reach beyond the boundary of an innovating firm's direct corporate venturing networks to a larger range of firms and a broader knowledge pool (Gulati, 1998; Beckman *et al*., 2004; Lin *et al*., 2007). Second, due to their unique knowledge base, external corporate venturing partners may help the innovating firm to find novel technologies. When novel technologies are spotted, external corporate venturing partners may further act as a knowledge reference to identify the relevance and complementarity of the knowledge for the innovating firm (Burt, 1992; Nooteboom, 2000a). In other words, external corporate venturing partnerships may act as a radar to detect relevant knowledge beyond a firm's network of venturing partners and they act as referrals concerning the usefulness of the new knowledge. Last but not least, the relationships between the innovating firm and its external venturing partners may affect third party's perceptions of the relative trustworthiness, organizational capabilities and performance of the innovating firm (Podolny, 2001). For instance, if the innovating firm has an external corporate venturing relationship with a firm having superior reputation and performance, other firms with complementary technologies will perceive the innovating firm as with great capability, competence and trustworthiness (Gulati, 1995; Nooteboom, 2000b). This, in turn, raises the odds for the innovating firm to explore new technological opportunities with firms with whom it had no venturing relationships before. In other words, external venturing partnerships may act as a 'prism' for other firms to evaluate the value of the innovating firm, which, in turn, affects the choice and success for the innovating firm to explore beyond its external corporate venturing network (Burt, 1992).

Combining these two types of explorative learning with the network of a firm's external corporate venturing partnerships creates the possibility to distinguish *two roles* for the latter in relation to explorative learning. First, increasing the number of external corporate venturing partnerships will directly increase a firm's technological exploration from these venturing partners. Second, even when an innovating firm is not relying on the technological capabilities of its partners to explore new technologies, the venturing partners may still have a role to play in facilitating the exploratory learning of the focal firm from other firms with whom it has no venturing relations. We know little about how a firm's exploratory learning from its venture partners (as one type of inter-firm relationship) may influence the exploratory learning from other social actors with whom the focal firm has no venturing relationships. In the following section, we investigate the different effects of external corporate venturing partnerships on ELP and ELN.

### *2.2 Corporate venturing and exploratory learning*

Corporate venturing has been recognized as a main source for firms to get access to external technology. Companies are increasingly using corporate venturing to gain technological knowledge beyond their boundaries. They have choices between different forms of corporate venturing. Each of these venturing relations has a specific governance mode offering the innovating company in this way a range of venturing relations with different levels of integration (Schildt *et al*., 2005). These venturing forms include corporate venture capital, non-equity alliances, equity alliances (including joint ventures), and mergers and acquisitions.

Corporate venturing investments (CVC) are usually flexible investments to get access to the knowledge of start-ups (Dushnitsky and Lenox, 2005). Investments in innovative start-ups may provide the corporation with and ensure a stake in novel technological opportunities. Non-equity alliances, including licensing, second-sourcing, distribution agreements and technology exchange agreements, refer to those technology agreements which do not involve an equity investment in the partner firm. Non-equity alliances are largely based on flexible contractual agreements. In contrast, equity alliances refer to those alliances that require either shared ownership, independent administrative, operational and incentive system (joint ventures), or one or more partners taking an equity stake in other partners' ownership (minority holdings) (Gulati and Singh, 1998). Both non-equity and equity alliances have been found to be positively related to firms' innovation performance because they enable firms to learn from their allied partners through various levels of cooperation (Stuart, 2000; Hagedoorn and Duysters 2002). Alliances that are established in order to search for new technologies from partners usually result in positive exploratory performance (Rothaermel, 2001; Rothaermel and Deeds, 2004). Finally, merger and acquisitions (M&As) allow the acquiring firm to get access to and absorb the knowledge from the acquired firms through ownership control. Prior research also found positive relationship between M&A and innovative performance (Ahuja and Katila, 2001; Keil, *et al.*, 2008; Vanhaverbeke et al., 2002).

Scholars have found empirical evidence that external venturing partnerships have a direct positive effect on exploratory learning from these partner firms (ELP) (Schildt *et al*., 2005; Keil, *et al.*, 2008; Van de Vrande *et al*., 2007). There are several reasons why we believe external venturing partnerships are also positively related to what we call explorative learning from non-partners (ELN). First, inter-firm networks are considered a potential source of learning (Levitt and March, 1988). Networks enable forums for discussion, direct attention to new practices, and facilitate the transmission of information (Beckman and Haunschild, 2002). With venturing relationships, a company can get connected to a much larger range of firms who are directly or indirectly connected with its venturing partners. This enlarged network of contacts serves as a conduit for technological information, which in turn may lead to the development of new technological capabilities (Davis, 1991). Hence, the possibilities of ELN increase when a firm has a large number of venturing relationships. Second, external corporate venturing partners may help the innovating firm to find novel technologies and to identify relevant and complementary knowledge with regard to its existing knowledge base (Burt, 1992; Nooteboom, 2000a). Finally, a firm with many external venturing partnerships could be considered as having a strong reputation and having control over strong innovation capabilities (Ibarra, 1993; Lin *et al*., 2007). External corporate venturing partnerships may signal to other firms the reputation and the technological capabilities of the innovating firm. External corporate venturing relations with prominent partners will facilitate the access to the technologies capabilities and expertise of other firms' with whom the innovating firm has no venturing relation. Hence, venturing partnerships might affect the success of the innovating firm to explore beyond the external corporate venturing relationships (Burt, 1992). Therefore, we expect that firms that are rich in external corporate venturing partnerships will be more likely to undertake ELP as well as ELN than those firms with few corporate venturing partnerships. Accordingly, we hypothesize

*Hypothesis 1a:* *The number of external corporate venturing relations is positively related to a firm's explorative learning from partners (ELP).*

*Hypothesis 1b:* *The number of external corporate venturing relations is positively related to a firm's explorative learning from non-partners (ELN).*

Although we expect a positive relationship between the external corporate venturing of an innovating firm and its exploratory learning, we might question whether the strength of this effect differs between the two types of exploration. First, external corporate venturing partnerships provide the innovating firm with direct connections and formalized relations with its partners. The exchange of knowledge between the innovating firm and its partners (ELP) is based on a certain level of reciprocity (Kachra and White, 2008) and regulated by a particular contractual agreement (Gulati, 1998). The contractual arrangements are instrumental in optimizing the technological cooperation and transfer of knowledge.

External corporate venturing partnerships also provide the innovating firm with some possibilities to get connected *indirectly* to other firms. Even if the innovating firm explores beyond the venturing partnerships via the connections of its venturing partners, the knowledge exchange between the innovating firm and other firms is not based on a contractual agreement as in the case for its external corporate venturing partnerships. Although external corporate venturing partnerships may enable an innovating firm to get connected indirectly to a much larger network of companies, these indirect relations, with are typical for ELN, are (by definition) not formalized by a contractual agreement. This in turn leads to a less controllable way to assimilate and integrate knowledge from these companies. Second, although a great number of external corporate venturing partners may increase the chance that novel and complementary technological knowledge beyond the venturing partnerships will be identified and effectively utilized by the innovating firm, this might not always be the case because the innovating firm has to rely on the network resources and technological capabilities of its venturing partners (Eisenhardt and Schoonhoven, 1996). A firm's corporate venturing partners vary in terms of their size, age, competitive position, product diversity, financial resources, etc. (Shan, 1990; Burgers *et al*., 1993) and their capabilities to facilitate the innovating firm to undertake ELN may differ as well. Finally, an innovating firm with many external venturing partnerships may be conceived by other firms as competitive in many industries and markets. Thus, firms, which have no venturing relationships with the innovating firm, may consider the former as a potential competitor and prevent their technologies from spilling over to the innovating focal firm (Schrader, 1991; Chang and Xu, 2008). In sum, we expect that the positive effect of external corporate venturing will be larger for ELP than for ELN. Accordingly, we hypothesize,

*Hypothesis 1c: The positive impact of the number of corporate venturing relations on ELP is stronger than on ELN.*

### *2.3 Governance modes of corporate venturing and exploratory learning*

External corporate ventures differ in terms of governances modes. This implies that innovating firms have the choice between different levels of hierarchical control and intensity of integration. Prior research on contract choices in corporate venturing has been influenced primarily by the transaction cost theory (Gulati, 1998). Two key dimensions of transaction cost economy are *assets specificity* and *uncertainty* (Williamson 1975, 1985). Assets specificity refers to the assets that are invested in a particular transaction and cannot be easily redeployed to another transaction. Uncertainty refers to the fact that relevant contingencies of a transaction are too unpredictable to be specified *ex ante* in a transaction (environmental uncertainty) or the performance of a transaction cannot easily be verified *ex post* (behavioral uncertainty). When firms deal with specific assets under uncertainty, they have to safeguard the transaction against partners' potential opportunistic behavior (Williamson 1985, 1991, 1996). In addition to safeguarding transaction hazards, relational risks such as *holds-up risks* and *spill-*

*over risks* (Nooteboom 2004a, 2004b) exist in various alliances relationships. Holds-up risks (lock-in/out) results from the interdependence of organizations and relational-specific investments. Spill-over risks (i.e. learning races) emerge as a consequence of the knowledge asymmetry between firms whose relationships are never exclusively cooperative or competitive (Nooteboom 2004a, 2004b, Gulati *et al.* 2000). The interactive nature of innovation and organizational learning requires appropriate governance to realize the potential of inter-organizational relationships and control the relational risks.

The different governance modes of external corporate venturing we introduced in this paper (CVC, equity and non-equity alliances and M&A) can be ranked according to the degree of integration between the partners. As noted by Powell and Brantley (1992), innovating firms collaborate with each other using different types of interorganizational contracting that fall between arms-length market transactions and vertical integration. Previous studies have argued that these modes of collaboration can be ranked along the continuum between arms-length transactions and a fully integrated solution (Gulati and Singh, 1998; Hagedoorn and Sadowski, 1999; Nielsen, 2000; Santoro and McGill, 2005; Villalonga and McGahan, 2005). In line with this idea of a continuum CVCs can be considered as the type of partnership that resemble most arms-length relationships among all these governance modes. M&As, on the contrary, requires a full integration between the acquirer and acquired firm (Schildt *et al.*, 2005; Van de Vrande et al., 2009). Alliances are positioned in the middle of the continuum. For non-equity alliances, coordination among partners is based on a contract. Members of the partners work jointly on behave of their own organization. Equity alliances represent a somewhat more integrated form of governance because of the equity investments of the partners. In the case of joint ventures there is a separate entity created by alliance partners. It requires not only specific equity investments, but also a tight coordination between alliance partners because a separate administrative, operational and incentive system needs to be established (Gulati and Singh, 1998). Empirical evidence shows that governance modes that appropriately aligned with the transaction requirements lead to enhanced performance (Geyskens *et al*., 2006). As exploration entails high levels of uncertainty, less integrated governance modes are more likely to be the appropriate for exploration (Schilt *et al*., 2005; Van de Vrande *et al*., 2009; Gilsing and Nooteboom 2006). However, the relationship between the integration levels of governance modes in external venturing on the one hand and a firm's *explorative learning from partners* (ELP) and *explorative learning from non-partners* (ELN) on the other hand, has received little attention in the literature.

The existing literature has argued that higher levels of integration in the governance modes of external corporate venturing are less likely to lead to explorative learning from partners because of the uncertain nature of the returns to this type of learning (compared to exploitative learning), and the uncertainty ex ante about the strategic importance and operational relatedness of the ventures (Schildt, *et al*., 2005; Van de Vrande, *et al*., 2006). In this case, innovating firms tends to form venturing partnerships using governance modes with low levels of commitment in order to remain flexible. In a similar vein, we argue that (low) high levels of integration in the governance modes of external corporate venturing may lead to (more) less explorative learning from non-partners. High levels of integration in governance modes entail more specific investments in the venturing relationships. This implies that the innovating firm has less flexibility to step out of existing venturing relationships. This flexibility might be necessary in the case of explorative learning from non-partners, because technological opportunities may change recurrently. As a result, an innovating firm can profit from loose ties with its partners, which it can easily establish or dissolve when new technological opportunities emerge: a changing portfolio of partners will inform a company about new technologies and market opportunities. When an innovating firm is tied to its partners through highly integrated venturing relations which are hard to reverse, it may not have the required flexibility to explore new opportunities as it is linked for a longer time to partners through strong ties (Gilsing and Nooteboom, 2006). Therefore, we expect that a firm having a corporate venturing portfolio with high levels of integration will be performing less well in explorative learning from non-partners. Accordingly, we hypothesize

*Hypothesis 2a: Lower levels of integration of the governance modes of external corporate venturing will increase a firm's performance on ELP and ELN.*

However, contrary to the arguments above, the theory of transaction cost economics (TCE) argues that exchange relationships between firms with high uncertainty will prefer highly integrated governance modes to control the transaction hazards and the risks of spillovers (Williamson 1975, 1991). Since exploratory learning between firms is highly uncertain in terms of returns, TCE predicts that exploration from partners requires hierarchical and integrative governance modes (Pisano, 1989, Van de Vrande, *et al*., 2006). There are also reasons to expect that not only ELP but also ELN may benefit from high levels of integration in the governance modes of venturing partnerships. Partners inform the innovating firm about opportunities beyond the corporate venturing network and the question is whether the governance mode has an impact on the richness and the quality of the information. In other words, is the information that is revealed through CVCs, alliances or M&As different? Is the innovating company informed in a different way through the different types of corporate venturing relations? And if so, how does the level of integration of these modes affect the information about opportunities beyond the corporate venturing network? Different governance modes provide the innovating firm with different types of information about technological opportunities because partners are different and they might focus on technologies in different stages of the technology life cycle. Integrated modes also offer more fine-grained information about the opportunities compared to less integrated modes. As a result, we argue that more integrated modes will lead to rich and adequate information between an innovating firm and its partners, which, in turn will inform the former more accurately about opportunities beyond the existing network. In this way the innovating firm can increase its explorative learning from non-partners. For these reasons, we formulate an alternative hypothesis to Hypothesis 2a:

*Hypothesis 2b: Higher levels of integration of the governance modes of external corporate venturing will increase a firm's performance on ELP and ELN.*

***2.4 Technological distance***

Another important factor that is likely to affect explorative learning from partners and non-partners is the *technological distance* between the focal firm and its venturing partners (Ahuja and Lampert, 2001; Nerkar and Roberts, 2004; Phene *et al*., 2006). Due to different experiences, technologies, markets and organizational histories, organizations have different foci, which yield the cognitive distance between organizations (Nooteboom, 1999, 2000a, 2004b). Technological distance reflects the technological dimension of the cognitive distance among firms. It provides firms with possibilities to explore novel combinations of technologies. Firms with large technological distance are more likely to get access to complementary information, resources and knowledge, which in turn will result in more exploration. However, firms also need sufficient organizational capabilities to digest novel knowledge and to develop it into marketable products or processes. At the firm level, this critical organizational capability has been recognized as *absorptive capacity* (Cohen and Levinthal, 1990). Absorptive capacity includes organizational capabilities to assimilate externally developed information, to internally distribute it, and implement knowledge in various activities. On the one hand, learning takes place where there are differences in knowledge. On the other hand, too large cognitive distance makes basic mutual understanding unachievable (Gilsing and Duysters, 2008). Many studies have found that though difference in knowledge base of innovation partners is a crucial condition leading to inter-organizational innovation (Nelson and Winter, 1982), it also has a negative effect on absorptive capacity because it creates learning problems resulting from the lack of basic mutual understanding between each other. For instance, Stuart (1998) argues that the most valuable alliances are those with similar knowledge foci and/or operating in similar markets, whereas distant firms are inhibited from cooperating effectively. Similarly, the diversification literature argues that firms learn most from alliance partners with related knowledge and skills (Tanriverdi and Venkatraman, 2005). These studies have revealed the importance of cooperation between firms with a minimum degree of similarity in their knowledge base in order to maintain sufficient absorptive capacity.

Given the possible positive effect of knowledge difference on novelty and the possible negative effect on firms' absorptive capacity, the combined effect of cognitive distance on innovation is expected to be a curvilinear function of innovation performance (Figure 1).

*Insert here Figure 1*

One can expect that in the case of ELP, innovating firms should hold a moderate level technological distance with their external corporate venturing partners because too small technological distance provides little novelty for learning and too large technological distance endangers the exploratory learning by diminishing the absorptive capacity of firms. Accordingly, we hypothesize

*Hypothesis 3: The technological distance between the innovating firm and its external corporate venturing partners has a curvilinear effect (inverted U-shape) on ELP.*

Technological distance between the innovating firm and its external corporate venturing partners can also have an effect on explorative learning from non-partners (ELN). The argumentation is however different from the one we developed for learning from partners (ELP). The central question here is how technological distance between the innovating firm and its corporate venturing partners plays a role in making the focal firm aware of interesting organizations beyond its own network with strong competencies in relevant or newly emerging technologies. How are corporate venturing partners instrumental in getting knowledgeable about these technological capabilities? Are partners at short or large technological distance more helpful in facilitating explorative learning from non-partners?

An innovating firm will avoid two extremes because they are not interesting in terms of explorative learning. First, a firm has sufficient absorptive capacity to detect, access and assimilate technology from non-allied organizations that are highly related to its own technology base. In this case, partners are simply redundant. Second, partners at large technological distance from the focal firm may not be helpful in providing information about organizations with a technology base that is at large technological distance from their own technological competencies and those of the focal firm. It is more promising when the partners are familiar with the technology of the focal firm or with that of the firm organizations whom the focal firm can learn from. If there is a relative large distance between a partner and the focal firm, the former can inform the latter about the technologies of organizations that are operating in the same or related technological fields as the partner. The focal firm will however experience problems in learning from its partner about this opportunity because it is not sufficiently experienced in the technology of the partner or its connections. In contrast, when the partner is working in similar technological areas it speaks has similar scientific and technological roots as the focal firm and, as a consequence, communication about technological opportunities outside the existing venturing network will be detailed and unbiased. Moreover, partners at relative short technological distances might also be active in markets that are supporting or adjacent to the focal firm's markets. Therefore, they can better evaluate technological opportunities and the commercial benefit the focal firm can reap from it. In addition, when partners are taking part in the same economic ecosystem of value creating system, they may have a greater incentive to spur the focal firm to get connected to organizations with strong technologies. In short, we argue that innovating firms can learn more easily from non-partners through partners that have a similar technology base as the focal firms. Accordingly, we hypothesize

*Hypothesis 4: The technological distance between the focal innovating firm and its external corporate venturing partners has a negative effect on ELN.*

## 3 Data, variables and method

### *3.1 Data and sample*

To test our hypotheses, we use a sample consisting of 153 firms that were active in the pharmaceutical industry between 1990 and 2000. The dataset was constructed in the following way. For each year of the observation period, the largest 200 companies in the industry were collected. The pharmaceutical industry consists of mainly two types of firms: generic drug companies and innovators. To distinguish between those, the selection was based on firms' prior patents in the pharmaceutical industry. That is, the selection was based on patents filed in the following patent classes 424, 435, 436, 514, 530, 536, 800, and 930[1] as defined by the USPTO (Rothaermel and Hess, 2007; Rothaermel and Thursby, 2007). Large organizations are more likely to engage in external technology sourcing activities and are more likely to report them publicly (Keil *et al.*, 2008). Prior research on alliances and acquisitions has for that reason also focused on the largest organizations in the industry (Ahuja, 2000; Gulati, 1995; Gulati and Garguilo, 1999; Hitt *et al.*, 1991, 1997; Keil *et al.*, 2008). After selecting the companies with patents in the relevant patent classes, research institutes and universities were removed from the sample. Next, the remaining sample was manually checked for parents and affiliates using Dun & Bradstreet's Who Owns Whom, which were then aggregated on the parent company level. After checking for duplicates, this leads to 153 independent companies to be included in the sample. We will refer to these independent companies as "focal firms", to distinguish them from their partners.

Next, we have gathered for these firms all the venture capital investments, technology alliances, minority holdings, joint ventures, and merger and acquisition activities during the period of 1985-2000, which allows us to calculate some of the independent variables using a five-year time lag.

[1] The description of the patent classes is as follows: 424: drug, bio-affecting and body treating compositions; 435: chemistry: molecular biology and microbiology; 436: chemistry: analytical and immunological testing; 514: drug, bio-affecting and body treating compositions; 530: chemistry: natural resins or derivatives; peptides or proteins; lignins or reaction products thereof; 536: organic compounds; 800: multicellular living organisms and unmodified parts thereof and related processes; 930: peptide or protein sequence.

Furthermore, we collected patent data and financial information. Corporate venture capital data was derived from the Thomson VentureXpert database. Data concerning alliances and joint ventures was obtained from the MERIT-CATI databank on Cooperative Agreements and Technology Indicators (Hagedoorn, 1993). We used Thomson ONE Banker to collect information regarding the companies' M&A activity. Both the collected alliances and corporate venture capital investments have a strong technology component, therefore, to make a consistent sample selection for all types of governance modes, we only included technological M&As in our sample, following the method by Ahuja and Katila (2001)[2].

Patent information was collected for all firms included in our sample using data from the US Patent and Trademark Office. Because the US Patent and Trademark Office grants patents both on subsidiary and on parent company level (Patel and Pavitt, 1997), and the organizational level on which patents are applied for differs between companies, we consolidated the patents on parent company level for each observation year, using *Who Owns Whom* by Dun & Bradstreet. In addition to that, we gathered financial data using *Worldscope*, including sales, research and development expenses and the number of employees.

### *3.2 Variables*

*Dependent variables*

We make a distinction between two types of dependent variables: explorative learning from partners (ELP) on the one hand and explorative learning from non-partners (ELN) on the other hand. We refer to Figure 2 to explain the distinction between both variables in detail. This figure illustrates how we can categorize different types of learning by tracking the backward citations of new patents of an innovating firm in a particular year. When companies build on prior technological knowledge, new patents must cite existing patents on which it builds. As a result, patent citations provide us with a unique and reliable instrument to define different types of exploration. This taxonomy is based on the assumption that when firms innovate, they usually build on existing technologies developed by their own or by other organizations (Nelson and Winter, 1982; Katila, 2002)[3].

---

2 The method employed in this paper is slightly different from the method by Ahuja and Katila (2001). Ahuja and Katila (2001) included also deals for which they found press releases indicating technology as a specific motivation for undertaking the M&A. Since we had no access to these press releases, we could only include deals in which the partner has applied for at least one patent in the 5 years prior to the acquisition.

3 We use patents and patent citations as a proxy for knowledge and knowledge flows. In line with the work of others (e.g., Ahuja & Katila, 2001; Almeida, 1996; Hoetker & Agarwal, 2007; Jaffe et al., 1993; Peri, 2005). Knowledge may flow between individuals and firms through a number of mechanisms including conferences, publications, professional social networks, reverse engineering in addition to patent reviews. Despite the various mechanisms for knowledge flow, knowledge and knowledge flows often leave their footprint in the form of patents (Jaffe, 1986). As a result, patents are an effective proxy for knowledge regardless of the

*Insert here Figure 2*

In some cases, firms invent completely new technologies not building on any prior art. These so called pioneering technologies have no technological antecedents and they represent the technologies that do not build on any existing technologies (Ahuja and Lampert, 2001). Pioneering technologies are interesting as they may have a disruptive effect on existing technologies, but they fall beyond the scope of this paper (Van de Vrande *et al*., 2006; Kleinschmidt and Cooper, 1991). We can further distinguish two different cases when a firm's new patent cites prior patents. On the one hand, a new patent can cite some of the firm's own patents. This implies that the new patent is built on the firm's prior expertise and experience and, as a result, the patent will have one or more self-citations. This type of patents is usually regarded as *exploitative* learning (Benner and Tushman, 2002; Rosenkopf and Nerkar, 2001; Schildt *et al*., 2005). By exploitation, firms deepen and refine their current technical capabilities that are most likely the important competencies underlying the current businesses of these firms. In other cases a firm can also successfully file new patents that do not cite any of its own prior art. When an innovating firm's new patents have no backward self-citations, the firm explores new technological areas and broadens its own technological capabilities by building on the knowledge from other organizations. Patents with no self-citations but citing patents from other firms are considered to be more explorative than those that also cite own prior technology. These patents are important to avoid problems related to a strong dependence on local search (March and Simon, 1958; Nelson and Winter, 1982; Helfat, 1994).

So far, we have only been summarizing some of the existing definitions of technological exploitation and exploration. This study contributes to the literature by further segmenting the exploratory patents into two subcategories. On the one hand, innovating firms may avoid local search by learning from their venturing partners. These venturing partners are connected to the innovating firm by various venturing relationships, including corporate venture capital, strategic alliances, joint ventures or M&As. A patent is categorized as an ELP-patent when there are no self-citations and when some backward citations refer to those organizations that have venturing relationships with the innovating firm during the last 5 years (Benner and Tushman, 2002; Schildt, *et al.*, 2005). On the contrary, a patent is categorized as an ELN-patent when there are no self-citations and when there are only

mechanism. The fact that examiners add citations to patent applications is not really a concern here. Independent examiners are involved in assessing the prior knowledge on which an innovation builds. One may criticize that these citations included by examiners do not reveal how a firm is building its technology on that of other companies. However, we feel comfortable that this is not a major issue for two reasons. First, as we mentioned already, learning is not necessarily based on explicit patent reviews. Second, in case we would consider those citations as random noise, then we can argue that if the empirical results in this paper reveal interesting relations, then they would be a priori hold in case we could eliminated the patent citations that the patent examiners added. Moreover, these extra citations lead to a better measure of the knowledge that an innovation actually builds upon.

backward citations referring to organizations with whom the innovating firm had no venturing relationships during the last 5 years. More specifically, we counted for every observation year t the number of times each technology-sourcing mode was established in the five years prior to the observation year (t-1 to t-5). This moving window approach is considered to be an appropriate timeframe during which the existing portfolio of external technology activities is likely to have an influence on the current technological performance of a firm (Kogut, 1988, 1989; Gulati, 1995).

Both dependent variables are count variables, indicating the number of new patent applications that fulfill r the requirements of an ELP or ELN-patent. *Explorative learning from partners* is calculated as the sum of patents successfully applied for per year by the focal firm[4], which have at least one citation to its partner's prior patents, but no citations to its own prior patents. *Explorative learning from non-partners*, on the other hand, is calculated as the number of patents successfully applied for per year by the focal firm which neither cites its own prior patents nor its partners' prior patents.

In our sample, there are 171,532 patents in total, of which 101,228 can be categorized as exploitative patents and 70,304 as exploratory patents; 15% of the exploratory patents cite partners' prior patents (ELP).

*Independent variables*

Hypotheses 1a, 1b, 1c, 2a and 2b predict a direct positive effect of CVC investments, non-equity alliances, equity alliances, M&As on ELP as well as on ELN. Therefore, for every observation year *t,* we counted the number of CVC investments, non-equity alliances, equity alliances and M&As respectively in the five years prior to the observation year (*t-1* to *t-5*). We took a five year moving window in line with the arguments developed above. This variables measure the effect of corporate venturing on the two types of explorative learning.

Technological distance is another independent variable. Technological distance refers to the (lack of) overlap between the knowledge base of the focal company and the knowledge base of the partnering firms. We use the method developed by Jaffe (1986) to calculate the technological proximity between two firms (*i* and *j*). Following this method, the technological proximity between two firms is computed as the uncentered correlation between their respective vectors of technological capital (measured as the cumulative patent applications in technology class k over the five years prior to the investment), $P_{ik}$ and $P_{jk}$ respectively:

---

[4] Successfully applied patents implies that these patents have been granted. However, we do not allocate a patent to the year it was granted, but prefer to allocate it in the year it was applied for because at that time the invention was already done.

$$T_{ij} = \frac{\sum_k P_{ik} P_{jk}}{\sqrt{\sum_k P_{ik}^2 \sum_k P_{jk}^2}}$$

The technological proximity ($T_{ij}$) measure takes a value between 0 and 1 according to their common technological interests. To calculate technological distance, this variable is transformed into a new one, which equals $1 - T_{ij}$.

*Control variables*

*Firm size*. Firms of different sizes innovate differently. In the classical Schumpeterian argument, companies' innovation performance increases more than proportionally with firm size because large firms simply having more resources to invest in R&D. Large firms usually have more external corporate venturing partnerships and are more centrally positioned in their venturing networks than small firms. They also have greater capacity to cooperate in multiple tasks, which is crucial for inter-organizational learning and absorptive capacity (e.g., Shan, 1990; Powell and Brantley, 1992). Prior research has found that large firms are more likely than small ones to undertake exploitative and exploratory learning at the same time whereas small firms can maximize innovative performance by adopting a focused approach on exploitation or exploration (Beckman et al. 2004, Stuart 2000; Lin *et al*., 2007). Approaching exploration in a different way, Almeida and Kogut (1997) suggest that smaller firms explore new technological opportunities that are ignored by larger ones. Small companies may be more likely to explore new technological areas with focused strategy in less crowded areas (Lin *et al*., 2007; Almeida and Kogut, 1997). A range of factors including financing, government, regulations, and the motives and goals of the entrepreneurs provide conditions for small firms that are more amenable to the exploration of new technology (Nooteboom, 1994; Acs and Audretsch, 1990). As a consequence small firms are better equipped to explore new technological areas.

These arguments, however, do not focus on the two types of explorative learning the current study focuses on. The argument related to the resource constraints does not provide a straightforward prediction. In line with the simultaneous development of exploitation and exploration, we could argue that large firms will be involved in both types of exploration at the same time because they have no resource constraints and it is much easier for them to allocate different activities at different units at various levels within an organization (Gupta *et al*., 2006). In this respect firms have to focus on one of the two types of explorations. However, if explorative learning from non-partners involves higher levels of uncertainty because the learning process in not embedded in manageable partnership relations, then we can argue in line with Almeida and Kogut (1997) that small firms will be relatively more inclined to explore from non-partners than from partners. We measure f*irm size* as the natural logarithm of sales of the innovating firms.

*R&D intensity*. Prior research has indicated a strong relationship between R&D inputs and innovation, and regarded R&D expenditures as a means to maintain absorptive capacity necessary to benefit from external technology sourcing (Cohen and Levinthal, 1990). Consequently, we include *R&D expenditures as a percentage of sales* as a control variable. The control variables *size* and *R&D intensity* are lagged by one year.

*Technological age*. Technological age is another firm-level control variable. To measure it, we first need to measure the technological newness of a firm's patent portfolio. Technological newness is operationalized in two steps (Van de Vrande et al., 2009). First, we determine the "age of all patent classes". This is calculated as the median of the age of all patents in a patent class in a particular year. The age of the patent is the time elapsed between the application year and the year of observation. To overcome outlier bias, we use the median age rather than the average to calculate the age. Second, to calculate the average technological age of a firm, we multiply the share of patent applications by the technology age for each patent class.  We control for the technological age of firms for the following reason: If a firm has a relevantly young portfolio of patents, it holds some technologies that are in the early phase of the life cycle. These technologies usually entail high technological uncertainty but also ample opportunities for technological exploration. As a result, we expect that technological age will be negatively related to both types of technological learning. However, there might also be a differential effect; Firms that are active in young technological areas may be inclined to learn from technologies of start-ups that are active in new technological areas. Since these firms are relatively new innovating firms cannot have developed (many) corporate venturing relations with them in the last 5 years.

Several types of dummy variables: The focal innovating firms are companies that are based in America, Europe, or Asian. Companies on different continents may have a different attitude towards explorative research due to the differences with respect to their cultural, and institutional background. Consequently, we use two dummy variables to control for the *geographic location of the focal firms*. (The firms based in America are set as default). We also introduced *dummy variable for industries*. Because the sample consists of firms in both pharmaceutical and chemical industries, we use one dummy variable to control for differences in explorative research between the two industries. Finally, we included dummy variables to control for the unobserved effects of time in each consecutive year.

### *3.3 Method*

The dependent variables, explorative learning from partners and non-partners, are count variables. A Poisson regression approach provides a natural baseline model for such data (Hausman *et al*., 1984; Henderson and Cockburn, 1996; Long and Freese, 2003). However, Poisson regressions assume that the mean and variance of the event count are equal. This assumption is likely to be violated since overdispersion usually occurs in patents. Because our data shows significant evidence of overdispersion (i.e. the variance exceeds the mean), a negative binomial regression model is more appropriate (Cameron and Trivedi, 1998). The negative binomial model for panel data is estimated using the XTNBREG command in STATA.

To determine whether a random- or fixed-effects model is more appropriate approach for the analysis, we further conducted a Hausman specification test (1978) upon the baseline model. The Hausman test was not significant, indicating that it is appropriate to use a random-effects model as an alternative for the fixed-effects model. Since random-effects model do not control for time-invariant variables (i.e., variables that differ between cases but remain constant over time), we used dummy variables to control for unobserved effects of industry and geographic regions.

### *3.4 Results*

The descriptive statistics and correlations between the variables for the 898 firm-year observations in the sample are presented in Table 1. The correlation between equity alliances and non-equity alliances is high (with a coefficient of 0.7145), which may cause multicollinearity problems. For this reason, we did not run the full model including all the different governance modes along with the control variables. Instead, we ran several models that include only one single governance mode in order to examine the effects of each type of governance mode on the two types of explorative learning separately. Next, we estimated two proxies of the full model. The first one includes CVC, equity alliances and M&As, and the second one model contains CVC, non-equity alliances and M&As, besides the control variables (see Table 2, Models 6, 7, 13 and 14; Table 3, Models 20 and 21). In this way, equity alliance and non-equity alliances are not included simultaneously in a single model.

*Insert here Tables 1 and 2*

Table 2 presents the results of the regression analysis using random-effects negative binomial estimations of the two types of exploration. The dependent variable in Models 1 to 7 is *explorative learning from partners* (ELP). The results for explorative learning from non-partners (ELN) are represented in Models 8 to 14. The baseline models (respectively Models 1 and 8) include the linear effects of the control variables. Hypotheses 1a and 1b predict that the number of corporate venturing relationships, including CVC, non-equity alliances, equity alliances, and M&A, are positively associated with both types of explorative learning. In Table 2, Models 2 through 5 show that all types of the governance modes are positively related to explorative learning from partners (the coefficients are significant at various levels). Models 9 through 12 reveal that all types of the governance modes have a positive effect on explorative learning from non-partners. The only exception is equity alliances (Model 10). As a result, we found strong support for Hypotheses 1a and 1b (except for the effect of equity alliances on ELN). This implies that an innovating firm can not only improve its technological exploration by tapping into its external venturing partners' – CVC, non-equity and equity alliances and acquisitions – technology sources but it can also use its contacts with its external venturing partnerships to explore new technologies from other firms with whom it has no prior venturing relationship. These findings support our claim that innovation partners play a *dual role* in technological exploration.

Hypothesis 1c predicts that the positive effect of the number of corporate venturing relations on explorative learning from partners (ELP) is stronger than the effect of the number of corporate venturing relations on explorative learning from non-partners (ELN). We find that the coefficients of each governance mode in the models explaining ELP are larger than the corresponding ones in the models for ELN. Hence, we find empirical support for Hypothesis 1c. This finding implies that the positive effect of external venturing partnerships on explorative learning from partners is stronger compared to the learning from non-partners. The stronger effect on ELP can be explained through the contractual arrangements and the management of the formal agreement(s) between the partners: the innovating firm has the possibility to control and monitor the innovation process by means of the formal agreements with its partners. Choosing the right governance mode and managing the partnership in an appropriate way helps a firm to improve its explorative learning. In the case of ELN partners are channels through which an innovating firm can detect other organizations with interesting technologies. The fact that partners enhance the innovating firm's ability to detect new or relevant technologies in other organizations is a side effect of the formal agreements with their partners. The innovating firm cannot force its partners to reveal their knowledge about technologies developed by companies that are not partners of the former. Rather, companies learn about these opportunities beyond the existing network through informal contacts, trust building and socialization with their venturing partners (Nooteboom, 1996, 2002). As a result, it is not surprising that the effect of venturing relations on ELP is stronger than their effect on ELN.

Hypotheses 2a and 2b predict the relationship between levels of integration in the governance modes of external corporate venturing and explorative learning with partners and non-partners from two seemingly conflicting perspectives. To test these two hypotheses, we included different types of governance modes into the semi-full models of Table 3. In Models 6 (for ELP) and 13 (for ELN), CVCs, equity alliances and M&As are included. Alternatively, in Model 7 (for ELP) and 14 (for ELN), we inserted CVCs, non-equity alliances and M&As. The results in Models 6 and 7 show that more integrated governance modes have a stronger positive impact on ELP. The results in Models 13 and 14 also confirm that more integrated the governance modes have a stronger positive effect on ELN (except for equity alliances in Model 13, $\beta$= -0,001, $p$>0.1). However, the effect is not as pronounced as the results in Model 7 for ELP. In sum, based on the results in Models 6, 7, 13 and 14, it is safe to conclude that M&As have a stronger effect on both types of explorative learning than alliances, and alliances are in turn more appropriate for ELP and ELN than CVC. In other words, we found support in favor of the traditional governance perspective, which argues that the risky and uncertain nature of exploration requires more integrated governance modes. Innovating firms need some specific investment to develop mutual understanding, to cross-cognitive distance (Nooteboom, 1999). Hence, we find empirical support for Hypothesis 2b.

Hypothesis 3 predicts that the technological distance between the focal innovating firm and its external corporate venturing partners has a curvilinear effect (inverted U-shape) on ELP. To test this hypothesis, we introduced a linear and a squared term of technological distance into the models. Table 3 represents the results of the regression analysis using random-effects negative binomial estimations of ELP. First, Model 15 – which is comparable with Model 1 in Table 2 - includes all the control variables, technological distance and its squared term, without the governance modes variables. In Models 15 to 21, the coefficients of the linear term of technological distance are positive and those of the squared term negative. The impact is always highly significant ($p<0.01$). These results support Hypothesis 3. They confirm the results of prior studies on the role of technological distance on innovation (Nooteboom *et al*., 2007; Van de Vrande, 2007). More interestingly, when the squared term of technological distance is added into the models explaining ELP in Table 3, the coefficients of governance modes in Model 16 till 19 are positive and significant (except for equity alliances). Moreover, in Models 20 and 21, where we include several external venturing modes simultaneously, the results are similar to the ones in the corresponding models of Table 2 (Models 6 and 7). Hence, the results shown in Table 4 further confirm the empirical support for Hypothesis 1a, 1b and 2b.

*Insert here Table 3*

Hypothesis 4 predicts that the technological distance between the innovating firm and its external corporate venturing partners has negative effect on ELN[5]. In Table 2, the Models 8 till 14 show that technological distance has a negative effect on explorative learning from non-partners. This implies that firms that establish ties with large average technological distance with its venturing partners are less successful in learning from non-partners. Hence, the results clearly support Hypothesis 4.

To summarize, the results of the empirical analysis support Hypothesis 1a, 1b, 2b, 3 and 4. The empirical support for these hypotheses leads to the following conclusions. First, corporate venturing, including CVC, non-equity alliances, equity alliances, and M&A, leads to more explorative learning from partners as well as from non-partners. However, the positive effect of external venturing partnerships on learning from non-partners is less pronounced comparing to their effects on learning from partners (ELP). Secondly, the argument that the risky and uncertain nature of exploration

[5] We ran some regressions explaining explorative learning from non-partners including the squared term of technological distance. The coefficients were not statistically significant.

requires integrated governance modes is supported by the fact that more integrated modes of external technology venturing than less integrated ones: M&As are more appropriate for both types of explorative learning than alliances and alliances are in turn more effective than CVCs. Finally, technological distance between the focal innovating firm and its external corporate venturing partners has an inverted U-shaped effect on explorative learning from partners while there is a negative effect of this variable on explorative learning from non-partners.

Finally, it is also interesting to have a look at several control variables in Tables 2 and 3. Firm size has a positive and significant effect in all models for ELP as well as for EBP. Recall that firm size is measured as the natural logarithm of sales so that the coefficient in a negative binomial regression model can be considered as elasticity. The fact that the coefficients of firm size consistently are positive but less than one ($\beta < 1$) implies that smaller firms are relatively more innovative than larger firms in both types of explorative search. This is consistent with previous research findings (Acs and Audretsch, 1990).

Next, the coefficients of R&D intensity are positive and significant in all models for both types of explorative learning (except for Model 7 in Table 2 and Models 20 and 21 in Table 3), which suggests that R&D investments facilitate firms' explorative search. While the coefficients of firm size are more or less comparable in size for ELP and ELN, those of R&D intensity are substantially larger for ELP compared to ELN. The stronger relation between R&D investments and ELP is not surprising. When firms establish partnerships, explorative learning from the partners will most likely increase when the partnering firms are investing more in collaborative research. In the case of explorative learning from non-partners more R&D investments do not necessarily facilitate learning from companies that are no innovation partners of the focal company. to manage the outcome as there is no formal agreement. If firms invest for instance more in their scouting of new technologies they may find relevant innovations and ideas that can foster ELN. However, the relationship between R&D investments and ELN will be weaker compared to the case where a company invests in a particular corporate venturing relation with one of its innovation partners.

## 4. Discussion and conclusion

This study investigates the dual role of external corporate venturing, including corporate venture capital (CVC), alliances and mergers and acquisitions (M&A), on two different types of exploratory learning – exploration from partners (ELP) and exploration from non-partners (ELN). They represent two different types of innovation strategies that tackle the problem of local search in a different way. On the one hand, innovating firms may avoid local search by learning from their corporate venturing partners. In this case, the knowledge within the venturing partners is the main reason why the focal firm sets up a relationship with them. They may own complementary technologies, be technological leaders in emerging technologies, co-create highly explorative research in new research areas, etc… As a result, the venturing relations can be considered as 'pipes' through which information and knowledge flows between the innovating firm and its partners.

On the other hand, companies can avoid local search by exploring technologies developed in organizations with whom they had no prior external corporate venturing relationships. The extant literature has studied the role of external venturing partnerships on explorative learning from partners in detail, but it has to a large extent overlooked the role of technology partners in learning from other companies with whom the innovating company has no prior venturing connections. We argued that external corporate venturing partnerships not only give the innovating firm access to the technology and know-how of its partners, but they also facilitate the exploration of the innovating firm in technological areas in which neither this focal firm nor its partners have expertise. In this way, venturing partners might be considered as 'prisms', acting as reference systems to identify the location, usefulness, relevance and complementarity of other technology sources. Similarly, the innovation firm can profit from its relations with different venturing partners as they may increase its reputation in the eyes of third parties (Podolny, 2001; Zuckerman, 1999, 2000; Stuart et al, 1999).

The empirical results of this study provide support for the idea that external corporate venturing partners not only give the focal firm access to the technological capabilities of its partners, but they are also instrumental in the focal firm's search to explore technologies beyond the current network of partners. In the first case (ELP), the expertise of the partners is determining the explorative learning of the focal firm. In the last case (ELN), it is the reputation of the firm's partners and their knowledge about who they know, that leads to better innovative performance. This confirms the dual role of external corporate venturing partnerships.

Next, we found that the positive effect of external venturing partnerships on explorative learning from non-partners is less pronounced than the one on learning from partners. This outcome is not surprising since exploratory learning from partners is based on direct information flows between the firms and its partners and they can shape their governance of their relationship in order to maximize the explorative learning. Partners help the focal firms also to explore beyond the scope of the venturing partner network. The risks associated with this type of learning cannot be directly controlled by the governance mechanisms of the venturing relationships. Furthermore, we found that the risky and uncertain nature of explorative learning requires highly integrated governance modes. In other words, M&As are more appropriate for ELP and ELN than alliances both types of explorative learning, and alliances are, in turn, more appropriate than CVC. Finally, the increase of technological distance between the focal innovating firm and its external corporate venturing partners from a low to moderate level will enhance learning from partners ELP, while the increase from a moderate to excessively high level will on the contrary hinder it. Our findings also suggest that the increase of technological distance between the focal innovating firm and its venturing partners is associated with a decrease of ELN, which implies that specific investments in the venturing relationships and maintaining sufficient technological proximity are important to absorb other types of external knowledge sources.

This study contributes to the innovation management literature in several ways. First, we refine the concept of exploration: we explicitly distinguished between explorative learning based on the knowledge of partners and non-partners To overcome the local search of exploiting its own internal knowledge, a firm can source new knowledge from its venturing partners. Firms can of course also source from other organizations with whom they have had no venturing relations. We explored how venture partners play a dual role in these two types of explorative learning. In explorative learning from partners, the technological capabilities of the venture partners are a major driven to reach out. In contrast, partners are also instrumental when an innovating firm is searching for new knowledge sources beyond the venturing partner network. In this case, partners help the innovating firm to get acquainted to new technological areas by connecting it to organizations that are active in these fields. Hence, partners exchange and co-create knowledge with the focal firm through venturing relationships but they also help it in reaching out to organizations with other technologies. Second, the positive effect of the network of external corporate venturing partners on is stronger on learning from partners compared to learning from non-partners. In explorative learning from partners the venturing relationships are conduits of knowledge and the governance of these relations enables the partners to optimize the learning process. In learning from non-partners, in contrast, partners help to reach out the focal firm to new technologies. This is a rather indirect side effect of having a network of partners. As a result, learning from non-partners is more risky and uncertain in terms of return. Third, we also explored the relationship between the level of integration of the venturing governance modes and the two types of explorative learning. We found that highly integrated modes are improving both types of exploration. Finally, we analyzed how technological distance has an impact on the two types of exploratory learning. The results indicate that learning from partners is maximized for intermediate technological distances. This result is in line with earlier findings (Nooteboom, 2000a; Nooteboom et al. 2007). In contrast, learning from non-partners requires that the average technological distance between the focal firm and its partners is relatively small. That implies that partners with strongly overlapping technological profiles are more interesting as referrals. They are more efficient in helping the firm to reach out to new technological areas. Further research should investigate whether this is because communication is easier when partners have similar technological backgrounds or whether they can be more informative about technological and business opportunities for the focal firm because.

This study also provides researchers with some new ideas for future research about organizational boundary spanning exploration. The first interesting issue is whether there are complementarities or tradeoffs between the two types of explorative learning. Tradeoffs might be induced by budget restrictions and inertia through path dependent learning. The two types of explorative learning may also be complementary because management might eventually benefit from strategically balancing different types of exploration. From a resource-based view, resource allocation is a strategic choice when available resources in a firm are limited. Resource allocation process usually needs budgeting, which inevitably involves explicit rankings and comparisons. Some projects are deemed more important than others and are awarded a larger share of available funds and management attention (Simons, 2006). Suppose a firm intends to enhance innovative performance by exploring new technology opportunities from external sources, top management might downplay learning from non-partners in favor of exploration from venturing partners because of budget restrictions.. In other words, different projects, even if they are for the same goal of learning, compete for resources and management attention. Tradeoffs may be also induced through organizational inertia. The outcome of a prior strategic action will reinforce and shape new choices according to the organizational learning literature (Levitt and March, 1988). Choices that lead to positive outcomes are reinforced, while the choices that lead to negative outcome will be avoided. Due to this path dependence in decision making, we propose that firms that gain positive experience in explorative learning from partners will continue to invest in the-is type of learning and pay less attention to learning from non partners, and vice versa. Finally, the two types of exploration might also be complements. As firms have to balance exploitation and exploration (March, 1991; Lin et al. 2007), they may eventually also benefit from balancing two types of exploration. Their focus and objectives are different and they jointly leverage external venture relationships, increasing in this way the effectiveness of their innovation process.

Other opportunities may be related to the operationalization of the two types of exploration. We have been using both concepts in an exclusive way. Once a patent cites prior patents of partners it is considered as learning from partners, irrespective of the number of citations to non-partners. In this way, the analysis can be improved by developing more sophisticated, continuous variables that range between 100% partner citations and 100% non-partner citations. Our current study on exploration can be easily extended to exploration to both organizational and technological boundary spanning (Rosenkopf and Nerkar, 2003). We only focused on exploration as an organizational boundary spanning activity. Including technological boundary-spanning as another dimension will certainly enrich the analysis. Finally, extending the types of relationships between partners (e.g. licensing, arm's length R&D-contracting, patent search, informal / personal contacts, etc.) may of course also help in getting a clearer picture how external sources of knowledge enhance firms' explorative learning. In a similar vein, one can introduce partners' partners and check whether the "non-partners" are indirectly linked to the focal firm or not. As shown in the alliance literature (Ahuja, 2000), a firm's partners' partners may also be an important source of external knowledge

This study also has several managerial implications. First, managers that want to encourage explorative learning should establish external venturing relations for two reasons. Partners can be interesting because of their technology base, but partners are also helpful in looking beyond the network of partners extending a firm's explorative learning into technologies in which both the firm and its partners have not prior expertise. This dual role of partners in explorative learning is not well understood, as firms establish partnerships mainly to learn directly from their partners. Managers should take into account that in establishing relations with partners, they will get informed about technologies, business opportunities, and organizations that might be interesting for a firm's explorative learning. Partners with a similar technology portfolio and with whom a firm has strong ties are in that respect more interesting than partners that have a complete different technology base or who are linking through weak ties. We hope our attempt in this study to analyze the dual role of partners explorative learning may provide new insights for the literature on inter-organizational learning in general and for technological exploration in particular.

## Reference:


Acs, Z.J., Audretsch, D.B., (1990). *Innovation and Small Firms*. MIT Press, Cambridge, MA.

Ahuja, G. (2000). Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study. *Administrative Science Quarterly,* 45(3) :425-455

Ahuja, G. and Lampert, C. M. (2001). Entrepreneurship in the large corporation: A longitudinal study of how established firms creates breakthrough inventions. *Strategic Management Journal,* 22: 521-543.

Ahuja, G and Katila, R. (2001). Technological acquisition and the innovation performance of acquiring firms: A longitudinal study. *Strategic Management Journal*, 22:197-220.

Almeida, P. 1996. Knowledge sourcing by foreign multinationals: Patent citation analysis in the U.S. semiconductor industry. *Strategic Management Journal*, 17: 155-165.

Almeida, P. and Kogut, B. (1997). The Exploration of Technological Diversity and the Geographic Localization of Innovation. *Small Business Economics*, 9, 21-31.

Beckman, C. M. and Haunschild, P. R. (2002). Network Learning: The Effects of Partners' Heterogeneity of Experience on Corporate Acquisitions. *Administrative Science Quarterly*, 42(1): 92-124.

Beckman, C. M., Haunschild, P. R. and Philips, D. J. (2004). Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection. *Organization Science*, 15:259-275.

Benner, M. J. and Tushman, M. L. (2002). Process management and technological innovation: A longitudinal study of the photography and paint industries. *Administrative Science Quarterly,* 47: 676-706.

Burgers, W. P., C. W. L. Hill and W. C. Kim (1993). A theory of global strategic alliances: The case of the global auto industry. *Strategic Management Journal,* 14(6):419–432.

Burt, R. S. (1992). *Structure Holes: The Social Structure of Competition*. Harvard University Press, Cambridge, MA.

Cameron, A. C. And Trivedi, P. K. (1998). *Regression Analysis of Count Data*. Econometric Society Monograph No.30, Cambrigde University Press.

Chang, S. J. and Xu, D. (2008). Spillovers and competition among foreign and local firms in China. *Strategic Management Journal*, 29:495-518.

Chesbrough, H.W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, Boston: MA.

Chesbrough, H.W. (2006). *Open innovation Business Models; How to thrive in the new innovation landscape.* Harvard Business School Press, Boston: MA.

Cohen, M. D. and Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly,* 35, 128 - 52.

Davis, G. F. (1991). Agents without principles? The spread of the poison pill through the intercorporate network. *Administrative science Quarterly*, 36:583-613.

Dosi, G. (1988). Sources, procedures, and microeconomic effects of innovation. *Journal of Economic Literature*, 26, 1120-1171.

Dushnitsky, G. and Lenox, M.J. (2005). When do incumbents learn from entrepreneurial ventures? Corporate venture capital and investing firm innovation rates. *Research Policy*, 34:615-639.

Eisenhardt, K. and C. B. Schoonhoven (1996). Resource-based view of strategic alliance formation: Strategic and social effects in entrepreneurial firms, *Organization Science,* **7**(2):136–150.

Geyskens, I., Steenkamp J.E.M. and Kumar N. (2006). Make, buy, or ally: A transaction cost theory meta-analysis. *Academy of Management Journal*, 49(3): 519–543.

Gilsing, V. A. and Duysters, G. M. (2008). Understanding novelty creation in exploration networks—structural and relational embeddedness jointly considered. *Technovation*, 28, 693-708.

Gilsing, V. and Nooteboom, B. (2006). Exploration and exploitation in innovation systems: The case of pharmaceutical biotechnology. *Research Policy*, 35 (1):1-23.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, 91(3): 481-510.

Gulati, R. (1995). Social Structure and Alliance Formation Patterns: A longitudinal Analysis. *Administrative Science Quarterly*. 40:619-652.

Gulati. R. (1998). Alliances and networks. *Strategic Management Journal*. 19(4): 293-317.

Gulati, R. and Garguilo, M. (1999). Where do interorganizational networks come from? *American Journal of Sociology*, 104:1439-1493.

Gulati, R., Nohria, N., and Zaheer, A. (2000). Strategic networks. *Strategic Management Journal*. 21:203-215.

Gulati, R. and Singh, H. (1998). The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. *Administrative Science Quarterly.* 4: 781-814.

Gupta, A. K., Smith, K. G. and Shalley, C. E. (2006). The interplay between exploration and exploitation. *Academy of Management Journal*, 49 (4): 693-706.

Hagedoorn, J. (1993). Understanding the rationale of strategic technology partnering inter-organizational modes of cooperation and sectoral difference. *Strategic Management Journal*, 14: 371-385.

Hagedoorn, J. and Duysters, G. (2002). Learning in dynamic inter-firm networks: The efficacy of multiple contacts. *Organization Studies,* 23(4): 525-548.

Hagedoorn, J., Sadowski, B., 1999. The Transition from Strategic Technology Alliances to Mergers and Acquisitions: An Exploratory Study. *Journal of Management Studies,* 36(1), 87-107.

Håkansson, H. (1982). *International Marketing and Purchasing of Industrial Goods: An Interaction Approach*, John Wiley & Sons: New York.

Hausman, J. (1978). Specification tests in econometrics. *Econometrica*, 46: 1251–71.

Hausman J., Hall, B. and Griliches, Z. (1984). Econometric models for count data with an application to the patents-R&D relationship. *Econometrica.* 52: 909-938.

Helfat C.E. 1994. Evolutionary trajectories in petroleum firm R&D. *Management Science,* **40**(12): 1720–1747.

Henderson, R. M. and Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly,* 35: 9-30.

Henderson, R. M., and Cockburn, I. (1996). Scale, Scope and Spillovers: The Determinants of Research Productivity in the Pharmaceutical Industry. *Rand Journal of Economics,* 26: 32-59.

Hitt, M. A., Hoskisson, R. E. Ireland, R. D. and Harrison, J. S. (1991). Effects of acquisitions on R&D inputs and outputs. *Academy of Management Journal*, 34:693-706.

Hitt, M. A., Hoskisson, R. E. and H. Kim (1997). International diversification: Effects on innovation and firm performance in product-diversified firms. *Academy of Management Journal*, 40(4), 767-798.

Hoetker, G., & Agarwal, R. 2007. Death hurts, but it isn't fatal: The postexit diffusion of knowledge created by innovative companies. *Academy of Management Journal*, 50(2), 446-467.

Howells, J. (2006). Intermediation and the role of intermediaries in innovation. *Research Policy*, 35(5): 715-728.

Hunt, S. D. and R. M. Morgan. (1997). Resource advantage theory: a general theory of competition? *Journal of Marketing*, 61(3): 74-82.

Ibarra, H. (1993). Network centrality, power, and innovation involvement: Determinants of tehnical and administrative roles. *Academy of Management Journal*, 36:471-501.

Jaffe, A. B. (1986). Technological opportunity and spillovers of R&D: Evidence from firms' patents, profits and market value. *American Economic Review*, 76: 984-1001.

Jaffe, A. B., Trajtenberg, M. & Henderson, R. M. (1993). Geographic localization of knowledge spillovers as evidenced by patent data. *Quarterly Journal of Economics*, 108: 577-598

Kachra, A. and White, R.E. (2008). Know-how transfer: The role of social, economic/competitive, and firm boundary factors. *Strategic Management Journal*, 29:425-445.

Katila, R. (2002). New product search over time: Past ideas in there prime? *Academy of Management Journal*, 45(5): 995-1010.

Katila, R. and Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45(6): 1183-1194.

Keil, T., M. Maula, H. Schildt, and S.A. Zahra (2008). The effect of governance modes and relatedness of external business development activities on innovation performance. *Strategic Management Journal*, 29(8): 895–907.

Kleinschmidt, E.J. and Cooper, R.G. (1991). The impact of product innovativeness on performance. *Journal of Product Innovation Management*, 8:240-251.

Kogut B. 1988. A study of the life cycle of joint ventures. In: Contractor, F., Lorange, P. (Eds.), *Cooperative Strategies in International Business*. Lexington Books, Lexington, MA, pp. 169–186.

Kogut B. 1989. The stability of joint ventures: reciprocity and competitive rivalry. *Journal of Industrial Economics,* 38, 183–198.

Kogut, B. and Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science,* 3(3): 383-397.

Lavie, D. and Ronsenkopf, L. (2006). Balancing Exploration and Exploitation Alliance Formation. *Academy of Management Journal,* 49(4): 797-818.

Leonard-Barton D. 1992. Core capabilities and core rigidities: a paradox in managing new product development. *Strategic Management Journal*, Summer Special Issue 13: 111–126.

Leonard-Barton D. 1995. *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*. Harvard Business School Press: Boston, MA.

Levinthal D.A., March JG. 1993. The myopia of learning. *Strategic Management Journal*, Winter Special Issue 14: 95–112.

Levitt, B. and March, J. M. (1988). Organizational Learning, *Annual Review of Sociology*, 14: 319-338.

Lin, Z., Yang, H. B. and Demirkan, I. (2007). The performance consequences of ambidexterity in strategic alliance formations: Empirical investigation and computational theorizing. *Management Science*, 53 (10):1645-1658.

Long, J. S. and Freese, J. (2003). *Regression Models for Categorical Dependent Variables Using Stata.* Stata Press. College Station, TX.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science,* 2(1): 71-87.

March J.G. and Simon H. 1958. *Organizations*. Wiley: New York.

McMillan, G.S., Narin, F. and Deeds, D. L. (2000). An analysis of the critical role of public science in innovation: the case of biotechnology. Research Policy, 29(1):1-8.

Meyer, K. E. (2004). Perspectives on multinational enterprises in emerging economies. *Journal of International Business Studies*, 35:259-276.

Nelson, R. and Winter, S. (1982). *An Evolutionary Theory of Economic Change*. Harvard University Press. Cambridge, MA.

Nerkar, A. (2003). Old is gold? The value of temporal exploration in the creation of new knowledge. *Management Science*, 49(2): 211-229.

Nerkar, A. and Roberts, P. W. (2004). Technological and product-market experience and the success of new product introductions in the pharmaceutical industry. *Strategic Management Journal*, 25:779-799.

Nielsen, B.B., 2000. *Synergies in Strategic Alliances: Motivation and Outcomes of Complementary and Synergistic Knowledge Networks*. Working Paper 4-2000, Copenhagen Business School, Department of International Economics and Management.

Nooteboom, B. (1994). Innovation and Diffusion in Small Firms: Theory and Evidence, *Small Business Economics.* 6(5), 327–348.

Nooteboom, B. (1996), Trust, opportunism and governance: A process and control model, *Organization Studies*, 17/6: 985-1010.

Nooteboom, B. (1999). *Inter-Firm Alliances: Analysis and Design*. Routledge, London.

Nooteboom, B. (2000a). *Learning and Innovation in Organizations and Economies*, New York: Oxford University Press.

Nooteboom, B. (2000b). Institutions and Forms of Co-ordination in Innovation Systems. *Organization Studies*. 21(5): 915-939.

Nooteboom, B. (2002). *Trust: forms, foundations, functions, failures and figures*, Edgar Elgar: Cheltenham UK.

Nooteboom, B. (2004a). Competence and governance: How can they be combined? *Cambridge Journal of Economics*, Vol. 28 (4): pp. 505-526.

Nooteboom, B. (2004b). *Inter-firm Collaboration, Learning and Networks: An Integrated Approach.* London: Routledge.

Nooteboom, B., Vanhaverbeke, W., Gilsing, V., Duysters, G. and Van den Oord, A. (2007). Optimal cognitive distance and absorptive capacity, *Research Policy*, 36: 1016–1034.

Patel, P. and Pavitt, K. (1997). The techonological competencies of the world's largest firms: Complex and path-dependent, but not much variety. *Research Policy*, 26:141-156.

Peri, G. (2005). Determinants of knowledge flows and their effects on innovation. *Review of Economics and Statistics*, 87(2), 308-322.

Phene, A., Fladmoe-Lindquist, K. and Marsh, L. (2006). Breakthrough innovations in the U.S. biotechnology industry: the effects of technological space and geographic origin. *Strategic Management Journal*, 27 (4):369-388.

Pisano, G. (1989) The R&D boundaries of the firm: an empirical analysis. *Administrative Science Quarterly*, 35(1): 109–126.

Podolny, J. M. . (2001) Networks as the Pipes and Prisms of the Market. *American Journal of Sociology* 107(1): 33-60.

Powell, W. W. and Brantley, P. (1992). Competitive Cooperation in Biotechnology: Learning through Networks. In N. Nohria and R. G. Eccles (Eds.), *Networks and Organization*, Cambridge, MA: Harvard Business School Press.

Puranam, P. and Srikanth, K. (2007). What they know vs. what they do: how acquirers leverage technology acquisitions. *Strategic Management Journal*, 28: 805–825.

Rigby and Zook (2002). Open market innovation, *Harvard Business Review*, Oct 2002, 80-89

Rosenkopf, L. and Nerkar, A. (2001). Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal,* 22: 287-306.

Rothaermel, F. (2001). Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal*, 22: 687-699.

Rothaermel, F. T. and Deeds, D. L. (2004). Exploration and Exploitation Alliances in Biotechnology: A System of New Product Development. Strategic Management Journal, 25(3): 201-222.

Rothaermel, F. and Hess A. M. (2007). Building Dynamic Capabilities: Innovation Driven by Individual-, Firm-, and Network-Level Effects. *Organization Science*, 18(6): 898-921.

Rothaermel, F. and Thursby M. (2007). The nanotech versus the biotech revolution: Sources of productivity in incumbent firm research. *Research Policy,* 36(6): 832-849.

Santoro, M.D., McGill, J.P., 2005. The Effect of Uncertainty and Asset Co-specialization on Governance in Biotechnology Alliances. *Strategic Management Journal*, 26, 1261-1269.

Schildt, H.A., Maula, M.V.J. and Keil, T. (2005). Explorative and exploitative learning from external corporate ventures. *Entrepreneurship Theory and Practice*, 29(4): 493-515.

Schrader, S. (1991). Informal technology transfer between firms: Cooperation through information trading. *Research Policy*, 20:153-170.

Schumpeter, J. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press.

Shan, W. (1990). An Empirical Analysis of Organizational Strategies by Entrepreneurial High-technology Firms. *Strategic Management Journal*, 11, 129-139.

Sidhu, J. S., Volberda, H. W. and Commandeur, H. R. (2004). Exploring Exploration Orientation and its Determinants: Some Empirical Evidence. *Journal of Management Studies* 41(6):913-932.

Simons, J. (2006). Big Pharma's New R and D Center: The Trash Bin. *Fortune*, (European edt.) 154(12): 28

Sorenson J.B. and Stuart T.E.. (2000). Aging, obsolescence and organizational innovation. *Administrative Science Quarterly*, 45: 81–112.

Stuart, T. E. (1998). Network positions and propensities to collaborate: An investigation of strategic alliances formation in a high-technology industry. *Administrative Science Quarterly*, 43, 668-698.

Stuart, T. E. (2000). Interorganizational alliances and the performance of firms: A study of growth and innovation rates in high-technology industry. *Strategic Management Journal*, 21: 791-811.

Stuart T.E., Hoang, H. and Hybels, R. (1999). Interorganizational Endorsements and the Performance of Entrepreneurial Ventures. *Administrative Science Quarterly* 44 (2): 315–49.

Tanriverdi, H. and Venkatraman, N. (2005). Knowledge Relatedness and the Performance of Multi-business Firms. *Strategic Management Journal*, 26(2), 97-119.

Van de Vrande, V., Lemmens, C. and Vanhaverbeke, W. (2006). Choosing governance modes for external technology sourcing. *R&D Management*, 36(3): 347-363.

Van de Vrande, V. (2007). *Not Invented here: Managing Corporate Innovation in a New Era*, PhD dissertation, Eindhoven Centre for Innovation Studies, Eindhoven University of Technology, the Netherlands.

Van de Vrande, V., Vanhaverbeke, W., and Duysters, G. (2009), External Technology Sourcing: The Effect of Uncertainty on Governance Mode Choice. *Journal of Business Venturing,* 24(1): 62-80.

Vanhaverbeke, W., Duysters, G., Noorderhaven, N., 2002. External Technology Sourcing Through Alliances or Acquisitions: An Analysis of the Application-Specific Integrated Circuits Industry. *Organization Science* 13(6), 714-733.

Villalonga, B., McGahan, A.M., 2005. The Choice among Acquisitions, Alliances and Divestures. *Strategic Management Journal,* 26, 1183-1208.

Von Hippel, E. (1988). *The source of innovation*. New York: Oxford University Press.

Von Hippel, E. (1986). Lead users: A source of novel product concepts. *Management Science*, 32(7), 791-805.

Von Hippel, E., S. Thomke and M. Sonnack (1999). Creating breakthroughs at 3M. *Harvard Business Review*, 77(5), 47-57.

Wiersema, M. F. and H. P. Bowen (2008). Corporate diversification: the impact of foreign competition, industry globalization, and product diversification. *Strategic Management Journal*, 29(2), 115-132.

Williamson, O. E. (1975). *Markets and Hierarchies: Analysis and Anti-trust Implications.* New York: The Free Press, NY.

Williamson, O.E. (1985). *The Economic Institutions of Capitalism: Firms, Markets and Relational Contracting.* Free Press, New York, NY

Williamson, O. E. (1991). Strategizing, economizing, and economic organization. *Strategic Management Journal*. 12:75-94.

Williamson, O.E. (1996). Economic organization: The case for candor. *Academy Management Review*, 21(1), 48-57.

Zuckerman, E. W. (1999). The categorical imperative: Securities analysts and the legitimacy discount." *American Journal of Sociology* 104 (5): 1398–1438.

Zuckerman, E.W. (2000).. Focusing the corporate product: Securities analysts and diversification. *Administrative Science Quarterly* 45: 59–619.

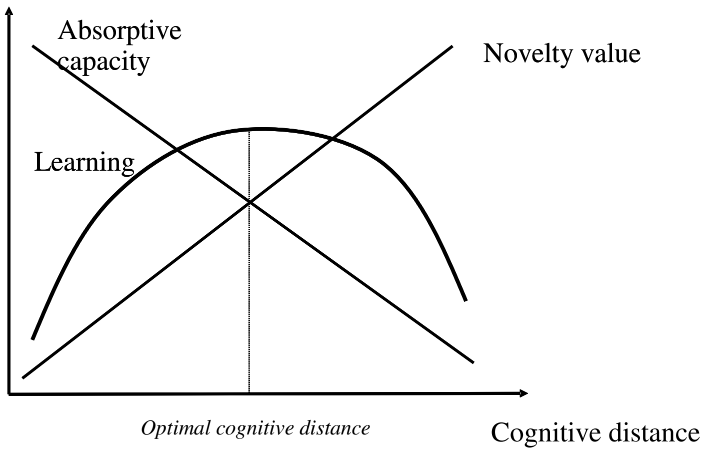


**Figure 1: Implications of cognitive distance on novelty and absorptive capacity** (source: adapted from Nooteboom 1999).

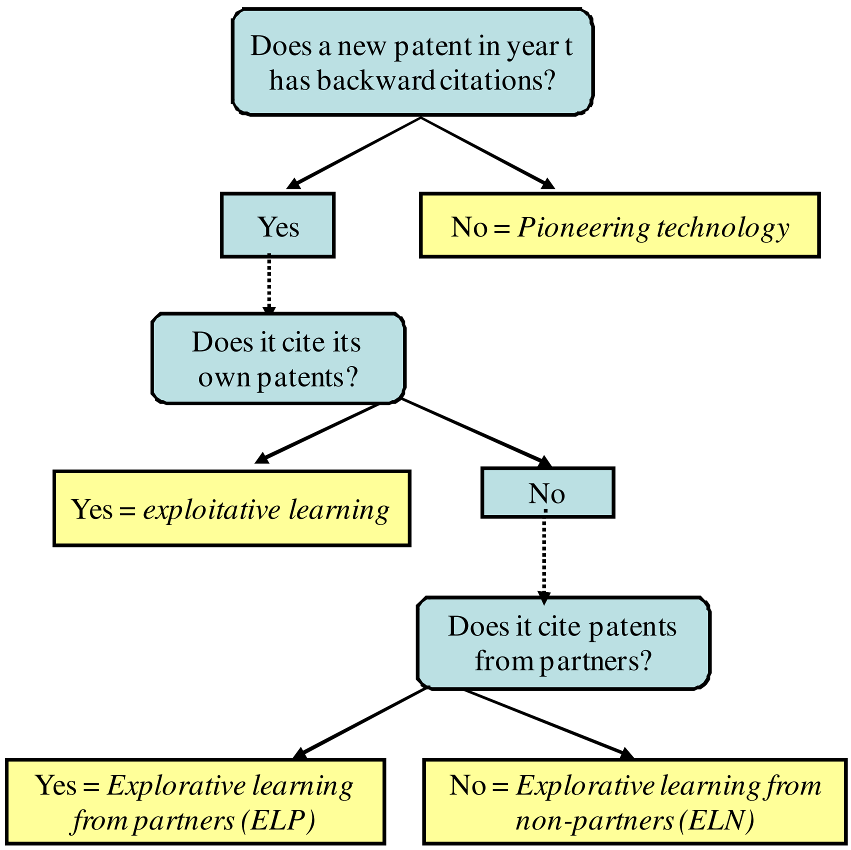


**Figure 2. How to distinguish between the two types of explorative learning**

**Table 1. Descriptive statistics**

**Correlations [a.]**

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. EFP | 1 | | | | | | | | | | | | |
| 2. EBP | 0.5205 | 1 | | | | | | | | | | | |
| 3. Firm size | 0.2851 | 0.2685 | 1 | | | | | | | | | | |
| 4. R&D intensity | -0.0421 | -0.0968 | -0.3448 | 1 | | | | | | | | | |
| 5. Technological age | 0.0207 | 0.0384 | 0.0233 | -0.2443 | 1 | | | | | | | | |
| 6. Dummy Europe | 0.0238 | 0.1909 | -0.1737 | 0.0082 | 0.1648 | 1 | | | | | | | |
| 7. Dummy Japan | 0.1128 | -0.0583 | 0.7589 | -0.0456 | -0.1615 | -0.3356 | 1 | | | | | | |
| 8. Dummy Industry | -0.2035 | -0.1776 | -0.0311 | 0.2820 | -0.4182 | 0.1153 | 0.1423 | 1 | | | | | |
| 9. Tech. distance | -0.0657 | 0.1216 | -0.1090 | -0.1061 | 0.2131 | 0.0614 | -0.1884 | -0.1906 | 1 | | | | |
| 10. CVC | 0.1085 | 0.1739 | -0.0191 | -0.0080 | -0.0778 | -0.0538 | -0.1319 | -0.0584 | 0.0785 | 1 | | | |
| 11. Non-equity alliances | 0.6676 | 0.4754 | 0.1231 | -0.0414 | 0.0138 | 0.1095 | -0.1131 | -0.1548 | -0.0007 | 0.2749 | 1 | | |
| 12. Equity alliances | 0.6511 | 0.4858 | 0.1854 | -0.0643 | 0.0403 | 0.0409 | -0.0599 | -0.2120 | 0.0059 | 0.2925 | 0.7145 | 1 | |
| 13. M&As | 0.2148 | 0.3625 | 0.0107 | -0.1404 | 0.2029 | 0.1915 | -0.3121 | -0.2259 | 0.1615 | 0.3739 | 0.3574 | 0.3650 | 1 |
| *Mean* | 11.8207 | 57.2861 | 9.7471 | 0.1738 | 10.2763 | 0.2984 | 0.2093 | 0.4788 | 0.7159 | 0.7438 | 6.6748 | 2.8596 | 2.9365 |
| *s.d.* | 51.5243 | 67.2342 | 2.1310 | 0.1738 | 1.9784 | 0.4578 | 0.4070 | 0.4998 | 0.1882 | 2.8199 | 12.8809 | 4.9199 | 3.7388 |

*N*=898,

Dummy year variables are not listed in the table.

**Table 2: Random-effects negative binomial estimations for EFP and EBP (with the linear effects of control variables in the baseline model)**

| Models | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ELP | ELP | ELP | ELP | ELP | ELP | ELP | ELN | ELN | ELN | ELN | ELN | ELN | ELN |
| Size | 0.596 | 0.576 | 0.554 | 0.503 | 0.495 | 0.411 | 0.375 | 0.408 | 0.403 | 0.422 | 0.401 | 0.384 | 0.388 | 0.371 |
| | (0.101)*** | (0.101)*** | (0.100)*** | (0.103)*** | (0.104)*** | (0.103)*** | (0.102)*** | (0.040)*** | (0.040)*** | (0.042)*** | (0.041)*** | (0.040)*** | (0.043)*** | (0.041)*** |
| R&D | 1.522 | 1.517 | 1.348 | 1.227 | 1.328 | 1.031 | 0.984 | 0.744 | 0.738 | 0.79 | 0.729 | 0.69 | 0.713 | 0.668 |
| | (0.623)** | (0.628)** | (0.613)** | (0.615)** | (0.625)** | (0.612)* | (0.604) | (0.229)*** | (0.229)*** | (0.232)*** | (0.230)*** | (0.226)*** | (0.231)*** | (0.227)*** |
| Europe | 0.222 | 0.267 | 0.139 | 0.275 | 0.214 | 0.061 | 0.175 | 0.077 | 0.099 | 0.081 | 0.062 | 0.025 | 0.053 | -0.009 |
| | -0.242 | -0.244 | -0.237 | -0.234 | -0.238 | -0.235 | -0.229 | -0.132 | -0.133 | -0.132 | -0.131 | -0.131 | -0.133 | -0.133 |
| Japan | -3.878 | -3.728 | -3.686 | -3.579 | -3.263 | -2.905 | -2.884 | -1.764 | -1.726 | -1.813 | -1.703 | -1.706 | -1.703 | -1.608 |
| | (0.569)*** | (0.573)*** | (0.561)*** | (0.559)*** | (0.589)*** | (0.573)*** | (0.559)*** | (0.248)*** | (0.249)*** | (0.252)*** | (0.248)*** | (0.246)*** | (0.251)*** | (0.246)*** |
| Pharma. Ind. | -1.428 | -1.402 | -1.307 | -1.284 | -1.454 | -1.272 | -1.275 | -0.143 | -0.143 | -0.166 | -0.111 | -0.112 | -0.127 | -0.072 |
| | (0.228)*** | (0.229)*** | (0.231)*** | (0.227)*** | (0.229)*** | (0.229)*** | (0.224)*** | -0.123 | -0.123 | -0.124 | -0.124 | -0.123 | -0.124 | -0.123 |
| Tech. age | -0.077 | -0.06 | -0.075 | -0.054 | -0.069 | -0.062 | -0.038 | -0.031 | -0.028 | -0.031 | -0.025 | -0.033 | -0.03 | -0.025 |
| | (0.043)* | -0.044 | (0.043)* | -0.043 | -0.043 | -0.044 | -0.045 | (0.013)** | (0.013)** | (0.013)** | (0.013)* | (0.013)** | (0.013)** | (0.013)* |
| Tech. distance | -1.372 | -1.422 | -1.07 | -1.001 | -1.739 | -1.351 | -1.364 | -0.225 | -0.232 | -0.245 | -0.203 | -0.275 | -0.285 | -0.256 |
| | (0.423)*** | (0.423)*** | (0.448)** | (0.443)** | (0.439)*** | (0.456)*** | (0.457)*** | (0.118)* | (0.117)** | (0.118)** | (0.119)* | (0.119)** | (0.119)** | (0.120)** |
| CVC | | 0.017 | | | | 0.001 | -0.01 | | 0.008 | | | | 0.006 | 0.001 |
| | | (0.009)* | | | | -0.009 | -0.009 | | (0.004)** | | | | -0.004 | -0.004 |
| Equity alliances | | | 0.005 | | | 0.008 | | | | -0.002 | | | -0.001 | |
| | | | (0.002)** | | | (0.002)*** | | | | -0.001 | | | -0.001 | |
| M&A | | | | 0.02 | | 0.047 | 0.059 | | | | 0.007 | | 0.015 | 0.022 |
| | | | | (0.006)*** | | (0.010)*** | (0.010)*** | | | | (0.003)*** | | (0.005)*** | (0.005)*** |
| Non-equity alliances | | | | | 0.038 | | 0.032 | | | | | 0.018 | | 0.01 |
| | | | | | (0.009)*** | | (0.006)*** | | | | | (0.005)*** | | (0.003)*** |
| Constant | -2.645 | -2.684 | -2.735 | -2.594 | -1.562 | -1.534 | -1.416 | -0.793 | -0.793 | -0.86 | -0.846 | -0.533 | -0.588 | -0.57 |
| | (1.055)** | (1.058)** | (1.039)*** | (1.058)** | -1.112 | -1.099 | -1.105 | (0.392)** | (0.390)** | (0.397)** | (0.396)** | -0.395 | -0.404 | -0.398 |
| log lik | -1427.57 | -1425.87 | -1425.32 | -1422.07 | -1419.57 | -1413.57 | -1406.95 | -3761.79 | -3760.04 | -3761.02 | -3758.73 | -3755.57 | -3754.62 | -3749.39 |
| lr-test | | 3.28* | 4.38** | 10.88 *** | 15.88 *** | 27.87 *** | 41.41 *** | | 3.51* | 1.55 | 6.13** | 12.46 *** | 14.36 *** | 24.81 *** |

N=898
Dummy variables of year is included but not listed in the table
Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

**Table 3: Random-effects negative binomial estimations for ELP and ELN (with the squared term of 'technological distance' in the baseline model)**

| Models | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|
| | ELP | ELP | ELP | ELP | ELP | ELP | ELP |
| Size | 0.573 | 0.553 | 0.558 | 0.506 | 0.467 | 0.404 | 0.379 |
| | (0.101)*** | (0.102)*** | (0.103)*** | (0.104)*** | (0.105)*** | (0.106)*** | (0.104)*** |
| R&D | 1.336 | 1.334 | 1.281 | 1.156 | 1.105 | 0.916 | 0.927 |
| | (0.604)** | (0.606)** | (0.608)** | (0.604)* | (0.608)* | -0.613 | -0.598 |
| Europe | 0.21 | 0.267 | 0.184 | 0.251 | 0.196 | 0.119 | 0.161 |
| | -0.241 | -0.244 | -0.241 | -0.233 | -0.239 | -0.239 | -0.231 |
| Japan | -3.614 | -3.454 | -3.553 | -3.344 | -2.987 | -2.726 | -2.571 |
| | (0.579)*** | (0.583)*** | (0.582)*** | (0.573)*** | (0.597)*** | (0.592)*** | (0.575)*** |
| Pharma.Ind. | -1.506 | -1.484 | -1.459 | -1.375 | -1.561 | -1.413 | -1.378 |
| | (0.227)*** | (0.228)*** | (0.237)*** | (0.228)*** | (0.230)*** | (0.235)*** | (0.226)*** |
| Tech.age | -0.089 | -0.072 | -0.088 | -0.065 | -0.084 | -0.072 | -0.043 |
| | (0.044)** | -0.044 | (0.044)** | -0.045 | (0.044)* | -0.045 | -0.045 |
| Technological distance | 11.229 | 11.375 | 10.833 | 10.905 | 11.807 | 10.784 | 11.434 |
| | (2.976)*** | (2.991)*** | (3.036)*** | (3.037)*** | (2.984)*** | (3.036)*** | (3.058)*** |
| $(\text{Technological distance})^2$ | -9.409 | -9.554 | -9.034 | -8.936 | -10.2 | -9.227 | -9.677 |
| | (2.135)*** | (2.144)*** | (2.213)*** | (2.187)*** | (2.148)*** | (2.212)*** | (2.212)*** |
| CVC | | 0.018 | | | | 0.005 | -0.006 |
| | | (0.008)** | | | | -0.008 | -0.008 |
| Equity alliances | | | 0.001 | | | 0.005 | |
| | | | -0.002 | | | (0.002)** | |
| M&A | | | | 0.015 | | 0.047 | 0.061 |
| | | | | (0.006)*** | | (0.010)*** | (0.010)*** |
| Non-equity alliances | | | | | 0.043 | | 0.027 |
| | | | | | (0.009)*** | | (0.006)*** |
| Constant | -6.183 | -6.302 | -6.061 | -6.097 | -5.24 | -4.877 | -5.213 |
| | (1.381)*** | (1.392)*** | (1.387)*** | (1.416)*** | (1.416)*** | (1.427)*** | (1.461)*** |
| Log likelihood | -1415.17 | -1413.18 | -1414.98 | -1411.73 | -1405.06 | -1402.64 | -1394.99 |
| lr-test | | 3.98** | 0.39 | 6.88*** | 20.24*** | 25.06*** | 40.36*** |

N=898
Dummy variables of year is included but not listed in the table
Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%