



The alliance innovation performance of R&D alliances—the absorptive capacity perspective

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ABSTRACT

In this work we explore the role of interfirm R&D alliances as a vital mechanism for creating new technological knowledge. Drawing on the absorptive capacity perspective, we argue that firms with a high level of such capacity seem to benefit more from their alliances. Specifically, three indicators of technology strategy relevant to absorptive capacity, including proportion of R&D alliances in an alliance portfolio, technological distance, and R&D intensity are explored to examine their impacts on innovation performance. Using alliance data from the Securities Data Company (SDC), patent data from the United States Patent and Trademark Office (USPTO), firm data from S&P COMPUSTAT, and co-patents granted as a proxy for the alliance innovation performance, these results show that while alliance networks potentially provide a firm with access to various benefits that can help in creating new technologies, R&D alliances in particular are more suitable than other types of partnerships to achieve this aim. Furthermore, given that information transfer and learning are key benefits of R&D alliances, moderate technological distance is needed if such alliances are to be successful. In particular, the innovation performance peaks at the moderate level of technological distance with alliance partners when this interacts with the proportion of R&D alliances in a firm's alliance portfolio. Finally, R&D alliances should be regarded as a complement to rather than a substitute for a firm's internal R&D.

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1. Introduction

The accelerating pace of technological change and shortening product life cycles are forcing many firms to create and commercialize knowledge in a more timely and cost-efficient manner. Firms are thus engaged in deepening and broadening their innovative capabilities, which are crucial for their long-term survival and growth (Faems et al., 2005; Sampson, 2007), by measures such as investing resources in R&D to speed up innovation and looking for alternatives to in-house R&D. However, while managers often assume that building R&D alliances can enhance innovation performance, this has received limited support in empirical research, and the results have shown both significant positive effects (Ahuja, 2000; Ahuja and Katila, 2001; Baum et al., 2000; Koschatzky et al., 2001; Love and Roper, 1999; Souitaris, 2001; Uzun, 2001; Keil et al., 2008) and non-significant ones (Hagedoorn et al., 2003; Kaufmann and Tödtling, 2001; Lee, 1995; Liu and White, 1997; Love and Roper, 2001; Weck and Blomquist, 2008).

This lack of consensus could be explained by the fact that an R&D alliance acts as a mechanism of knowledge acquisition to achieve innovation is greatly influenced in practice by the firm's absorptive capacity (Landry et al., 2002; Lee, 1995; Liu and White, 1997). In other words, firms which are able to acquire, assimilate, and exploit the knowledge acquired from outside sources have a greater chance of achieving a high level of innovation performance and competitive advantage (Lane and Lubatkin, 1998; Lane and Koka, 2006; Zahra and George, 2002; Bierly III et al., 2009; Camison and Fores, 2010; de Jong and Freel, 2010; George et al., 2001; Laursen et al., 2010; Murovec and Prodan, 2009; Xia and Roper, 2008). Consequently, this study examines why some alliances are more productive than others in terms of creating new technology. More specifically, three dimensions of absorptive capacity, knowledge acquisition, assimilation, and exploitation are taken into account to answer this question.

With regard to a firm's knowledge acquisition capacity, the proportion of R&D alliances in a firm's alliance portfolio is seen in this work as a major determinant of alliance innovation performance. Given the diversity of alliance activities in knowledge-intensive industries, it is proposed that R&D alliances are formed to explore new technology. It is also argued that most R&D alliances do not serve as channels for the diffusion of existing knowledge and competencies, but rather allow the recombination

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of such elements to create new knowledge. Therefore, a higher proportion of R&D alliances in a firm's alliance portfolio brings a higher exposure to external knowledge and leads to more experience in knowledge acquisition, and so a higher level of innovation output is expected.

Exploring the nature of the second dimension of absorptive capacity, knowledge assimilation, we examine the effect of technological distance from the cognitive viewpoint. In recent years, some studies have focused on the impact of alliance partner similarity on firms' innovation performance (Cowan and Jonard, 2009; Gilsing et al., 2008; Luo and Deng, 2009; Sampson, 2007). Prior research argued that more similar partners can have more effective knowledge transfer and easier communication because of their similar characteristics and routines, which benefit inter-organizational collaboration. However, if firms have too much overlap, they will bring less new knowledge to each other, and fewer complementary elements, thus reducing the benefits of such alliances. Sampson (2007) empirically examined the impact of partner technological distance and alliance organizational form on firm innovation performance, and found that alliances with moderately similar partners contribute significantly more to firm innovation than alliances with minimally or highly similar ones. Likewise, Nooteboom et al. (2007) examined the relationship between technological distance and the innovation achievement of firms engaged in technology-based alliances, and confirmed an inverted U-shaped effect of technological distance with collaborators on firm innovation. In this study, we focus on the moderating effect of technological distance on the relationship between the path dependency of acquisition of external knowledge and alliance innovation performance.

Furthermore, with the third dimension of absorptive capacity, knowledge exploitation, we explore the effect of the R&D intensity of the focal firm. This variable was used as a proxy of absorptive capacity by Cohen and Levinthal (1990), who argued that technology acquisition by an alliance is not a substitute to internal development, but a complement to it, as a new external technologies brought into a firm builds upon existing internal ones (Cohen and Levinthal, 1990). Escribano et al. (2009) empirically examined the relationships among absorptive capacity, external knowledge managing ability, and innovative outcomes, asserting that the absorptive capacity of a firm positively moderates the impact of external knowledge flows on its innovative outcomes. This study thus suggests that the relationship between the path dependency of the acquisition of external knowledge and the alliance innovation performance is indeed contingent on R&D intensity of the focal firm. We propose that the more dependence a firm has on the external knowledge gained through R&D alliances, the more investment in internal R&D capacity is needed to gain higher returns related to the alliance innovation performance.

This study addresses the following gaps in the existing literature. Firstly, while there is agreement that absorptive capacity is a multidimensional construct involving the ability to acquire, assimilate, and apply knowledge (Cohen and Levinthal, 1990), empirical studies do not always capture the rich theoretical arguments and the multidimensionality of the absorptive capacity construct to explain why some alliances are more productive than others in terms of innovation outputs. Drawing on the perspective of absorptive capacity, this study explores the proportion of R&D alliances in an alliance portfolio, technological distance, and R&D intensity, which are viewed as characteristics of the technology strategy of the focal firm, to examine their impacts on the alliance innovation performance in the context of R&D alliances. Furthermore, drawing on the concept of interdependency among the multidimensional constructs of absorptive capacity, the moderating effects of technological distance and

R&D intensity on the relationship between the proportion of R&D alliances in an alliance portfolio and the alliance innovation performance are examined. Secondly, by specifying and examining these relationships, we can provide some insights into the questions "What drives innovation performance differences among R&D alliances?" and "How do firms achieve high alliance innovation performance in an R&D alliance?", and thus improve our understanding of the complex conditions associated with R&D alliances. Finally, while previous studies investigated the association between alliances and innovation by looking at the patents of individual firms (Ahuja, 2000; Stuart, 2000), these are difficult to attribute to alliance-related activities, and thus in this study, following Kim and Song (2007), the number of co-patents resulting from an R&D alliance are used as a proxy of alliance innovation performance. By focusing our attention on inter-firm co-patents, a better measurement is proposed to evaluate the innovation output resulting from alliances, which will be helpful to verify whether such partnerships can be useful for collaborative innovation.

The remainder of the paper is organized as follows: Section 2 develops the theoretical underpinnings, drawing on the related literature on R&D alliance formation and absorptive capacity. Section 3 presents the research methodology, including the data and variables. Section 4 provides the results of the statistical analysis, while Section 5 draw up the conclusions and managerial implications of this study.

2. Theoretical development: an absorptive capacity perspective of R&D alliances

Many studies have provided evidence that inter-firm alliances can benefit the innovative performance of firms (Ahuja, 2000; Baum et al., 2000; Hagedoorn and Duysters, 2002; Keil et al., 2008). For example, Ahuja (2000) demonstrated that the extent of a firm's alliance activity has a positive relationship with both patents and innovation. Baum et al. (2000) also argued that alliances contribute to the knowledge base of organizations, and found that bio-tech firms with more alliances are more innovative. Recently, focusing on the R&D alliances in the alliance portfolios of firms, some studies have proposed that such alliances provide a superior means for the sharing and transfer of technological capabilities among organizations (Luo and Deng, 2009; Sampson, 2007).

Indeed, a broad range of earlier research has demonstrated that inter-organizational relationships positively influence the number of patents, which is often measured as patents granted to a focal firm after participating in R&D alliances. However, there are few studies examining the role of R&D alliances in creating new technology based on patent development at the level of individual interactions, with the notable exceptions of Hagedoorn et al. (2003), Kim and Song (2007), and Weck and Blomquist (2008). Hagedoorn et al. (2003) compared jointly owned US patents filed in 1989–1998 with the MERIT-CATI database on R&D alliances, and found that while formal R&D partnerships, such as joint ventures and R&D contracts, may generate several benefits, in addition to the sharing of intellectual property rights (IPR) through joint patenting. Similarly, drawing from a survey of 90 patent-development processes in the European telecom industry from the inventors' viewpoint, Weck and Blomquist (2008) found that inventors search for and utilize external knowledge in both the generating of new ideas and the solving of problems related to patent development. However, the amount of new knowledge that is created internally by the firm is closely related to patenting most for the issue of knowledge appropriability. While those findings seem to show that inter-organizational

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