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Linking alliance portfolios to recombinant innovation: The combined effects of diversity and alliance experience

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Innovating firms establish alliance portfolios in hopes of creating recombinant innovation, an outcome of combining new ideas from diverse technological domains. We draw on research in alliances, social networks, and knowledge spillovers to identify the configuration of alliance portfolio that links to recombinant innovation. Our longitudinal analysis of firms in the biotechnology industry shows that the technological diversity of a firm's alliance portfolio has a positive impact on the breadth of recombinant innovation produced by the firm. This relationship is strengthened in the presence of explorative alliance experience, rather than exploitative alliance experience, between the firm and its portfolio partners and among the portfolio partners. However, the positive influence of alliance experience in general diminishes when more than half of portfolio partners have prior ties with the firm. Finally, our licensing revenue data show that the breadth of recombinant innovation is strongly related to the economic value of the innovation. Our findings suggest that innovating firms need to manage the balancing act between sourcing for ideas from unfamiliar domains and leveraging alliance experience in configuring their alliances in aggregate. This study offers new insight into the composition and the collective experience of alliance portfolios, extending our understanding of alliance performance beyond the outcome of bilateral alliances.

Introduction

Firms in growing high-tech sectors are increasingly faced with the challenge to create recombinant innovation, an outcome of exploring and recombining distant ideas from diverse knowledge domains (Fleming, 2001; Hargadon and Sutton, 1997). Recombinant innovation is strategically important because it can be disruptive to existing businesses and lead to superior firm performance (Hargadon, 2003). Alliance portfolio research has shown that diverse partnerships enable a firm to obtain variety of entrepreneurial opportunities, growth options, and to acquire non-redundant knowledge, capabilities, and other valuable resources that exist beyond the firm's organizational and technological boundaries (Baum et al., 2000; Cui and O'Connor, 2012; Faems et al., 2005; Lavie, 2007; Ozcan and Eisenhardt, 2009; Phelps, 2010; Powell et al., 1996; Srivastava and Gnyawali, 2011; Vassolo et al., 2004; Vasudeva and Anand, 2011). This implies that an alliance portfolio supports the process of creating recombinant innovation to the extent that a firm can benefit from broadened search with the help of diverse partners whose knowledge domains complement those of the firm (Cui and O'Connor, 2012; Faems et al., 2005; Phelps, 2010; Srivastava and Gnyawali, 2011).

A diverse alliance portfolio, however, may pose challenges to the firm due to high search costs and failure risks associated with exploring too broadly in knowledge domains relatively unfamiliar to the firm. Such alliance portfolios are often characterized by unpredictability of technological interdependencies among partners and complexity of alliance management and coordination (Carnabuci and Operti, 2013; Faems et al., 2010; Fleming, 2001; Oerlemans et al., 2013). Several studies have theorized both the advantages and disadvantages of alliance portfolio diversity and found an inverted u-shaped relationship between alliance portfolio diversity and performance outcomes (Bruyaka and Durand, 2012; Duysters and Lokshin, 2011;

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Jiang et al., 2010b; Laursen and Salter, 2006). Yet, a recent study by Wuyts and Dutta (2014) has shown a u-shaped relationship between alliance portfolio diversity and innovation performance, implying that firms with either focused or diverse alliance portfolio strategy outperform other firms that attempt to strike a balance in configuring their alliance portfolios. Thus far, the findings have not been conclusive about alliance portfolio diversity, and very few studies have examined the performance impact of alliance portfolio diversity from a contingency perspective (Cui and O'Connor, 2012; Duysters et al., 2012; Wuyts and Dutta, 2014).

To understand what contribute to the mixed findings, our review of the literature points to two areas which call for more comprehensive investigation of alliance portfolio diversity (Duysters et al., 2012; Parkhe, 1991; Wuyts and Dutta, 2014). First, prior studies have measured alliance portfolio diversity in multitude ways without recognizing the different dynamics across the different types of diversities. According to Parkhe (1991), interfirm diversity can be conceptualized as two types: by differences in partners' resources and capabilities that support the complementary roles of the respective partners, and by variation of partners' characteristics such as culture, management practices, and geographical origins which often affect the functioning of alliances. These two types of interfirm diversity can affect how partners interact, learn, and adapt differently (Parkhe, 1991). Second, scholars in strategy and organization research argue that a firm's relative alliance experience in knowledge exploration versus knowledge exploitation affects firm performance and innovation outcome differently (Rothaermel and Deeds, 2006; Yamakawa et al., 2011). Explorative alliances engage in knowledge-intensive R&D activities, whereas exploitative alliances engage in downstream activities leveraging partners' existing capabilities in marketing development (Rothaermel and Deeds, 2006). Extant research cautions that depending on the context, a trade-off between the two kinds of activities is necessary to achieve optimal firm performance in the long term (Gupta et al., 2006; Raisch and Birkinshaw, 2008). While the contingent effect of general alliance experience in managing a diverse portfolio has been explored, how the orientation of prior alliances in terms of exploration and exploitation influences the role of alliance portfolio diversity in innovation has so far been ignored. Thus, it is imperative to (a) focus on a specific type of alliance portfolio diversity and its related performance implications, and (b) examine how a particular kind of alliance experience attained through learning between partners, such as in explorative and exploitative alliances, condition a firm's ability to benefit from a specific type of alliance portfolio diversity.

Against this backdrop, our study investigates the impact of a firm's alliance portfolio, consisting of partners collaborating in diverse technological areas (termed as technological diversity of alliance portfolio), on the firm's recombinant innovation, and examines how explorative and exploitative alliance experiences shape that relationship. As significant innovations are outcomes of combining interdisciplinary knowledge and skills, our study is focused on technological diversity of alliance portfolios. We further analyze the moderating role of alliance experience that exists (a) between focal firm and portfolio partners, and (b) among portfolio partners, not involving the focal firm. The contingency view is based on the assertion that a firm can leverage these alliance experiences, which are know-how and capabilities acquired from managing prior alliance activities (Duysters et al., 2012; Rahman and Korn, 2014; Sampson, 2005; Zollo et al., 2002), to improve its search efficiency and ease of access to diverse knowledge within an alliance portfolio. Powell et al. (1996: 120) explain that “knowledge facilitates the use of other knowledge. What can be learned is crucially affected by what is already known”. Building on this line of reasoning, we refer to a firm's alliance portfolio as a set of simultaneous partnerships that can be characterized by the knowledge scope and the alliance portfolio experience involving old and new partners. Alliance portfolio diversity thus presents a multitude of technical possibilities for recombinant innovation. And, the manner in which a firm can benefit from a technologically diverse alliance portfolio hinges on the firm's experience with its partners and the experience among the partners (Duysters and Lokshin, 2011; Wuyts and Dutta, 2014).

We test our conceptual model using data from the biotechnology industry, in which research and development (R&D) is a priori an interdisciplinary pursuit. Our empirical setting features a panel dataset of 222 biotechnology firms, with patent, publication and alliance data from 1990 to 2000. Since we focus on the innovation outcome of the firm in association with alliance portfolio diversity, an alliance portfolio in our research comprises partners with whom the focal firm has established an R&D alliance in the year of observation. For technological diversity of alliance portfolio, we measure the variable by 1-Herfindahl index of the technological focus areas as stipulated in the R&D alliance agreements between the focal firm and its portfolio partners. Rather than using a count measure, we compute the breadth of recombinant innovation by the spread of technology classes of patents referenced (backward cited) by each focal patent of the firm. Alliance experience is measured as two constructs based on the proportion of partnerships in the past five years (a) between focal firm and portfolio partners and (b) among portfolio partners. The respective type of explorative and exploitative alliance experiences is differentiated by whether past alliances consisted of R&D activities or strictly non-R&D activities.

Our results show that the technological diversity of a firm's alliance portfolio has a positive impact on the breadth of recombinant innovation. The explorative alliance experience, but not the exploitative alliance experience, between focal firm and portfolio partners and among portfolio partners, positively moderates the relationship between technological diversity of alliance portfolio and breadth of recombinant innovation. However, we also find that the alliance experience between focal firm and portfolio partners is helpful to a limited extent; the benefits for recombinant innovation starts to decline when more than 52% of portfolio partners have had prior relationships with focal firm. This result underscores the importance of striking a balance between old and new partners within an alliance portfolio (Lavie and Rosenkopf, 2006).

Our research contributes to a growing body of empirical studies on alliance portfolios. First, we offer a configuration of alliance portfolio for enhancing recombinant innovation, which is contingent upon the specific alliance experience of the focal firm and its portfolio partners. Our research departs from prior alliance portfolio research by focusing on technological

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