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Technological collaboration in product innovation: The role of market competition and sectoral technological intensity☆

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ABSTRACT

Drawing on the strategic alliances and innovation literature, this study proposes that the impact of technological collaboration on product innovation is contingent on market competition and sectoral technology characteristics. Specifically, it argues that the generally observed positive effect of technological collaboration on product innovation may be diluted in highly competitive markets, and the interactive effect of technological collaboration and market competition on product innovation will be further moderated by sectoral technological intensity. Data on the product innovation and technological collaboration of 944 Chinese firms across five manufacturing sectors provide robust support for the contingent effects of technological collaboration on product innovation.

1. Introduction

There is a significant body of literature examining the impacts of strategic alliances[1] on firm innovation activities and outcomes (Brown and Eisenhardt, 1995; Bougrain and Haudeville, 2002; McGill and Santoro, 2009; Smith et al., 1991). Prior researches generally suggest that strategic alliances enable firms to access complementary assets (Teece, 1992; Baum et al., 2000), user and/or supplier know-how (Belderbos et al., 2004; Fritsch and Franke, 2004), complementary technologies (Mohnen and Hoareau, 2003; Miotti and Sachwald, 2003), and enhance learning capabilities (Becker and Dietz, 2004; Kleinknecht and Reijnen, 1992), thus boosting firm innovation performance.

While the positive impacts of strategic alliances on innovation performance seem quite evident, two important deficiencies in previous researches limit our understanding of the relationship involved. First, research on strategic alliances has mainly focused on identifying mechanisms through which strategic alliances help enhance firm innovation performance (Powell et al., 1996; Stuart, 2000; Bell, 2005; Ahuja, 2000). Yet, despite the extensive literature in this area, little research has directly examined the negative consequences of strategic alliances on product innovation. This lacuna is surprising because prior studies have revealed several caveats for strategic alliances—including opportunistic behaviors (Das and Teng, 2000), learning races between partners (Hamel, 1991), costs imposed due to the structural rigidity of collaborative arrangements (Doz, 1996), and potential knowledge leakage to the partners (Kale et al., 2000). However, the caveats for or the negative effects of strategic alliances have, generally, not featured in the empirical modeling or testing other than as possible causes of insignificant coefficients.

Second, previous research has not paid adequate attention to the external environments that shape the relationship between strategic alliances and firm product innovation, in spite of the large body of evidence documenting the influences of external environments on firm innovation (e.g., Vossen, 1999; Audretsch, 1998; Malerba, 2002; Pavitt, 1984; Malerba and Orsenigo, 1997). The strategic alliances scholars have argued that market competition and sectoral technological characteristics are two important environmental conditions that influence an actor's motivation (selfish or mutual benefits) of and its behaviors (cooperative or competitive) in strategic alliances, which have important implications for organizational learning and performance (e.g., Harrigan, 1988; Doz, 1996). However, theoretical and empirical studies fail to take account of these external influences that shape the relationship between strategic alliances and innovation performance.

This study is designed to fill these gaps by proposing that the relationship of strategic alliances and product innovation is context

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[1] Following the prior studies (e.g., Ahuja, 2000), I use the terms strategic alliances, collaborative relationship to refer to collaborative arrangements between independent firms to share key resources (e.g., technologies).

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specific. Scholars from the strategic alliances and innovation fields have suggested that cooperative relationship with other firms can help reduce the inherent uncertainty associated with novel technologies and products (Powell et al., 1996), and market competition and sectoral technology characteristics affect the impacts of strategic alliances on organizational learning and performance (Harrigan, 1988; Doz, 1996). Drawing on these insights, this study examines how market competition and sectoral technology intensity moderate the relationship between a firm's strategic alliances and innovation performance. Specifically, it argues that the positive effect of strategic alliances on product innovation is less salient in highly competitive markets, but more important in high-tech sectors accompanied with intense rivalry. Hypotheses are tested on data about the product innovation and technological collaboration of 944 firms from five manufacturing sectors in the context of China's emerging market. It contributes to the literature in three aspects. First, it develops an integrated framework to elucidate how environmental factors may strengthen or weaken the relationship between strategic alliances and firm product innovation. It thus sheds important light to the boundary conditions of strategic alliances in firm product innovation. Second, this study empirically shows how the positive and negative effects of strategic alliances on product innovation are contingent on market competition and sectoral technology condition. It thus provides scant empirical evidence on the negative consequences of strategic alliances for product innovation. Third, this is the first to provide evidence on *whether* and *how* emerging market firms can improve product innovation through technological collaboration.

2. Theoretical development and hypotheses

2.1. Strategic alliances: competition vs. cooperation

The strategic alliances examined in this study are technological collaboration, which refers to voluntary arrangements between competing firms to facilitate the commercialization of new technologies and the development of new products (Teece, 1992; Ahuja, 2000). Over the last few decades, a rich body of literature has emerged on the topic of strategic alliances. Among this extensive and diverse literature, this study identifies two perspectives as especially useful in understanding the effects of strategic alliances on firm product innovation. The first perspective, with its emphasis on the *cooperative* behaviors in strategic alliances, suggest that collaborative behaviors in strategic alliances can enhance firms' learning capability (Powell et al., 1996; Hagedoorn and Schakenraad, 1994), increase the likelihood of successful innovation activities (Ahuja, 2000; Uzzi, 1997), develop and strengthen internal competencies (Mitchell and Singh, 1996; Ahuja, 2000), reduce risks and costs of the innovation process (Das and Teng, 2000; Tyler and Steensma, 1995), shorten innovation cycles (Pisano, 1990), obtain efficiency gains such as economies of scope and scale (Ahuja, 2000), and to access to new markets (Mowery et al., 1998). The rationale behind this perspective premises that firms only possess parts of the necessary resources and capabilities and lack several others, which, being tacit and complex, cannot be easily accessed or acquired through market exchanges (Penrose, 2009). The time and resource constraints in developing these resources and capabilities internally would increase firms' needs to collaborate in order to access complementary technologies and a wider scale and scope of assets, achieve economies of scales and so on (Teece, 1992; Das and Teng, 1998). Moreover, cooperating and interacting with other firms provides a firm greater opportunity to refine and improve internal routines and processes, which, in turn, increase its capability to discover and absorb new technology.

The second perspective, with its emphasis on the *competitive* aspect of strategic alliances, suggests that intense competition stimulates firms to jockey for competitive behaviors in strategic alliances (Das and Teng, 2000). If firms do not institute appropriate monitoring mechanisms or invest sufficient resources in critical activities such as trust building, their partners might indulge in opportunistic behavior (e.g., shirking, cheating, appropriating resources and knowledge, distorting information), which can lead to failed collaboration (Hamel, 1991; Larsson et al., 1998). Further, learning race within the strategic alliances would result in a shift in relative competitive positions among the partners, making the slower learner to be competitively disadvantageous against the faster learner. This is particularly salient in strategic alliances where partnering firms are direct competitors (Hamel, 1991).

Short-term vs. long-term orientation. There is another reason explaining why partnering firms may be less inclined to cooperate than to compete in a collaborative relationship. If a firm views the collaborative relationship as transitional in nature, it will probably look for instant and tangible results (Das and Teng, 2000). Because a collaborative relationship is full of risk largely due to unveiled intentions held by partners, firms tend to adopt a short-term goal aiming to achieve prompt and visible outcomes (Newman, 1992). In contrast, if a firm views the collaborative relationship as a relatively stable entity, it will show more patience and commit more to the collaborative relationship. Accordingly, firms shift their focuses from short-term profits, one-shot deals to long-term, durable relations and are willing to work through the problems together with partners in a close relationship for a long time.

Firms' short-term and long-term orientations toward the collaborative relationships regulate their behaviors in the subsequent interactions. Those firms with short-term prospects of the collaborative relationship tend to be less concerned about the possibility of repeated future interactions with the same partners and will behave opportunistically at the expense of their partners (Das and Teng, 2001). Such opportunistic behaviors result in the increasing skeptics and doubts among the partners. As a result, they are more aggressive to launch competitive moves toward each other, leading to the heightened competitive force in the collaborative relationship. By the contrary, when the partners embrace a long-term orientation toward the collaborative relationship, they tend to be more concerned about the repeated interactions in the future, which discipline them from opportunistic behaviors. They emphasize a satisfactory cooperative relationship and value cooperative behaviors, leading to the heighted cooperative force in the collaborative relationship.

In sum, firms with short-term orientation are less inclined to undertake cooperative behaviors than competitive behaviors in the collaborative relationship. External environments will influence firms' orientation (short-term vs. long-term) toward a collaborative relationship, which in turn regulates their behaviors toward partnering firms in the collaborative relationship.

2.2. External environmental conditions

Previous studies have directly examined various environmental determinants of firm innovation including market structure (Vossen, 1999; Geroski, 1994), sectoral system (Malerba, 2002; Pavitt, 1984), technological regime (Malerba and Orsenigo, 1997; Martin, 1994), geographic cluster (Audretsch, 1998), regional and national innovation systems (Lundvall et al., 2002), and multidimensional space where firms operate (Antonelli, 2007). Among these environmental determinants of firm innovation, scholars from the strategic alliances perspective have suggested that market competition and sectoral technological intensity are two critical important environmental conditions that are likely to influence the effects of strategic alliances on organizational outcomes and performance (Harrigan, 1988; Doz, 1996). Harrigan (1988), for example, argued that technological traits and industrial competition affect a