

Interfaces with Other Disciplines

Collaboration in R&D activities: Firm-specific decisions [☆]

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Abstract

In this paper, we study the strategic R&D collaboration by introducing a virtual player to reveal cooperative incentives and keeping investment share and market share independent of each other. Not consistently with the traditional opinions, we show that the superiority of the R&D cartel is due to the coexistence of cooperation and competition when spillovers are exogenous. Moreover, we conclude that high R&D input share must be reflected implicitly by high market share, and that firms' R&D decisions vary with firms' specific characteristics when spillovers is endogenous.

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1. Introduction

Collaboration plays an important role in research and development (R&D) activities, and has spurred research into their effects on firms' strategic decisions. The advantages of collaboration in R&D are outstanding, especially in high-tech firms: the collaboration helps firms to crack new markets, gain skills and technologies, realize economies through reorganization and exploitation of complementarities, share costs and risks, and control competitive forces (Veugelers, 1998). A famous model for R&D collaboration mixing with competition in the literature is the two-stage game presented by D'Aspremont and Jacquemin (1988). In their model, firms cooperate in the first stage (R&D collaboration) while compete in the second stage (market competition), and the outputs of firms' post-innovation products in the second stage only depend on the R&D investment (expenditure) decisions in the first stage. By extending this model, the mainstream of the literature in Industrial Organization (IO) find that spillovers increase the relative profitability of the R&D collaboration once spillovers are sufficiently high (D'Aspremont and Jacquemin, 1988; De Bondt, 1996; Kamien et al., 1992; etc.). Furthermore, the cartelized RJV (research joint venture) is the best R&D scenario; at least for industries with nearly firms with symmetric constrains (Amir et al., 2003).

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The two-stage game models bring convenience to compare the equilibria or the social welfare among different R&D scenarios defined as Kamien et al. (1992). But they suppose that firms in the alliance contract on the future market. Indeed, they ignore the fact that such formal and complete interfirm contracts are extremely difficult to write down and enforce, especially for those trying to identify the output share with the input share. There are two main difficulties. First, the R&D collaboration normally progresses over a long period while the market share relies on the protean market circumstances, as well as firms' internal characteristics. It is difficult to choose the quantity of post-innovation products only according to R&D investment. On the contrary, many R&D strategic decisions rely partly on firm's current market share. Second, what actions can be taken in the second stage is unbelievable, at least imperfectly unbelievable. There is no sound reason to suppose that such complete binding contracts or agreements are at work or that they are even possible. Before the R&D collaboration, the agreement of the market share of post-innovation products must suffer from the uncertainty in the production process and that in the R&D process. The risk is so high that firms have no incentives to contract on the output sharing of post-innovation products, since the R&D collaboration has to suffer inherent uncertainty during a long period. As shown in Negassi (2004)'s empirical study, the market variable which indicates firms' market share is positive but not significant in explaining collaboration. One plausible interpretation is that firms invest in R&D and estimate approximate prospective quantity independently and simultaneously.

Based on the two-stage game models, the theoretical studies mainly focus on the role of spillovers. According to Katz (1986), spillovers refer to the research done by one firm which can be used by another firm even though the latter does not receive permission (i.e., purchases a license) to use the inventive output. Besides spillovers, there are various determinants presented by other studies. According to the theoretical studies, the determinants of the R&D collaboration generally include spillovers, absorptive capacity,¹ complementarity,² heterogeneity,³ firm size, market share, R&D intensity,⁴ human capital, technological transaction, appropriability, and public subsidies (see Hernán et al., 2003; Negassi, 2004; Belderbos et al., 2004; etc.). Recently, empirical interpretations are paid more attentions (e.g., see Cassiman and Veugelers, 2002; Becker and Dietz, 2004; Confessore and Mancuso, 2002; Negassi, 2004). By focusing on the frequency of occurrence of the R&D collaboration or the R&D expenditures, most empirical studies discuss which determinants are more beneficial to the R&D collaboration. Although most determinants have been considered in the literature, their effects on firms' decisions are discussed separately. Indeed, there exist interrelations among them. Up to now, there is no research into the significant determinants holistically.

Moreover, the coexistence of cooperation and competition in R&D activities make non-cooperative game theory partly inefficient in anticipating firms' decisions. Traditional non-cooperative game theory assumes that all people are exclusively pursuing their material self-interest and do not care about "social" goals per se. While in an actual competition players care about their own profits as well as the profits of their opponents in order to keep or improve their competitiveness. They have incentives to cooperate each other since their cooperation may benefit their total profits. Certainly, the cooperators maybe have adverse incentives to increase their opponents' profits. The relations among firms are seldom of a wholly cooperative type or a wholly competitive one: firms sometimes cooperate with each other and do not cooperate at other times, or they cooperate in some areas as well as compete in others. The two-stage game models resolve the R&D collaboration⁵ through maximizing the total profits prior to the individual profits. This implies that the cooperative incentives are more important than the competitive ones. Indeed, the cooperative incentives and the competitive incentives always coexist, and their importance in the alliance cannot be distinguished. Thus, a

¹ Cohen and Levinthal (1989) define the absorptive capacity as firm's capability to identify, assimilate, and exploit knowledge from its rival firms.

² Veugelers and Kesteloot (1994, 1995) introduce complementarity through a "synergy effect", a fixed mark-up on the marginal productivity of investment in R&D, which arises when R&D is carried out under an RJV and member firms do not cheat on the agreement.

³ Belderbos et al. (2004) explore heterogeneities in the determinants of innovating firms' decisions by differentiating between four types of cooperation partners: competitors, suppliers, customers, universities and research institutes. They find that the determinants of R&D cooperation differ significantly across the cooperation types.

⁴ König et al. (1994) view it as R&D expenditures scaled by total sales.

⁵ Collaboration here means the situation where firms cooperate without loss of competition.

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