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Joint ventures in patent contests with spillovers and the role of strategic budgeting☆

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ABSTRACT

We consider an R&D contest between n firms in the presence of external spillovers. Our analysis focuses on the effects of these spillovers on joint venture activities between firms. In particular, we are interested in how different budget responsibilities within the research joint venture (RJV) affect profits of firms taking part in the joint venture and profits of their non-cooperating rival firms. Three arrangements for RJVs are analyzed: First, cooperation, in which the firms participating in the joint venture completely share the research they create in the innovation process and each firm has a sovereign budget responsibility. Second, a collusive arrangement in which the participating firms not only share their research but have joint budget responsibilities in the sense that they make all strategic choices cooperatively and maximize joint profits. Third, a hierarchical form, in which the cooperating firms establish joint headquarters which have strategic budget responsibility in the sense that it can strategically subsidize R&D efforts of its member firms so as to maximize overall RJV profits. We show that the first two arrangements can be mimiced in the hierarchical structure and that a hierarchical structure is optimal if it completely subsidizes its members' R&D activities. In this case all rival firms are driven out of the contest.

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1. Introduction

Due to the increasing complexity of innovations and the simultaneous rise in development cost, a natural means for firms to keep up with the process of technological change is to combine research efforts and internalize technology spillovers. It is not surprising that research joint ventures (RJVs) as organizations jointly controlled by at least two participating firms whose primary purpose is to engage in cooperative research and development (R&D) have exploded during the last couple of decades.[1]

This phenomenon of RJVs has attracted a great deal of both theoretical and empirical work in the recent year. This literature is mainly focused on the performance evaluation of various forms of cooperative R&D relative to non-cooperating R&D for firms competing in a product market. A seminal contribution within the economic analysis of RJVs is that of d'Aspremont and Jacquemin (1988). Their analysis is conducted in terms of a two-stage model of oligopolistic competition with R&D spillovers. In the first stage, firms decide on their cost-reducing R&D either cooperatively or non-cooperatively. In the second stage they engage in quantity competition in the product market. Building on this framework, Kamien, Muller, and Zang (1992) analyze a model allowing a richer set of R&D cooperation scenarios. In particular, they compare two different types of RJVs: First, firms may coordinate their R&D efforts in order to maximize their joint product market profits while conducting R&D in separate labs. Second, firms may decide on their R&D efforts in a non-cooperative way but jointly agree to fully share their R&D activities among RJV partners. Kamien et al. (1992) refer to the former scenario as RJV cartelization, to the second one as RJV competition. They show that the cartelized RJV is superior to RJV competition as well as to two other scenarios in which firms either cooperatively or non-cooperatively decide on their R&D activities but do not share R&D efforts.

Concerning RJVs there are, of course, other possible modes of organizing the cooperation between RJV partners. Of particular interest and realized in several real world examples are RJVs in which firms coordinate their R&D activities in a hierarchical structure. Cooperating firms establish a new separate organizational entity that is jointly owned by all participating partners in the RJV and in charge of the coordination of all partners' R&D activities. In the following we call this type of cooperation RJV hierarchy: Cooperating firms set up an entity in the form of RJV headquarters that coordinate the R&D activities carried out in the firms' respective R&D units. The advantage of an RJV hierarchy comes from the headquarters' possibility to influence the R&D activities of their member firms strategically in the competition with non-cooperating firms. In particular, we assume that headquarters can subsidize the R&D costs of the participating firms in the RJV so as to maximize overall profits.[2]

Different to most of the existing literature on RJV following d'Aspremont and Jacquemin (1988), we do not analyze the organizational design of RJVs in the context of process innovation.[3] Instead, we focus on product innovations and model R&D as a patent contest, see Bagwell and Staiger (1997): Firms compete to enter a new market with an innovation. To be the first to serve the new market or to serve an existing market with a new product implies a quasi-monopoly in form of additional profits compared to other firms. To improve their innovation potential and to increase their chances of winning the R&D contest, firms compete by spending resources in innovation activities. These efforts cannot be recovered, whether the firm wins the patent or not. Examples for such R&D contests are high-technology industries in which the firm with the best idea wins an exclusive right for commercializing its idea, such as the contest sponsored by the Federal Communications Commission to develop the best technology for high-definition television, see Baye and Hoppe (2003), or the pharmaceutical industry

[1] See, for example, Hagedoorn and Schakenraad (1990, 1991, 1992) for the emergence of inter-firm cooperative agreements since the early 1980s.

[2] For other possibilities how the headquarter of the RJV could influence its members' incentives to invest in R&D, see Section 3.3.

[3] Some other contributions have extended d' Aspremont and Jacquemin' model in several ways: For example, Suzumura (1992) extends the model to n-firms, Poyago-Theotoky (1995) studies the endogenous number of participants in the RJV, Salant and Shaffer (1998) study optimal asymmetric strategies in RJV, Petit and Tolwinski (1999) introduce dynamics and asymmetries, and Molto, Georgantzis, and Orts (2005) consider cooperative R&D with endogeneous technology differentiation.