International Journal of Industrial Organization 31 (2013) 342–353

Contents lists available at SciVerse ScienceDirect

International Journal of Industrial Organization

journal homepage: www.elsevier.com/locate/ijio

Breaking up a research consortium ☆

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ARTICLE INFO

Article history:
Received 25 October 2010
Received in revised form 14 May 2013
Accepted 21 May 2013
Available online 28 May 2013

JEL classification:
C72
D82
L20

Keywords:
Optimal R&D contracts
Adverse selection
Breakup date
R&D collaboration

ABSTRACT

Inter-firm R&D collaborations through contractual arrangements have become increasingly popular, but in many cases they are broken up without any joint discovery. We provide a rationale for the breakup date in R&D collaboration agreements. More specifically, we consider a research consortium initiated by a firm A with a firm B. B has private information about whether it is committed to the project or a free-rider. We show that under fairly general conditions, a breakup date in the contract is a (second-best) optimal screening device for firm A to screen out free-riders. With the additional constraint of renegotiation proofness, A can only partially screen out free-riders: entry by some free-riders makes sure that A does not have an incentive to renegotiate the contract ex post. We also propose empirical strategies for identifying the three likely causes of a breakup date: adverse selection, moral hazard, and project non-viability.

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1. Introduction

The last three decades have witnessed a barrage of inter-firm collaborations on Research and Development (R&D), particularly in industries like pharmaceuticals, information technology, aerospace, defense, automotive, consumer electronics, chemicals, instrumentation, and medical equipment (Hagedoorn, 2002). Out of this increasing popularity of R&D collaborations, a noticeable change comes from their organizational arrangements: a majority of inter-firm R&D partnerships were established not through Research Joint Ventures – that have been the focus of numerous theoretical studies[1] – but through non-equity contractual agreements. Narula and Hagedoorn (1999) report that R&D collaborations via contractual arrangements account for more than 70% of all R&D partnerships.

The waves of R&D collaborations have attracted a lot of attention among economists interested in studying the impact of collaboration on R&D productivity. To their surprise, many R&D consortia broke up after a short period. Kogut (1989) finds a large number of R&D partnerships failed in the first year. Kale et al. (2002) notice that around 40% of R&D partnerships were judged as unsuccessful. Reuer and Zollo (2005) further find that more than half of R&D collaboration agreements were terminated by one partner or through contract expiration. In fact, the failure rate in biotech-pharmaceutical R&D alliances is as high as 70% (Hansen, 2003). The high incidence of failure has led some economists to caution readers about their empirical findings because of the selection effect due to only more promising research consortia being formed (Danzon et al., 2005).

Why would a firm initiate an R&D collaboration with another and then break up at a later time? Conventional wisdom points to the story of firms' finding out that their joint research projects are not viable during R&D collaboration. This, however, is not the case in many failed R&D collaborations since often the remaining partner continues the R&D project on its own.[2] Further, in some cases

☆ We thank participants of IIOC 2009 in Boston, EARIE 2009 in Ljubljana, the Midwest Economic Theory Meeting 2010 in Evanston, Vidya Atal, Mario Bersem, Yossi Spiegel, and two anonymous referees for helpful comments. We gratefully acknowledge the hospitality of the Managerial Economics & Decision Sciences and Management & Strategy Departments at the Kellogg School of Management at Northwestern University, where part of this research project was conducted. The first author thanks the Swiss National Science Foundation for financial support through grant PBBE1-121057 and the Deutsche Forschungsgemeinschaft for financial support through SFB-TR 15.

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[1] For example, Katz (1986), d'Aspremont and Jacquemin (1988), and Kamien et al. (1992). They and others have justified R&D cooperation on a number of grounds, such as internalizing spillovers, avoiding duplicate R&D efforts, and capturing technological complementarities. In contrast, the literature on R&D contracts is sparse. See Section 6 for a discussion of the related literature.

[2] For example, in 1993 Airbus and Boeing agreed to jointly conduct R&D on Very Large Commercial Transport. The cooperation was ended in 1995, after which Airbus continued to develop the super jumbo jet A380 by itself. Similar observations can be made in the pharmaceutical industry: after having terminated the R&D collaboration agreement with GlaxoSmithKline, Cytokinetics continues its drug development and clinical trials.

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http://dx.doi.org/10.1016/j.ijindorg.2013.05.002

research partners voiced the suspicion that their partner was not truly committed to the success of the project, either because it could cannibalize one of its products or because of the intention to free ride on the other firm's effort.[3] Ample evidence indicates that R&D partners' private information about their own interests and willingness to commit to their joint projects are among the major causes of R&D collaboration failures.[4] Therefore, it is an interesting and insightful approach to consider how the anticipation of meeting a free-rider affects the choice of collaboration contracts ex ante. Above all, the termination clause is the most negotiated item in R&D collaboration contracts (Lerner and Malmendier, 2005).[5]

In contrast to conventional wisdom, we show that the breakup clause can be seen as an ex ante efficient measure — it serves as an effective screening device in an R&D collaboration contract. Using contract theory to analyze R&D collaboration contracts, we show that under fairly general conditions, a breakup rule in the form of a term limit is necessary and optimal in screening out bad partners. In particular, a breakup rule makes sure that only committed research partners agree to participate in a collaboration. The reason for this is that a breakup rule makes participation less attractive for non-committed types who are more inclined to drag out the project in order to reap private benefits.

Specifically, we consider a firm A, the principal, that owns the right to conduct R&D on a project and can choose whether to start an R&D consortium with a firm B, the agent. Firm B's type is its private information. It can be a committed research partner or a free-rider. We show that a breakup becomes necessary when there is a misalignment of incentives: while the principal prefers to collaborate with a committed agent because it generates higher profits for the principal, a free-rider actually has higher private benefits than a committed agent.[6] This misalignment of incentives turns out to be quite common in the pharmaceutical industry where big pharmaceutical firms free-ride small research firms' R&D by accepting collaboration requests but providing little cooperation.[7] Upon success, the big pharmaceutical firm can reap much higher benefits due to economies of scale and scope in the industry. In this respect, our story is especially relevant in explaining the high frequency of breakups in pharmaceutical R&D consortia. In particular, we show in a setup with the possibility of commitment to a breakup that if the ratio of free-riders is large, the optimal contract is a single fully separating contract with a breakup date. The principal is willing to incur the cost of inefficient breakup with a committed research partner in order to avoid the cost of a likely cooperation with a free-rider. However, if the ratio of free-riders is small, then the principal is willing to take the small risk of cooperation with a free-rider rather than bearing the cost of an inefficient breakup with a research partner who is likely to be committed. Hence, the principal chooses a pooling contract without a breakup date.

Our second contribution concerns the time inconsistency problem of a breakup date as a screening device: while it is ex ante efficient to include a breakup clause to screen the committed agents, ex post – after the agent revealed its type – it may not be optimal to actually break up. We extend the setup to one with imperfect commitment: the principal cannot commit not to renegotiate the contract. We show that the solution of this contracting under imperfect commitment problem can take two forms: a pooling contract or a partially separating contract. The pooling contract is clearly renegotiation proof since the agent does not reveal its type. The partially separating contract (or equilibrium), in which free-riders randomize between participating and not, is renegotiation proof because the fraction of free-riders makes the principal (weakly) better off by not continuing the cooperation. Furthermore, we derive a necessary and sufficient condition under which a renegotiation proof single partially separating contract is feasible and is preferred by the principal to both the pooling contract and to the principal conducting research alone. If the ratio of free-riders is low, the principal cannot credibly commit to breakup. However, if commitment to a breakup is credible, i.e. a breakup clause is renegotiation proof, then breakup is optimal for the principal.

Our results have relevance for the empirical study of R&D collaborations. Empirical studies on R&D cooperation often face a challenging problem — firms with strong R&D capabilities, which are typically more committed, are more likely to participate in R&D collaborations. This selection problem has become the "probably single greatest econometric problem facing any analysis seeking to measure the impact of government support on commercial R&D activity" (Branstetter and Sakakibara, 2002). The problem of asymmetric information has been recognized in the empirical studies of R&D collaboration contracts,[8] but little has been accomplished in disentangling hidden information, hidden action, and imperfect knowledge of the viability of the project. This is because the identification of adverse selection and moral hazard is widely considered a challenging problem since both of them are unobservable. Our model tells a story from the adverse selection perspective, although hidden action and unknown viability may also play a role empirically. A full-blown empirical analysis is beyond the scope of this paper. Nevertheless, we propose several empirical identification strategies to determine the role of termination dates (see Section 5). In addition, the closed form solution from our simple model generates many empirically testable hypotheses. For example, our results show that a firm that has better possibilities of commitment (e.g. because a firm is large or known to be a long-run player in the industry[9]) is more likely to include a breakup clause with its partner and to actually break up, once the breakup date is due.

The remainder of the paper is structured as follows. Section 2 lays out the model and Section 3 discusses the main results under perfect commitment. Section 4 considers contracts when commitment is not possible. Section 5 discusses several empirical strategies for identifying the role of the termination date. Section 6 discusses the related literature and concludes the paper. Appendices B to E are provided as a web appendix (see the working paper version Niedermayer and Wu (2013)).

[3] Esty and Ghemawat (2002) quote an Airbus employee suspecting that the research collaboration between Airbus and Boeing failed because Boeing had different objectives and did not want to see the new super jumbo jet cannibalize their 747 product line.

[4] For example, see Mahnke and Overby (2008). The authors observe that many R&D collaborations fail because "the participants maximize their private benefits at the expense of the common ones".

[5] Lerner and Malmendier (2005) find that "firms pay an enormous amount of attention to negotiating termination rights. These terms have been described as 'probably the most heavily negotiated (at least in terms of time) provision' in biotechnology research agreements." Hagedoorn and Hesen (2007) find that termination clauses in R&D collaboration contracts have attracted more attention in the recent economics and management literature. A termination clause usually includes both a termination date and post-termination arrangements such as payments and control right allocation. Termination dates are widely observed in R&D collaboration contracts. In an empirical analysis of 52 R&D collaboration contracts in the telecommunications equipment industry, Ryall and Sampson (2009) note that firms usually set a fixed termination date for joint R&D development. They also note that having an explicit termination clause ex ante could facilitate the smooth functioning of the R&D collaboration contract.

[6] We relax this assumption in the section on multidimensional types: breakup can be optimal as long as the agent's private benefit is not perfectly negatively correlated with the principal's profit.

[7] See Hansen (2003) for this asymmetric contractual arrangements in biotech-pharmaceutical industries. Danzon et al. (2005) provide evidence on counter-productive R&D when small firms collaborate with large firms with broad scopes.

[8] The right of termination has not been studied from a contract theoretical perspective in empirical literature until recently. Lacetera (2009) studies the control right among industry-university R&D collaboration contracts. Lerner and Malmendier (2010) test the cross-substitution problem in biotech research collaborations.

[9] Note that firm size or whether a firm is a long-run player as a proxy for commitment power may have some endogeneity issues if not all characteristics are controlled for.

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