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Cooperative and noncooperative R&D in experimental duopoly markets

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Abstract

We analyze the relation between technological spillovers and R&D cooperation in a duopoly experiment based on the well-known model of d'Aspremont and Jacquemin. For scenarios without and with full spillovers, two noncooperative treatments are run, one without and one with non-binding communication possibilities, and one cooperative treatment, with binding contract possibilities. We find that without technological spillovers, binding R&D contracts are needed for R&D decisions to deviate from the subgame perfect Nash R&D level towards the cooperative level. With full spillovers, the possibility of non-binding cheap-talk may suffice to move closer to R&D cooperation.

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1. Introduction

In the last decade an abundance of theoretical papers modelling competition and cooperation in R&D activities with technological spillovers has arisen. Most of these are

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extensions or modifications of the paper of d'Aspremont and Jacquemin (1988)[1] (henceforth AJ), where duopolists first decide on R&D expenditures and then compete in the product market. In these models, R&D conducted by a firm reduces its unit production cost and may have spillovers, reducing the unit cost of the other. A general finding is that R&D investment and welfare are higher under R&D cooperation than under R&D competition if the spillover is above a certain threshold, and lower otherwise. The results are often interpreted as a rationale for governmental support of research joint ventures in industries with large knowledge spillovers.

A related and important question is whether spillovers increase firms' incentives to cooperate in R&D. A number of empirical studies have addressed this issue, providing mixed results. Cassiman and Veugelers (2002), for example, find that the probability of firms cooperating in R&D is lower when outgoing spillovers are high (low appropriability). These results are in conflict with most of the AJ like theoretical models, which predict that–when spillovers are above a critical level–cooperative R&D incentives of firms increase with the level of (incoming and outgoing) spillovers. On the other hand, Cassiman and Veugelers (2002) also find that the incentives to cooperate in R&D are higher when incoming spillovers are high, which can be viewed as evidence in support of the theoretical prediction. Kaiser (2002) finds that (horizontal) spillovers increase the probability to cooperate in R&D, while Belderbos et al. (2004) find no significant influence.[2] Hernán et al. (2003) provide evidence for a positive relationship between outgoing spillovers and incentives to cooperate.

Given the difficulty in measuring spillovers and the differences in data sets underlying econometric estimations, in estimation methods and in ways of defining or computing proxies that should represent technological spillovers,[3] it is not surprising that these empirical studies have yielded different results and it is unlikely that a consensus can emerge in the near future.

In this paper we use experimental methods to investigate whether incentives to cooperate in R&D are different for different levels of spillovers. An important advantage of the experimental approach is that the characteristics of spillovers and other assumptions made in the models can be controlled. For two spillover scenarios (no and full spillovers), we ran two noncooperative treatments (a baseline and a cheap-talk treatment) and one cooperative treatment. In the noncooperative treatments subjects played a noncooperative R&D game and did not have any contract possibilities. The cheap-talk treatment contained a possibility to send (non-binding) messages containing information on intended R&D investment. We included a cheap-talk treatment since previous oligopoly experiments have shown that allowing for an appropriate form of non-binding communication may increase cooperation rates (see, e.g. Holt and Davis, 1990; Cason, 1995; Harstad et al., 1998). In the cooperative treatment, binding contract possibilities were allowed, as in a cooperative R&D game.

[1] Examples are Kamien et al. (1992), Poyago-Theotoky (1995), Leahy and Neary (1997), Petit and Tolwinski (1999), Hinloopen (2000), and Amir et al. (2003).

[2] They do find a significant influence of vertical spillovers on vertical cooperation.

[3] Spillovers are difficult to measure empirically because they can arise through different channels, such as through the movement of R&D personnel, networks, meetings, patent applications and reverse engineering (see Veugelers, 1998).