

Response to comment on Clark & Sand (2009) "Endogenous Technology Sharing in R&D Intensive Industries", Economics Discussion Paper, No 2009-28

We appreciate the detailed comments provided by the anonymous author, and we will in due course revise the paper to take the comments into account. Before proceeding with our response to the comments, we would like to take some time to justify our formulation of the effect of the technology sharing and the simplifications that we feel have been necessary to be able to combine the literature on R&D and the literature on endogenous coalitions when introducing asymmetries.

Our R&D cooperation involves a simple sharing of technology advancements without coordination of the R&D activities, which is an approach that has been coined "RJV competition" by Kamien, Müller & Zang (1992). This is one of the four models analysed in their work. Consequently, we feel that our formulation of the R&D cooperation is within the realm of the R&D literature, but we acknowledge the fact that a great number of papers on R&D incorporate cooperation also at the stage of deciding on R&D expenditure. This is briefly mentioned in the Introduction where we write "RJVs can take various forms, ranging from simple information sharing arrangements with non-cooperative investment decisions by separate R&D units, to fully integrated R&D units where investment decisions are made to maximize joint profits". Our approach is also compatible with a number of technology sharing arrangements, among them the aircraft engine manufacturing example provided in the paper. We will attempt to clarify and justify our assumptions on R&D cooperation in some more detail in a revised version.

The suggested literature is certainly relevant to mention, and will be included in a revision. Our approach is related to that of endogenous spillovers in that the *formation* of a coalition has implications for spillovers between firms. By agreeing to join a coalition with one or two competitors, the partners implicitly agree to share technology advancements. This is similar in many respects to firms deciding how much of the technology advancements should be transferred to rival firms (i.e., how large is the spillover parameter chosen to be). The importance of the degree of spillover for innovative activity is studied by numerous authors (see, e.g., De Bondt, 1996, for an overview). Gil Molto et al (2005) analyse a situation where firms endogenously choose the design of the R&D process, where more compatible R&D technologies leads to higher degrees of spillover. Related to this is also the literature on absorptive capacity and spillovers, with Kamien and Zang (2000) and Wiethaus (2005) as examples of this avenue of research. The main idea there is that firms choose (endogenously) R&D approaches, idiosyncratic or broad approaches, which again have implications for the degree of spillovers. These papers come to different conclusions with respect to the choice of R&D approaches by competing firms. Furthermore, if the firms undertaking R&D can protect their inventions, e.g., by the use of some kind of patent protection, this is also in effect a way of limiting the degree of spillover from the investing firm to its rivals. This is analysed in, e.g., Milliou (2009).

Allowing for limited spillovers, as opposed to the perfect spillovers analysed in our paper, may have implications for the predicted outcomes. It is possible to solve for the various coalitions we consider with less than perfect spillovers, but it turns out to be very difficult to solve for the endogenous coalition which is an important part of our analysis. The issue of less than perfect spillovers is mentioned in the last paragraph of the section "Technology sharing between the most efficient firms". The main trade-off is the following: Less than perfect spillovers (between partners) would, *ceteris paribus*, reduce the effective cost reduction and

moderate the increasing dominance effect. However, less than perfect spillovers also imply that the free-riding effect would be less dominant and work in the opposite direction. A potential effect on the ranking of welfare is mentioned in the section “Concluding Remarks”. With low spillovers, the value to society measured in terms of added consumers’ surplus is naturally lower. However, it is likely that even with very low spillovers firms would choose to join a coalition if it is costless to join, and if its cost advantage over its rivals is not deteriorated.

In highly concentrated industries, which is the case that we consider, competition policy authorities would generally be reluctant to allow too much cooperation even though research & development collaborations are provided with a block exemption from Article 81 in the EC Treaty. In particular, with a block exemption on a R&D cooperation project it is unlikely that coordination of the production of the final product will be allowed. As mentioned in the comment to our paper, it is certainly a plausible sharing of technology information which allows the partners to produce at the lowest cost technology available. However, our concern is with a situation where not all technological knowledge is distributed to all coalition partners, which in our opinion is a highly likely scenario. In such a case, the coalition partners are faced with their initial cost of production, but they are able to obtain technological advances from the partners, which reduce their production costs in some dimensions complementary to a firm’s own R&D effort.

One argument for coordinating R&D expenditures is to reduce socially wasteful R&D effort, which would provide an additional social gain from cooperation (often due to elimination of fixed costs of R&D). In the context of our analysis, the cost of doing research involves a quadratic cost function, and the technology advances are complementary. This implies that the eliminating R&D undertaken by one firm does not necessarily imply a social benefit. Furthermore, to achieve the same total impact of the R&D another coalition partner would have to increase its R&D spending if one firm reduces his spending, which due to the quadratic R&D cost function would imply higher total expenditure on R&D.

We certainly do agree that it is an interesting avenue for further research to include cooperation at the two different levels mentioned in the comments (cooperatively setting R&D expenditures, and sharing information on R&D results). This would move the focus of the analysis more over to endogenous spillovers, but we feel that this is beyond the scope of the present paper.

References (in addition to the three provided in the comments):

- De Bondt, R. 1996. Spillovers and innovative activities. *International Journal of Industrial Organization*
- Kamien, M., E. Muller and I. Zang. 1992. Research Joint Ventures and R&D cartels. *American Economic Review*.
- Kamien, M. and I. Zang. 2000. Meet me halfway: Research Joint Ventures and absorptive capacity. *International Journal of Industrial Organization*