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THEME F

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**European Research Joint Ventures and Innovation:
a microeconomic analysis of RJV impact on
firms' patenting activity**

Abstract

Evolutionary theories of technological change and industrial dynamics give primary importance to interaction between heterogeneous agents, endowed with complementary assets and competencies. Accordingly, support to co-operative R&D is given a central role in technology policy, as a mean for increasing system connectivity, triggering virtuous cycles of learning and promoting variety. However, despite the increasing attention to the rationales, benefits and costs of R&D agreements, that, within the broader debate about technology policy, have been extensively investigated through appreciative theories, game theoretical models, and strategic management studies, there has been little corresponding empirical work on their efficacy. The empirical investigations have been conducted mostly at the level of case-studies or one-time surveys of participants. The technology policy emphasis on extensive collaborative programmes, covering nearly every area of industrial research and involving very large numbers of organisations, has been barely matched by systematic investigations on large samples.

In particular, no extensive study about the impact of collaborative R&D activities, supported by EU institutions or intergovernmental agreements, on firms' *innovative potential*, as measured by effective patenting output, has yet been produced¹.

The paper proposes an assessment exercise of European RJVs' effects on patenting activity, which elaborates a large panel data of European firms, the RJV_EPO dataset, which combines information about RJVs with data about participants' patenting behaviour.

The analysis focuses on R&D consortia in the area of *Information and Communication Technology* and *Medical and Biotechnology*, which play a critical role for the development of a competitive European Innovation System.

The presentation and interpretation of econometric results are linked to the discussion of specific methodological issues, which are particularly relevant when studying economic count data, such as patent applications.

The first part of the econometric investigation is inspired by the analysis of Branstetter and Sakakibara (1998), who estimate the effects of participation in R&D consortia on Japanese firms' innovative performance. The analysis extends their basic framework, explores differences between technological areas, discusses the peculiar nature of the process being modelled and, in a second stage, proposes the application of non-linear models in place of the standard linear model, emphasising the significant drawbacks of a linear approximation, when dealing with count data which exhibit a high frequency of zero-value observations and a greatly skewed distribution.

The formalisation of the patenting process follows the Knowledge Production Function Approach, which is extensively used in the literature about R&D productivity and spillovers (Griliches, 1984, 1995,1998; Jaffe, 1986). The production of knowledge is related to industry and individual characteristics, including the participation to collaborative R&D projects. Patent activity is assumed to reflect this process of knowledge generation, although propensity to patent may vary over industries and individual organisations.

The estimation is run on a sample referring to the period 1992-1996 and including both participants to European RJVs and a counterfactual of non-participating firms. The latter is selected according to a stratified sampling methodology, which attempts to replicate in the "Control Group" the industry and country composition of RJV members.

The descriptive statistics reveal a high degree of heterogeneity between RJV participants and non-participants: firms which enter European R&D consortia are, on average, bigger and more

¹ Recent econometric analyses based on comprehensive dataset concerning European Programmes have focussed on the impact of RJV affiliation on firms' performance, as measured, for instance, by total factor productivity (e.g. Benfratello and Sambenelli, 2000; Bussoli, 2000).

innovative than non-participants. This first-level analysis points to the need for addressing the issue of self-selectivity, before conducting the proper panel data estimation.

Hence, the work discusses the problem of self-selection of RJV members, whose higher level of innovativeness may reflect a greater “prior-to-entry” innovative ability, which is therefore independent of RJV participation. The assessment of self-selectivity follows the approach of recent empirical works in the area of international trade, which deal with the evidence of a positive correlation between firms’ productivity and exporting activities (Bernard and Jensen, 1995; Clerides et al., 1998, Aw et al., 2000). The overall findings of the proposed empirical tests seem to be consistent with the self-selection hypothesis, but there is also evidence of learning processes taking place once the (more innovative) firms enter R&D consortia, so that the innovative gap in relation with non-participating firms widens. The research further discusses the identification of appropriate control variable, such as size and knowledge capital, which may allow to disentangle the self-selection of innovative firms from the learning effect induced by co-operative action.

The econometric analysis employs Poisson and Negative Binomial models, developed by Hausman, Hall and Griliches (1984), that generalise the basic assumptions of fixed and random effects panel data model to the case of count data, in particular to the analysis of patenting behaviour.

Interesting results about the role of knowledge capital, size and differences between technological macro-sectors emerge.

First of all, patent output appears to be positively related to cumulated knowledge in all technological areas. The finding is consistent with the idea that the generation of technological knowledge is a cumulative process.

Size seems to matter more in the Information Technology (IT) area than in the Medical and Biotechnology (MB) field, where no clear evidence of largest firms being more innovative is found. Mostly interesting, in terms of policy analysis and evaluation of European innovative strategies, when controlling for cumulated innovative experience, size and industry effects, it appears that participation to European R&D consortia has positively affected patenting output in the MB area, whereas the impact seems negligible in the IT area. The positive effect in the MB field appears to reflect the role played by European consortia in opening up innovative networks to new members, whereas, in the IT field, European programmes seem to have strengthened the position of the major industry leaders.

The last section of the paper evaluates whether the relationship between patenting activity and RJV participation changes over size classes. The estimation results point again to interesting differences between technological areas. In both IT and MB fields, we estimate a negative impact of RJV participation on small firms’ patenting activity, whereas the effect appears to differ, in the two

areas, for other size classes. In the IT field the estimated impact is slightly significant, and positive, for medium-size firms, and is negligible for large firms. In the MB area the effect appears greatly significant and positive for medium-large firms.

The conclusive part of the work comments the results of the empirical investigation and points at interesting areas for further studies, such as additional inquiry about the differences between technological macro sectors, or the role of cumulated innovative experience and size in determining ability to reap benefits from co-operation.

In this respect, an important place in the research agenda is to be assigned to the identification of appropriate measures of knowledge-related characteristics. In fact, the limitations of the patent measure, which captures only one aspect of the structure and extent of the knowledge base of economic agents and only partially reflect “innovative potential”, appear all the more binding.

In this sense, empirical research is to benefit from the development of tools for investigation that more closely reflect the rich conceptualisation of knowledge and innovative processes proposed by the evolutionary literature about technological regimes (Malerba and Orsenigo, 1993, 1997) and knowledge creation in co-operative settings.

References

- Benfratello L., Sambenelli A. (2000), *Research Joint Ventures and Firm Level Performance*, W.P. 13-2000, Fondazione Eni “Enrico Mattei”, Milan
- Bernard A.B., Jensen J. B. (1995), ‘Exceptional exporter performance: cause, effect or both?’, *Journal of International Economics* 47 , pp. 1-25
- Branstetter L., Sakakibara M. (1998), ‘Japanese Research Consortia: a microeconomic analysis of industrial policy’, *Journal of Industrial Economics*, vol XLVI, pp 207-233
- Bussoli P. (2000), *An empirical analysis of technological convergence process and RJVs in Europe at the firm level*, WP 12-2000, Fondazione Eni “Enrico Mattei”, Milan
- Griliches Z. (1984), *R&D, Patents and Productivity*, University of Chicago Press, Chicago

- Griliches Z. (1990), 'Patent Statistics as Economic Indicators: a Survey', *Journal of Economic Literature*, vol XXVIII, December, pp. 1661-1707
- Hausman J., Hall B. Griliches Z. (1984), 'Econometric Models for Count Data with Application to Patents- R&D Relationship', *Econometrica*, 52, pp. 909-938
- Jaffe A. (1986), 'Technological Opportunity and Spillovers of R&D: evidence from firms' patents, profits and market value', *American Economic Review*, vol 76, No 5, pp. 984-1001
- Llerena P., Matt M. (1997), *Inter-organizational collaborations: the theories and their policy implications*, WP 9703, BETA, Université "L. Pasteur", Strasbourg
- Lundvall B.A. (ed) (1992), *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*, Pinter Publishers, London
- Lundvall B.A., Borrás S. (1997), *The globalising learning economy: implications for innovation policy*, Report based on the preliminary conclusions from several projects under the TSER Programme, DG XII Commission of the European Union
- Malerba F., Orsenigo L. (1993), 'Technological Regimes and Firm Behavior', *Industrial and Corporate Change*, vol 2, No 1, pp. 45-74
- Malerba F., Orsenigo L. (1997), 'Technological Regimes and Sectoral Patterns of Innovative Activities', *Industrial and Corporate Change*, 6, pp. 83-118
- Metcalf J.S. (1995), 'The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives', in P. Stoneman (ed), *Handbook of the Economics of Innovation and Technological Change*, Basil Blackwell, Oxford
- Nelson R.R. (ed) (1993), *National Innovation Systems: a Comparative Analysis*, Oxford University Press, New York
- Peterson J., Sharp M. (1998), *Technology Policy in the European Union*, Macmillan Press, London