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Simultaneous embeddedness in different networks and its effect on scientific knowledge generation: evidence from Spanish scientists

Abstract: Introduction: research topic

Interactions between Public Research Organisations (PROs henceforth) and Industry are at the forefront of policy agendas world-wide as they are instrumental to foster technological development and economic competitiveness. Interactions between PROs and industry can also help attenuate the pressures that the current global economic crisis place on public sector research budgets – especially in countries with high levels of debt –by providing external private funding, directly oriented to the generation of marketable innovations. The scope of this paper is to deepen the understanding of PROs-Industry links with reference to the antecedents of their formation and the impact of these links on the world of scientific knowledge production. In broad terms this endeavour involves the analysis of the process through which knowledge producers (i.e. scientists) both organize within their own community and interact with industry to generate scientific knowledge.

Main research questions

Although previous research has studied topics such as the process by which the different incentive structures of scientists and industry staff align to produce different instances of PROs-Industry links (Arvanitis et al., 2008; Landry et al., 2010) and the effect of PROs-Industry links on scientific productivity (Azoulay et al., 2009; Toole and Czarnitzki, 2010), extant literature has concentrated to a lesser extent on how the complex organisational structure of the scientific community affects scientific productivity (Uzzi et al., 2007). In particular, two main gaps are worth noting.

First, former studies have focused on a limited set of mechanisms of knowledge generation and transfer, mostly including patents, publications and academic spin-offs while almost completely disregarding others such as R&D contracts and consulting (D'Este and Patel, 2007). This gap is particularly unfortunate, because they are more frequent compared to other means of engagement in knowledge transfer activities; they are often critical channels through which public research can impact on industrial R&D and they are also appreciable as streams of income (Perkmann & Walsh, 2007).

Second, not only single relationships between scientists and external agents are important but also the overall structural properties of the network of relationships are essential in nurturing the generation of knowledge. Although a large literature in organization science, economics and management of innovation has analysed the structure and characteristics in the organisation of science, to our knowledge only Breschi and Catalini (2010) have tried to model the simultaneous embeddedness of scientists in different networks. In particular, they combined data on scientific co-authorship with data on patent co-invention to assess the extent of the overlap between the two communities and to identify the role of key individuals in the process of knowledge transfer. They show that the extent of the connectedness among scientists and inventors is rather large, and that authors-inventors

act as gatekeepers and bridge the boundaries between the two domains, are fundamental to ensuring this connectivity.

Overall, our contribution tries to address the gaps outlined above by answering to the following research questions: (i) What is the effect of a more complete range of knowledge transfer activities – such as contract R&D and consulting – on the generation of scientific knowledge? (ii) Is the simultaneous embeddedness in multiple networks (i.e. scientific co-authorships, patent co-inventions, collaboration on contract R&D and collaboration in consulting activity) influencing knowledge creation? (iii) how different structural network properties – such as brokerage position within a network of relationships (e.g. network of collaboration in consulting activity) and brokerage position between different networks (e.g. between the network of patent co-inventions and the network of collaboration in consulting activity) – affect the generation of scientific knowledge?

Data and method

The empirical analysis exploits a unique dataset containing detailed project/contract level information on PROs-Industry links in Spain. The database contains information on the population of scientists (i.e. 4757) working at the Spanish Scientific Research Council (CSIC) over the period 1999-2008. CSIC is the main publicly funded research organisation present in Spain and the third in Europe. It is composed of 135 institutes covering all fields of science (Physics, Chemistry, Biology, Medicine, Mathematics, Computer Science, Humanities, Social Sciences) and comprises about 3200 scientists (permanent staff). Several unique features of the database are worth mentioning. First, the data comes from the administrative records of the CSIC and, thus, they are not affected by usual concerns relative to survey-based measures, i.e. self-report bias. Second, the longitudinal nature of the data allows the exploitation of recent advancements in econometrics to tackle endogeneity issues. Thirdly, the data is characterised by a richness of details at: (i) scientist level providing information on age, affiliation, position, experience, scientific field and the highest degree attained and (ii) the contract/project level providing comprehensive information on the typology of the contract (i.e. collaborative grant, R&D contract or consulting), duration, the amount contracted and the content of the contract. Moreover, information on the publication and patenting activity of the scientists contained in the dataset for the period 1999-2008 has been retrieved from PATSTAT and ISI-WEB. From a methodological viewpoint, we aim at exploiting the longitudinal nature of the data to address our research questions. In particular, we will employ non-linear panel data models with fixed effects and quasi-experimental procedures (in particular, conditional difference-in-differences) in order to identify whether the research productivity (measured in terms of quality weighted number of publications) changes along different characteristics (e.g. within and between structural constraints, measures of centrality, age, experience, etc.).

Expected contributions

We believe that the paper will contribute to uncover the conditions that favour (or hamper) an optimal organisation of scientific activity, as well as to shed new light on the effect of different kinds of structural holes on the extent of research productivity at the individual level. The results of this paper should therefore contribute to fill an important gap in the existing literature on university-industry knowledge transfer and organisation of science, as well as providing valuable suggestions to improve the effectiveness of policies oriented to favour university-business interactions.

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