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Factors affecting university–industry R&D projects: The importance of searching, screening and signalling

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Abstract

This paper presents an empirical analysis of the determinants of research cooperation between firms and Public research organisations (PROs) for a sample of innovating small and medium-sized enterprises (SMEs). The econometric analysis is based on the results of the KNOW survey carried out in seven EU countries during 2000. In contrast to earlier works that provide information about the importance of PROs' research, we know the number of firm/PRO collaborative research and development (R&D) projects. This allows us to study the determinants of firm collaboration with PROs in terms of both the *propensity* of a firm to undertake R&D projects with a university (do they cooperate or not) and the *extent* of this collaboration (number of R&D projects). Two questions are addressed. Which firms cooperated with PROs? And what are the firm characteristics that might explain the number of R&D projects with PROs? The results of our analysis point to two major phenomena. First, the propensity to forge an agreement with an academic partner depends on the 'absolute size' of the industrial partner. Second the openness of firms to the external environment, as measured by their willingness to *search*, *screen* and *signal*, significantly affects the development of R&D projects with PROs. Our findings suggest that acquiring knowledge through the *screening* of publications and involvement in public policies positively affects the probability of signing an agreement with a PRO, but not the number of R&D projects developed. In fact, firms that outsource research and development, and patent to protect innovation and to *signal* competencies show higher levels of collaboration.

JEL classification: H4; L3; O3

Keywords: Public research organisations; University–industry R&D relationships; Openness

1. Introduction

Since the 1980s, many countries have implemented policies to promote and sustain university–industry partnerships. In the light of this phenomenon, an increasing number of academic contributions have attempted to understand, explain, and justify these interactions in economic terms. In Europe, university–industry relationships have been analysed mainly from a qualitative point of view or by relying on case studies of single universities.[1] Very few contributions have been supported by systematic data analysis. Some country-

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[1] See, among others, Faulkner and Senker (1995) for a qualitative technology-specific study. See Geuna et al. (2004), among others, for a university specific case (University Louis Pasteur, Strasbourg).

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specific data have been gathered and analysed: Meyer-Krahmer and Schmoch (1998) and Beise and Stahl (1999) provide interesting evidence of the contribution of public research to industrial innovation in Germany. At the European level, apart from the PACE (Policies, Appropriability and Competitiveness for European Enterprises)[2] questionnaire and the three Community Innovation Surveys (CIS),[3] there are few databases that facilitate analysis of the links between universities and firms taking into account firm, sector and country effects.

The aim of this paper is to develop an original quantitative analysis of the determinants of firms' participation in research and development (R&D) projects with public research organisations (PROs are defined here as universities and other public research centres). Our analysis provides preliminary evidence of the characteristics that affect firms' involvement with PROs in R&D projects, controlling for country and sector fixed effects.[4] We use the results of the 2000 KNOW survey covering seven EU countries, including the four largest. The survey was limited to five sectors: food and beverages, chemicals (excluding pharmaceuticals), communications equipment, telecommunications services and computer services, and focused on small and medium-sized enterprises (SMEs) employing a minimum of 10 and a maximum of 999.

The econometric estimations are based on direct measurement of the extent of cooperation between firms and PROs. Unlike previous studies we have information on the number of R&D projects conducted jointly with PROs in the 3 years before the survey (1997–2000). This direct measure of university–industry interaction allows us to assess the factors that affect: (a) the probability of a firm developing cooperation with a PRO and (b) the number of R&D projects developed by the firm in the previous 3 years. Specifically, we address two main questions. Which firms established partnerships with PROs during the 3 years before the questionnaire? What are the particular characteristics that might explain the number of their R&D projects with PROs?

Particular attention is devoted to the idea that the openness of the firm to the external environment has an important effect on the development of collaboration with PROs. Openness refers here to the broad set of activities that firms can conduct to acquire knowledge from, voluntarily disclose knowledge to and/or exchange knowledge with the external world. These activities include *searching*, *screening* and *signalling* and can be carried out in different ways. It is important to account for these activities in order to understand whether their impact on both the propensity and the extent of collaboration is similar. In addition to openness we analysed the influence of other variables on firms' collaborations with PROs. Among these control factors we tested for firm size, firms' R&D activity, firms' innovative activity and firms' tendency to outsource R&D.

The paper is organised as follows. Section 2 briefly reviews the literature on university–industry R&D cooperation. Section 3 discusses the information collected in the KNOW survey and in-depth interviews, relevant to the understanding of university–industry links. The propensity for and extent of engaging in R&D projects are examined in Section 4 using an econometric model. Finally, Section 5 summarises the main results of the analysis.

2. University–industry relationships

The extensive literature on university–industry relationships is mainly empirical and based on case studies, patent and bibliometric analyses, or large surveys. One part of the literature highlights the positive impacts of scientific results on the economic sphere. Without academic research outcomes many innovations could not have been realised or would have come much later (Mansfield, 1991; Beise and Stahl, 1999). Scientific results brought about increased sales and higher research productivity and patenting activity for firms (Cohen et al., 1998). A second strand of the literature examines the relative importance of PROs, from the point of view of firms, as an external source of information both for new ideas and innovation completion. Cohen et al. (2002a) and Fontana et al. (2003) show that although in both phases public research is less important than contributions from the vertical chain of production (suppliers, buyers, the firm itself), among the sources that are not in the production chain (competitors, consultants, joint ventures) the contribution of PROs is indeed significant. Other contributions study the importance of the channels used by both actors to exchange knowledge. Cohen et al. (2002a) find that the channels of open science (publications, public meetings and conferences) are crucial. Other studies (Meyer-Krahmer and Schmoch, 1998; Arundel and Geuna, 2004) underline the importance of

[2] See Arundel et al. (1995) and Arundel and Geuna (2004) for an analysis based on the PACE data, which focused on the large EU R&D intensive firms.

[3] See, among others, Mohnen and Hoareau (2003) for an analysis based on CIS II.

[4] In the paper, we look at R&D project between firms and PROs. However, the word 'collaboration' is frequently used throughput the text as a synonym. Indeed, R&D projects can broadly be interpreted as collaborations since the majority of R&D projects probably entail a collaborative element.