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Antecedents of innovation impacts in publicly funded collaborative R&D projects



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ABSTRACT

This study investigates antecedents of innovation impacts derived by firms participating in publicly funded collaborative R&D projects. Innovation impacts are reflected in product and process innovation, and inimitability of the resulting technology. Project and firm-specific factors are considered. The dataset for our analysis is based on survey responses from 694 firms collected through an extensive data collection effort of pan-European scale. The general picture emerging from our results is that firms engaging in such projects can gain in terms of innovation, conditional on their superior in-house capabilities and the nature of the project itself.

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1. Introduction

It is widely understood that firms do not rely exclusively on their internal R&D activities to maintain their technological competitiveness (Powell and Grodal, 2005; Malerba and Vonortas, 2009). Technological inter-firm alliances constitute a prominent complementary vehicle for the creation and exploitation of new knowledge, a process upon which economic and social development is based. Since the mid-eighties the number of R&D alliances has grown rapidly (Hagedoorn, 2002), and so has the academic and policy interest in the phenomenon. Reflecting the latter, direct subsidies for collaborative research have become a central element in research and technology policy in advanced economies.

Our aim in this study is to identify determinants of innovation impacts obtained by firms that participate in publicly funded cooperative R&D projects; specifically, projects funded by the fifth and sixth European Union (EU) Framework Programme (FP) for Research, Technological Development and Demonstration (1998–2006). Public funding of research and innovation is typically justified in terms of market failures related with problems of incomplete appropriability of the returns to R&D resulting from knowledge spillover mechanisms (Nelson, 1959; Arrow, 1962),

failures that lead to serious private sector underinvestment in R&D. Public intervention is also needed to address systemic failures that block the functioning of innovation systems as a result of conflicting incentives between enterprises and public sector organizations, institutional rigidities stemming from narrow specialization, asymmetric information, and lack of networking (OECD, 1999). Seen under this light, the FP represent a key instrument of the European research policy towards the (admittedly ambitious) goal of transforming the EU into the most competitive and dynamic knowledge-based economy in the world (i.e. the “Lisbon objectives”).

At the EU level, there exists convincing evidence from a large number of evaluation studies that the FP do indeed play a significant role in the European R&D landscape. At the national level of analysis, the potentially positive effects of publicly funded collaborative research projects on participating organizations' innovative activities and performance have been fairly well established in the literature (see, for example, Hagedoorn et al. (2000), Link et al. (2002), Hemphill and Vonortas (2003), Busom (2000), Wallsten (2000), Lach (2002), Almus and Czarnitzki (2003), Czarnitzki et al. (2007)). We know little, however, about the factors that contribute to the innovation impacts obtained by participants in such projects. Our study is an attempt to provide answers towards this direction.

For present purposes, innovation impacts are conceived to comprise two basic dimensions: first, new/improved products (goods and services) and processes achieved by participating firms and second, the “inimitability” of the resulting technology. Project

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and firm-specific factors are considered, together with a number of controls. The dataset for our analysis is based on survey responses regarding collaborative R&D behavior and outcomes collected through an extensive data collection effort of pan-European scale. The field survey targeted exclusively organizations (companies, universities, research institutes, etc.) that were known to have been involved in the fifth and/or sixth Framework Programme (FP5, FP6). As such, ours is *not* a study about the causal impact of (publicly funded) collaborative R&D *per se*, as this would require an entirely different research design (notably the presence of an additional comparable sample of firms *not* engaged in cooperative research, or perhaps a comparable sample of firms participating in *privately*-funded research consortia); neither do we adopt an *additionality* perspective in an attempt to isolate the impact of public support on the innovative behavior of participating firms (i.e. how the firm would carry out its innovative activities absent public funding) (see, for example, [Wanzenböck et al. \(2013\)](#), [Hsu et al. \(2009\)](#), [Lee \(2011\)](#)), as this would require that we observe our sample firms *before* and *after* participation in the focal project. Instead, we seek to identify project- and firm-level correlates of innovation impacts derived by companies participating in FP research projects. The general picture emerging from our analyses is that such antecedents concern superior in-house innovation-related capabilities and the nature of the project itself.

The remainder of the paper is organized as follows. The next section presents the theoretical background and hypotheses development. [Section 3](#) describes the data collection methodology and the measures used in our analyses. [Section 4](#) presents the results, followed by a discussion of the findings. The final section concludes.

2. Background and hypotheses

Given the central role the FP play within the wider context of European science and technology policy, it is not surprising that a vast and diverse body of policy and professional literature has sought to evaluate their impacts; in contrast, to our knowledge, there is very little research about the *specific factors* contributing to firms' ability to derive innovation impacts from their participation in public support schemes.

A number of evaluation studies over the past couple of decades have culminated evidence that the FP support scientific excellence by attracting top scientists and leading research institutions; contribute significantly to long-term economic growth; deliver positive social and environmental impacts; generate crowding-in effects (i.e. have a positive effect on the total availability of R&D funding and on the level of companies' R&D investments); and appear to produce large numbers of patents, innovations, and other types of micro-economic benefits for the participating enterprises, even though firms take part in such projects to achieve knowledge and technology-related objectives rather than to develop commercial products and services. (For a detailed review of these impacts, see "Impact Assessment Accompanying the Communication from the Commission 'Horizon 2020 – The Framework Programme for Research and Innovation'", 2011.)

The academic literature, on the other hand, conducted mainly, but not exclusively, at the national level of analysis and basically looking at issues of additionality of public support for innovation, at least partially confirms the idea that public funding (including, but not limited to, support for collaborative R&D) has a positive effect on innovation activities and outputs. For instance, [Masso and Vahter \(2008\)](#), using Estonian data from CIS4 (2002–2004), find that public innovation funding positively affects product but not process innovation (using CIS3 data, covering 1998–2000, the impact is insignificant). Using cross-country data from CIS3, an

OECD study ([Jaumotte and Pain, 2005](#)) finds that an increase of 1 percentage point in the proportion of firms receiving public support corresponds with a rise of 0.4 percentage points in the likelihood of being a successful innovator, a statistically significant association. In addition, it is found that this positive effect concerns "true innovators" but not imitators, and firms in manufacturing but not in services. In a study of UK firms using data from the CIS4, [Battisti and Stoneman \(2010\)](#) find that the percentage of firms that received public support increases with the intensity of innovative activity.

Focusing more narrowly on subsidized cooperative research, [Czarnitzki and Fier \(2003\)](#) find that publicly supported networks in Germany tend to patent more compared to privately financed consortia. [Mora-Valentin et al. \(2004\)](#) examined a sample of publicly supported cooperative research agreements in Spain and found that the factors with the highest effect on firm's perceptions of success are commitment, previous links, definition of objectives and, negatively, the degree of conflict. Using the second and third waves of the CIS from Germany and Finland, [Czarnitzki et al. \(2007\)](#) find that both public R&D funding and collaborative research positively affect patenting activities of the participating organizations. In Japan, [Branstetter and Sakakibara \(2002\)](#) found that participants in publicly funded research consortia increased their patenting activities over time. There exists, therefore, fairly strong evidence that public support is positively related to recipient firms' innovative behavior and performance, and – more closely related to our purposes here – that participation in publicly funded collaborative research schemes confers a positive impact in terms of innovation outputs. But as noted above, we know very little as to what drives these impacts for firms participating in such projects, and this is what we now turn to.

2.1. Hypotheses

The conceptual framework guiding this study is simple and intuitive. At the center of our analysis lie the innovation impacts a firm can derive from its participation in a publicly funded collaborative R&D project (i.e. product and/or process innovation, and the inimitability of the resulting technology). We consider determinants of these impacts along two basic levels of analysis: project and firm. Project-related factors refer to the intrinsic character (i.e. novelty and complexity) of the technology pursued; firm-level characteristics refer to those internal attributes (i.e. innovation-related capabilities and experiences) that enable a participating firm to benefit from cooperative R&D. We expect that both types of factors will have a bearing on the likelihood of innovation, as explained below.

2.1.1. Project-specific effects on innovation impacts

Innovation impacts derived by a firm participating in an R&D consortium necessarily will be influenced by the intrinsic characteristics of the explored technology. Publicly financed R&D programmes, such as the EU FP, seek to support projects that otherwise would not be undertaken by the private sector precisely because of the high risk and complexity associated with the research.

Novelty here refers to the degree of change in the technology relative to prior technologies and the extent of familiarity with it ([Stock and Tatikonda, 2000](#)). The degree of novelty manifests itself not only in terms of the technical risk of actually developing the basic knowledge underlying the technology in question as well as the required functionality, but also in terms of the commercial risks associated with any new technology. Complexity refers to the degree of interdependence between the subcomponents in the technology, the degree of interdependence between the technology and elements external to it, as well as to the scope of the

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