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Harnessing the science base: Results from a national programme using publicly-funded research centres to reshape firms' R&D

Kevin Mulligan, Helena Lenihan, Justin Doran & Stephen Roper

Synopsis

Since 2000 and the launch of Science Foundation Ireland (SFI), Irish policymakers have been involved in a large-scale national science policy programme. Starting from a position with little pre-existing research infrastructure beyond its traditional higher education system, Ireland allocated significant public resources to rapidly develop an extensive research centres programme. These centres are designed to harness knowledge embedded in the national science base to impact firm-level Research and Development (R&D). The OECD's (2015) Frascati Manual defines R&D as including three components: basic research; applied research; and development. Basic research is experimental/theoretical work undertaken primarily to acquire new knowledge (without any particular application or use in view). Applied research is also undertaken to produce new knowledge, but with a specific, practical aim. In contrast, development draws on knowledge which already exists, to produce new products or processes. In summary, basic and applied research represent the 'R' in R&D. Each SFI research centre focuses on basic and applied research (as opposed to development), targeted at prioritised sectors of the economy.

Using a novel panel dataset (2007–2017), our analysis provides the first evaluation of these research centres. While most previous studies have only been able to examine firms' overall R&D, our data enable us to focus on overall R&D, as well as basic and applied research. Results indicate that research centre collaborations increase firm-level R&D. Over time, collaboration re-orientates firms' R&D more towards the 'R' in R&D.

Introduction and Background

Collaborating with key actors in the national science base, such as universities, can be a catalyst for firm-level R&D, driving innovation and firm performance (Readman et al., 2018). However, firms and universities often have fundamental differences in their institutional logics and priorities (Hall, 2003). This is particularly true for the 'research' component of R&D, which necessitates the creation of so-called 'new knowledge,' as opposed to development which applies pre-existing knowledge (OECD/Eurostat, 2018). Engaging in knowledge creation is essential for firms to build in-house scientific capabilities (Arora et al., 2018), which are a key driver of firm performance (Durand et al., 2008). However, firms and academics are said to inhabit two different worlds: While firms tend to view new knowledge as a means of achieving competitive advantage, knowledge creation can be an end in itself for university academics (Dasgupta and David, 1994). Known as the 'two-worlds' paradox, this issue presents a potential barrier to successful firm-university collaborations (Hewitt- Dundas et al., 2019).

This issue is a major concern for policymakers seeking a return on their investment in higher education (OECD, 2011). In this context, Science Foundation Ireland (SFI) research centres were designed to bridge the gap between university-based knowledge and firm-level R&D (DBEI, 2014; SFI, 2018), so as to create a step change in Ireland's R&D

Authors

Dr Kevin Mulligan, Department of Economics, Kemmy Business School, University of Limerick, Ireland

Prof Helena Lenihan, Department of Economics, Kemmy Business School, University of Limerick, Ireland

Prof Justin Doran, Spatial and Regional Economics Research Centre, Department of Economics, Cork University Business School, University College Cork, Ireland

Prof Stephen Roper, Enterprise Research Centre and Warwick Business School, University of Warwick, UK

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landscape (Indecon, 2018; Technopolis, 2014). To achieve this, each SFI research centre has a dual mandate to conduct world-leading scientific research (as opposed to development), and enhance the economy through research collaborations with firms.

Issues and Questions Considered

Our study addresses the following key research question: What impact does collaborating with publicly-funded research centres have on firm-level R&D?

In examining this research question, our study makes two significant contributions to the literature on public funding for R&D. First, previous studies have focused primarily on the impact collaboration has on the total scale of firms' R&D. However, Vanino et al. (2019) and Nilsen et al. (2020) argue that distinguishing between research, as opposed to more development-focused projects, is crucial, but this has not been explored in the literature to date. Therefore, our first contribution is to go beyond whether collaboration changes the total volume of firm-level R&D, and examine specific impacts on basic and applied research.

Our second contribution focuses on whether the impact of research centre collaboration on firm-level R&D varies, depending on the sector firms operate in, firm size, and what research domain the research centre operates in (e.g. biotechnology or software development). As noted by Becker (2015), examining whether the impact of different public R&D supports varies in different groups of firms, can have significant implications for policy. Policy effects may be identified in the general sample of firms, but not in a specific sub-group which policymakers may wish to target. Despite their potential importance, sub-group analyses remain rare in the literature. Our study provides, to our knowledge, the first sub-group evidence on research collaborations and firm-level basic and applied research.

Methodology

Our analysis is based on a novel panel dataset, which merges administrative data on Science Foundation Ireland (SFI) research centre collaborations with detailed survey data on firms' R&D activities, from the Business Expenditure on Research and Development (BERD) survey, for the period 2007–2017. This dataset distinguishes between firms' basic research, applied research, and development (i.e. the 3 components of overall R&D). This data enables us to examine whether research centre collaboration leads firms to re-orientate their R&D towards basic and/ or applied research. Such a fundamental re-orientation may take time to manifest. Therefore, we examine the impact of research centre collaboration on firms' R&D over 1–2, 3–4, and 5–6 year periods. Our econometric analysis combines Propensity Score Matching (PSM) with a Difference-in-Differences (DiD) estimator. PSM enables us to compare firms who collaborated with SFI research centres, with a statistically identical comparator group

of firms who did not collaborate, based on firm-level characteristics which are captured in our dataset (Scandura, 2016). Our DiD estimator then uses the panel structure of our data, to control for any potentially important firm-level characteristics which are not captured in our dataset (Szücs, 2018).

Outcomes and Findings

Our analysis suggests three main empirical findings. First, firms that collaborated with Science Foundation Ireland (SFI) research centres experienced an increase in their in-house R&D intensity in the 1–2 year period after the collaboration begins. The magnitude of this impact increases over time. Second, collaborating with publicly-funded research centres can stimulate the research component of firms' in-house R&D, but it takes time for this impact to materialise. Firms that collaborate with SFI research centres significantly increase the proportion of applied research in their in-house R&D, in the 3–4 and 5–6 year periods following the collaboration's start date. Third, firm size and sector play a significant role in determining the impact of research centre collaborations on firm-level R&D. While the impact of collaboration on firms' overall in-house R&D is greater for large firms (≥250 employees), Small and Medium-sized Enterprises (SMEs; <250 employees) experience a greater increase in applied research orientation. This suggests that large firms may already have sufficient absorptive capacity to internalise the knowledge spillovers from the collaboration. In contrast, SMEs may need to build up the specific scientific part of their absorptive capacity to reap the full benefits of collaboration.

From a policy perspective, our findings suggest two potential implications. The first implication concerns the specific impacts associated with a major shift in national science policy on firm-level R&D. Results from the Irish experience of the strategic decision to embrace large-scale, targeted investment in basic and applied research, suggest that this type of policy programme is a viable policy option for other countries (with similar underlying conditions to Ireland when the policy programme was launched). Our study's second policy implication concerns SFI research centres' dual mandate to conduct scientific research, and collaborate with firms. Our findings suggest that the dual mandate criteria helps to build industry-relevant research capacity within selected fields of the higher education system, where little pre-existing infrastructure existed.

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Authors:
Kevin Mulligan, Helena Lenihan, Justin Doran & Stephen Roper

For further information and comments, please contact:

Dr Deirdre O'Loughlin
Assistant Dean, Research
Kemmy Business School
University of Limerick, Ireland
T: +353 61 213375
E: Deirdre.OLoughlin@ul.ie

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