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R&D policy instrument mix sequencing: Evaluating the impact of receiving R&D grants and R&D tax credits over time on firm-level R&D

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Synopsis

The R&D policy instrument mix concept has become increasingly important for understanding how public R&D support drives firm-level R&D. Empirical studies have conceptualised the R&D policy instrument mix as a static unit, with firms receiving R&D instruments at one point in time. However, firms can also receive different instruments in a sequence, *over time*. Our study is the first to evaluate how R&D policy instrument mix sequencing impacts firm-level R&D. Using a unique dataset over a 17-year period for Ireland, we find that R&D policy instrument mix sequencing is highly effective at driving firm-level R&D, and that some sequences are superior to others.

Introduction and Background

The impact of public support to R&D in firms, in terms of incentivising additional private investment in R&D (i.e. input additionality), has been extensively studied (see Dimos and Pugh 2016; Becker 2019). Evidence suggests that both R&D grants and R&D tax incentives generate positive R&D input additionality in firms. Since the works of Nauwelaers et al. (2009) and Flanagan et al. (2011), the concept of the R&D policy instrument mix has gained increasing attention for better evaluating the impact of public R&D funding on firm-level R&D. An R&D policy instrument mix occurs when firms receive a combination of different R&D policy instruments that target similar policy goals. Evaluation studies considering a mix of R&D policy instruments have focused almost exclusively on firms that receive

different instruments at one point in time (as opposed to over time in a sequence). Coburn et al. (2021, p. 20) have highlighted this fact, calling for future empirical research “to study the sequencing of interventions over the long term”. We address this issue, by investigating the following critical research question: *What is the impact of receiving R&D grants and R&D tax credits in different sequences over time on firm-level R&D?*

Issues and Questions Considered

In the empirical context of Ireland, which is the focus of our study, R&D grants are allocated based on specific R&D projects. R&D tax credits can be claimed on eligible R&D spending. Firms can use R&D grants and R&D tax credits for the same project, but they cannot claim R&D tax credits for grant-supported R&D spending. This means that the same R&D project can be funded by both instruments, but the same spending cannot be publicly-funded twice. Therefore, a sequential R&D policy instrument mix implies either a sequencing of spending on ‘the same’ R&D project over time, or a sequencing of different R&D projects at the firm level.

Considering the above, we begin by focusing on situations whereby firms first receive an R&D tax credit, *followed by* an R&D grant in later periods. We suggest that a higher input additionality, as compared to receiving only one type of R&D policy instrument, is likely to occur. This is because R&D tax credits will enable firms to start R&D projects that otherwise would have been postponed, or

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not pursued, due to too low expected return on investment. We then focus on situations whereby firms first receive an R&D grant, *followed by* an R&D tax credit in later periods. Here, we also suggest that a higher input additionality, when compared to receiving only one type of R&D policy instrument, is likely to occur. This is because R&D grants can enable firms to invest in building-up new R&D capabilities and explore new fields of technology or application, and pursue this with R&D tax credit funding. Finally, when examining R&D policy instrument mix sequences, we propose that receiving an R&D grant first, *followed by* an R&D tax credit in later periods, will result in higher levels of R&D additionality. A key argument here is that R&D grant funding can enable significant learning effects in firms, and expose new areas of R&D investments for firms.

Methodology and Data

As described in Figure 1, we construct a unique and novel dataset based on two main sources. The first source comprises administrative data from the Irish funding agencies and government bodies (Enterprise Ireland, IDA Ireland and the Irish Revenue Commissioners) responsible for allocating R&D grants and R&D tax credits to firms in Ireland (from 2006 to 2017). These detailed administrative data are combined with our second source: The Annual Business Survey of Economic Impact (ABSEI). This annual survey includes information on firms' R&D activities, covering the period from 2000 to 2017. This results in a unique dataset, comprising 8,556 unique firms, and 36,136 firm-year observations, over a 17-year period for Ireland.

For our analysis, we develop a novel way to measure R&D policy instrument mix sequencing, focusing on the R&D policy instruments firms receive over a four-year

time window. We use this measure in a multi-treatment panel-data matching approach, which addresses issues of selection bias.

Outcomes and Findings

We find firms that receive R&D grants and R&D tax credits as part of a sequence over time, invest more in R&D compared to firms that receive a single R&D grant or R&D tax credit. Importantly, we find that the most impactful way to drive input additionality, is when firms first receive an R&D grant, *followed by* an R&D tax credit.

Our paper contributes to the empirical literature on the R&D policy instrument mix in two significant ways. Our first contribution is to bridge the gap between theory and empirical analysis, in how the R&D policy instrument mix impacts firm-level R&D. Our second contribution is the development of a novel empirical strategy for R&D policy instrument mix *sequencing*. We conceptualise each R&D policy instrument mix sequence over time as individual and distinct treatment units. We use a panel matching approach to analyse the R&D expenditure of treated firms, *vis-à-vis* a pure control group of firms that share a statistically identical pre-treatment history. Finally, we compare the treatment effects across the different treatment units (i.e. the sequences). This empirical approach allows us to achieve a detailed understanding of the impact of different R&D policy instrument mix sequences over time, on firm-level R&D.

In terms of implications for policy, our findings suggest that policymakers should account for the sequence in which R&D policy instruments are provided over time. This is of great potential importance for policymakers in terms of R&D policy instrument design, allocation, and implementation, and most importantly, as they evaluate the eventual impact of public R&D support on firm-level R&D.

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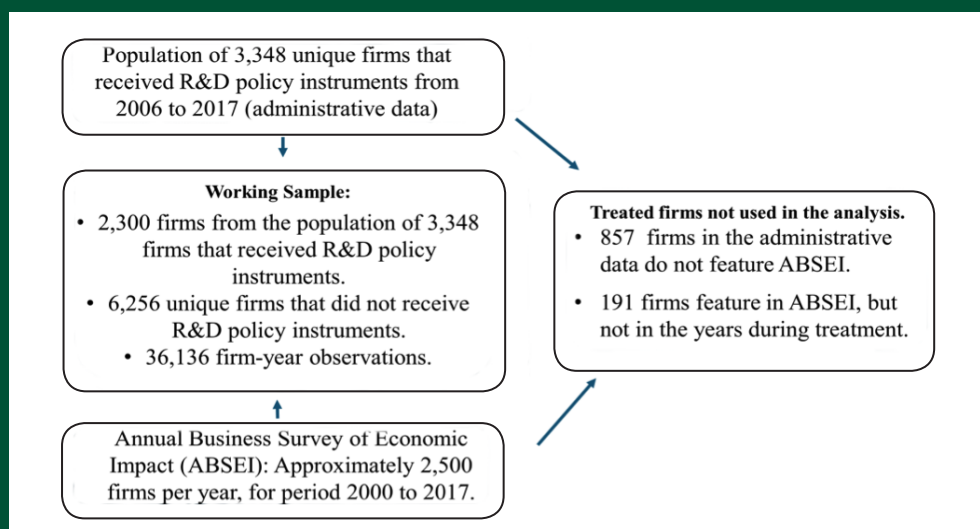
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Figure 1: Diagram of Working Sample



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