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Do the effects of R&D tax credits vary across industries? A meta-regression analysis

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ABSTRACT

This paper presents a survey of the micro-econometric literature on the effects of R&D tax credits on firms' innovation activities. We focus on one specific aspect that has not received sufficient attention in previous research: the sectoral dimension. Our meta-regression analysis (MRA) sets up a new database collecting a large number of firm-level studies on the effects of R&D tax credits and investigates the factors that may explain differences in the estimated effects that are reported in the literature. The main result of the MRA analysis is indeed that sectors matter. Specifically, the additionality effect of R&D tax credits is on average stronger for SMEs, firms in the service sectors, and firms in low-tech sectors in countries with an incremental scheme. The paper proposes a simple framework to investigate why the innovation and economic effects of R&D tax credits vary across sectors and points out new directions and hypotheses for future research.

1. Introduction

R&D tax credits are a major public policy instrument that has the objective to increase private firms' incentives to invest in R&D activities. A large empirical literature has investigated the effects of fiscal incentives to R&D, in the attempt to estimate the extent to which a given amount of tax credits leads to an increase in firms' R&D investments (Hall and Van Reenen, 2000). While the earlier literature focused on a few countries only, and in particular the US, an increasing number of micro-econometric studies on a large number of economies have been presented during the last few years (Parsons and Phillips, 2007; Mohnen and Lokshin, 2009). The exponential growth in the literature is partly due to the increasing popularity of tax credits, which are now adopted in more than 20 OECD countries; but it has also been fostered by the greater availability and diffusion of firm-level data in several countries, and particularly in Asia and in Europe (OECD, 2010).

The bulk of this micro-econometric literature provides estimates of the rate at which R&D investments increase due to the introduction of fiscal incentives (additionality ratio) or, correspondingly, the rate at which the marginal costs of R&D investments decrease (user-cost elasticity). One dominant characteristic common to most of the existing studies is that their main objective is to estimate the average effect of R&D tax credits in a large sample of firms. So far, however, the literature has not questioned explicitly whether this average estimated parameter may vary among industrial sectors, and the possible reasons for cross-industry differences.

One of the major results in the field of innovation studies is that sectors matter (Malerba, 2005). Firms in different industries differ substantially in terms of the innovation strategy they adopt and the technological performance they achieve. The sectoral context provides micro agents (firms) with a set of opportunities and constraints that greatly shape the way in which they organize their innovative activities (Dosi, 1982; Pavitt, 1984). Specifically, the R&D distribution of firms varies greatly by sectors. Other sector-specific factors – such as the degree of market competition, technological opportunities, and the intensity of knowledge diffusion and spillover effects – do also differ substantially across industries. It is therefore reasonable to suspect that firms' responsiveness to fiscal incentives to R&D, and the related innovation and productivity effects, may vary considerably among industries.

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So, do the effects of R&D policy support vary systematically by sector, and if so, why? Our paper intends to investigate this new research question by carrying out an updated overview of the literature and a meta-regression analysis to study whether the effects of tax credits differ across industries.

Our meta-regression analysis (MRA) builds up a new database containing information on a large number of firm-level studies on the effects of R&D tax credits. We make this MRA database publicly available in order to allow replications and future extensions of the present study.[1] We then investigate the factors that may explain differences in the estimated effects that are reported in the literature. In addition to several other control factors, the key explanatory variable that we focus on refers precisely to the sectoral dimension: our MRA regressions investigate whether those studies that have controlled for sectoral characteristics, e.g., by comparing high- and low-tech industries, have on average achieved different results than other micro-econometric works. The main result of the MRA analysis is surprising: empirical studies that have focused on a sub-sample of high-tech industries have on average obtained a smaller estimated effect of R&D tax credits, particularly in countries that adopt an incremental system. Further, we also find that the additionality effect of R&D tax credits is stronger for SMEs and for firms in the service sectors.

These are interesting patterns that call for further research. If corroborated by future investigations, these findings would cast doubts on the effectiveness of R&D tax incentives. This would in fact imply that fiscal resources intended to stimulate R&D and economic competitiveness have a relatively stronger effect on those industrial sectors that are characterized by low technological opportunities and weak spillover effects to the rest of the economy. If so, R&D tax incentives mechanisms should be redesigned in order to take into account the sector-specific conditions that shape innovation propensity and dynamics in different industries of the economy, and in particular allocate a greater amount of fiscal incentives to R&D to high-opportunity and technologically dynamic sectors.

There exists a few thorough overviews of this literature, and in particular Hall and Van Reenen (2000), Garcia-Quevedo (2004), Parsons and Phillips (2007), Ientile and Mairesse (2009), Mohnen and Lokshin (2009) and Cerulli and Poti (2012). The specific novelty of our survey paper and its intended contribution to the literature are threefold. First, the MRA database that we make available opens up for future updates and extensions of this type of analysis of the effects of R&D tax incentives. Secondly, by explicitly investigating the role of the sectoral dimension, we create a bridge between the R&D policy literature, on the one hand, and the important strand of research on sectoral patterns of innovation, on the other. Thirdly, we propose a simple framework to investigate why the effects of R&D tax credits vary across sectors and point out new directions and hypotheses for future research.

The paper is organized as follows. Section 2 introduces the literature on the effects of R&D tax incentives. Section 3 presents the MRA database, indicators and econometric methods. Section 4 summarizes the MRA regression results. Section 5 discusses a framework for future research. Section 6 concludes and outlines the implications of the work.

2. The effects of R&D tax credits

Business firms' R&D investments are important for the growth and competitiveness of national economies. Several countries have recently increased their efforts to strengthen innovation performance by means of R&D policy, following e.g., the guidelines of the Lisbon Agenda in EU (Lundvall and Borràs, 2005). R&D policy can basically take two distinct forms: it can either directly allocate public R&D resources through grants or procurement, or alternatively provide indirect support by means of R&D tax incentives.

R&D tax incentives are tax deductions that firms can claim if they are involved in R&D activities, thus providing them with an incentive to increase their innovation efforts. Tax credits are typically directed to all firms in the economy and hence let private agents decide what type of project to apply for. Their effect is to reduce the marginal cost of R&D investments (Hall and Van Reenen, 2000). By contrast, R&D subsidies target specific projects with high social returns and a longer time horizon, and their effect is to raise the marginal rate of return of R&D (David et al., 2000). An advantage of tax incentives vis-a-vis subsidies is that the former are less subject to policy inefficiencies, since they are designed in a bottom up fashion and based on agents' decisions, whereas subsidies are more likely to incur in policy failure because they are highly dependent on the information available to the policy makers that manage the R&D program and the strategic priorities set by these.

R&D tax incentives by now have become a popular innovation policy instrument. More than 20 OECD countries currently support private R&D investments through this type of schemes, including not only advanced countries but also developing economies such as Brazil, India, China and South Africa (OECD, 2010). The widespread adoption of this type of R&D support schemes has increasingly attracted the attention of innovation scholars and fostered the development of a large stream of applied research, which investigates the effects of tax credits on firms' R&D expenditures by making use of firm-level data. While most of the early studies focused on enterprises in US states, the literature has recently been fostered by the increasing availability of firm-level datasets in several other countries in Asia and in Europe.

Hall and Van Reenen (2000) present a seminal overview of methods and results in this field. Parsons and Phillips (2007) provide an updated survey of the main results in the literature, and Cerulli and Poti (2012) is a comprehensive discussion of econometric methods in R&D policy evaluation. Researchers interested in the effects of R&D tax incentives on firms' innovation have typically adopted two distinct microeconometric approaches. The first is to estimate the following equation:

$$\mathrm{RD}_{ij} = \eta + \beta \mathrm{TC}_{ij} + \theta X_{ij} + \mu_{ij} \quad (1)$$

where RD_{ij} is the R&D expenditures of firm i in industry j, TC_{ij} is a variable measuring the tax credit received by the enterprise, and X_{ij} is a vector of firm-specific characteristics affecting its R&D strategies (e.g., past R&D, cash flow and financial conditions, size, technological capabilities). In this specification, the parameter β (expected positive) measures the additionality ratio, which indicates the average increase that a tax credit induces in firms' R&D investments.[2] The second approach estimates instead the following equation:

$$\ln\mathrm{RD}_{ij} = \kappa + \lambda \ln\mathrm{UC}_{ij} + \psi X_{ij} + \nu_{ij} \quad (2)$$

in which UC_{ij} is a variable measuring the user cost of R&D (i.e., its marginal costs), and the parameter λ (expected negative) is the elasticity of R&D with respect to its price, measuring by how much R&D will increase when its marginal costs decrease (see Hall and Van Reenen, 2000: 467).

Most of the early studies focused on US and Canadian firms, where R&D tax credits schemes have a longer and well established tradition, and initially made use of OLS approaches to estimate Eq.

[1] The database is available at: http://english.nupi.no/Activities/Projects/R-D-Policy-by-Sector-A-Cross-Country-Investigation.

[2] The additionality ratio is either pointed out as treatment effect, if matching or difference-in-difference estimators are used, or simply as incrementality ratio through OLS and IV estimators.