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Radical or incremental: Where does R&D policy hit?

Mathias Beck[a], Cindy Lopes-Bento[b,c,*], Andrea Schenker-Wicki[d]

[a] University of Zurich, Department of Business Administration, Affolternstrasse 56, CH-8050 Zurich, Switzerland
[b] Maastricht University, School of Business and Economics, Tongersestraat 53, 6211 LM Maastricht, Netherlands
[c] Centre for European Economic Research (ZEW), Mannheim, Germany
[d] University of Basel, Faculty of Business and Economics, Petersgraben 35, CH-4001 Basel, Switzerland

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ABSTRACT

This study investigates the impact and effectiveness of a public R&D support policy. In a policy design that aims at incentivizing radical as well as incremental innovations, we test where the policy impact is highest. While the privately motivated R&D expenditures are significant for both types of innovation, the policy-induced part is significant only for radical innovation. Furthermore, given that the funding agency encourages collaboration, and particularly industry-science collaboration, we further test whether effects are enhanced in collaborating firms. We do not find any evidence pointing to increased effects for the latter.

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1. Introduction

Innovation is largely acknowledged to be a main factor of a country's sustainable and competitive development (Aghion and Howitt, 1992; Griliches, 1990; Romer, 1990). It is also recognized that due to market imperfections, firms are unlikely to reap all the benefits from their research, leading to underinvestment in R&D in the economy. Therefore, governmental support is a widely accepted means to foster socially valuable innovation.

The concept of market imperfection goes back to Nelson (1959) and Arrow (1962), who state that firms do not invest the socially desired level in R&D efforts due to market imperfections including limited approbiability, lower private than social returns, financial market constraints, high risks about technological standards, high costs and high uncertainty of R&D projects and further forms of negative externalities (Martin and Scott, 2000). The implications of this under-investment in R&D have encouraged policy makers to establish public support mechanisms. In the current paper, we are interested in one particular type of support, namely direct funding for R&D projects. More precisely, we aim at contributing to an ongoing debate about the returns of public R&D funding (Jones and Williams, 1998; Salter and Martin, 2001), and in particular about whether public money is used in the most effective way (David and Hall, 2000; David et al., 2000; Klette et al., 2000). In order to do so, we investigate the impact of the Swiss public support policy on outcome characteristics that have so far largely been ignored in this stream of literature. Specifically, we analyze where the policy effect is highest: incremental or radical innovation.

Based on the market failure theory stipulating that underinvestment in R&D may be particularly pronounced for more radical innovations because of higher uncertainty linked to such projects, one may expect to see an effect of public support on radical rather than on incremental innovation. Indeed, as shown by Karlsson et al. (2004) for instance, there is a higher probability of no returns on investment for more radical innovation when compared to

* Corresponding author at: Maastricht University, School of Business and Economics, Tongersestraat 53, 6211 LM Maastricht, Netherlands.
E-mail addresses: mathias.beck@business.uzh.ch (M. Beck), c.lopes-bento@maastrichtuniversity.nl (C. Lopes-Bento), andrea.schenker@unibas.ch (A. Schenker-Wicki).

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incremental innovation. Likewise, given the riskier nature of such projects, firms may have more difficulties to find external funding (see e.g. Kamien and Schwartz, 1978). As a consequence, given that funding agencies want to stimulate projects which are socially desirable but would not be undertaken without public support, one would assume that the impact is particularly pronounced for the latter. In the case of the Swiss innovation policy, the goal is however not merely destined at promoting frontier breaking innovation but also to maintain or enhance the competitiveness of the recipient firms, which can be achieved through incremental and radical innovations alike. It is therefore of high interest to know if the created impact is the same for both types of projects or if one type yields more returns than the other.

For the policy maker, such information is crucial in order to optimize the policy structure. Indeed, it is essential to know if the ex-ante project evaluation is appropriate to prevent firms from crowding-out of private R&D expenditures due to public R&D funding. Consequently, in a first step, we investigate the effectiveness of the policy scheme and test if the subsidy leads to higher R&D expenditures. In a second step, we analyze how this policy induced R&D expenditures translate into innovation output, differentiating between radical and incremental innovation. Indeed, even in case of positive input additionality (meaning higher R&D expenditures due to the subsidy), it remains unclear if the policy induced R&D is as productive as the privately induced R&D. Indeed, based on portfolio maximization theory, firms spent their private money first on projects with the highest expected returns. In case of equal (or even higher) productivity, it remains so far indeterminate whether the impact is highest for more radical or more incremental innovation projects. Therefore, a first and main contribution of this paper lies in disentangling the effects of privately invested and publicly induced R&D on innovation outcome, according to the degree of novelty of the products.

Our second contribution pertains to taking into account the firms' collaboration status. It has been proven that R&D collaboration is likely to impact innovation performance due to spillover effects, risk and cost sharing. Collaboration is therefore encouraged by the funding agency. Taking collaboration as well as the type of collaboration into account is therefore crucial as it can advise policy makers on the efficiency of this policy criterion. Within the various collaboration types, the Swiss funding agency particularly encourages collaboration with science. Shedding light on whether collaboration has an important impact on innovation outcome as well as what type of collaboration (i.e. is it mainly science, as encouraged by the agency or do other partners also play a role?) seems therefore particularly relevant in this context. So far, the literature does not advice on this issue, as the impact of the type of partner in a subsidy scheme has not been analyzed in previous papers. Indeed, most papers in the evaluation literature merely account for R&D collaboration (if at all), but do not pay attention to partner diversity.

Thirdly, the present study is undertaken on a representative sample of Swiss firms, which despite being considered an innovation leader among OECD countries, has not received as much attention as many other countries on this subject.

Finally, in contrast to most policy evaluation studies, our analysis also allows drawing conclusions from a managerial perspective. Knowing where the impact of an R&D subsidy is highest in order for them to best adapt grant application efforts to innovation strategies plays indeed an important role. Likewise, knowing whether input and/or output additionality is enhanced through collaboration (as well as through the type of partner) seems essential information for a manager to optimize its R&D project portfolio.

We base our analysis on a representative firm-level data-set covering the period between 1999 and 2011 of the Swiss innovation survey. We find that, on average, the receipt of an R&D subsidy translates into higher R&D investment. In terms of innovation performance, we find that the impact of public support is only significant for radical innovation, while no impact of policy-induced R&D is found for incremental innovation. Privately financed R&D on the other hand is significant for both types of innovation. In terms of collaboration, we do not find evidence that the impact of the policy is improved through collaboration. We can thus conclude that while the Swiss public R&D policy is efficient in terms of stimulating R&D investment and innovation performance of more radical nature, the current tendency of encouraging R&D collaboration does not seem to enhance such effects.

2. Institutional context of the Swiss innovation policy

Many countries have launched innovation policy programs to promote national innovativeness and competitiveness. An outstanding performance in R&D and innovation activities is considered an important factor not only for economic growth but also for a sustainable economic perspective in terms of employment, ecology and education for a modern knowledge society. In Switzerland, public funding of R&D has increased by 5.3% between 2000 and 2010. In 2010, the financial budget for appropriations or outlays dedicated to R&D covers an amount of 4.6 billion CHF, which corresponds to 0.81% of the country's GDP. In an international comparison (measures from 2008), Switzerland holds the eleventh rank of 31 OECD countries with public R&D funding corresponding to 0.73% of the country's GDP. The United States (1.02%) and Finland (0.98%) are on the top positions of the public funding per GDP ratio (FSO, 2012).

In Switzerland there are two major R&D funding agencies providing public grants for R&D programs and projects—the Swiss National Science Foundation (SNSF) and the Commission for Technology and Innovation (CTI)—with a total budget of 1.0 billion CHF in 2010. While the SNSF is mainly in charge of providing public grants to R&D projects or programs conducted by public research institutes or by individual researchers, the CTI is the responsible funding agency for R&D projects in the private sector, with a total budget of 118 Mio CHF in 2010. As a consequence, the subsidies under review in this study mainly stem from the CTI.

The subsidy scheme is not based on calls for proposals, but firms can apply with R&D projects all year long. Likewise, there are no restrictions in terms of technology fields supported by the agencies. Nonetheless, the CTI has the general goal to stimulate innovation in SMEs and encourages joint R&D activities between private companies and public research institutes. The focus of the policy is two-fold: on the one hand, the agency provides support for applied and market-oriented R&D projects which lead to the generation of improved technologies and products to strengthen the country's innovation position (CTI, 2011). On the other hand, the CTI also supports high risk but promising, cutting-edge technologies. As can be seen in Fig. 1 on the subsidy distribution by innovation type, there is hardly any difference between the number of subsidies going to firms with radical or incremental innovation output.[1]

Applicant firms have to provide a detailed description on the project's impact and a clear business and financial plan. The ex-ante evaluation is done by external and internal referees, which evaluate the expected effectiveness of the R&D projects. In 2010, 780 projects were evaluated, and 343 (44%) projects have been retained for public support (CTI, 2013).

In case of a positive evaluation, the firm receives a subsidy in form of a matched grant, where the public funding typically

[1] The distribution of subsidies across firm size classes and sectors can be found in Appendix 1, Tables A.1 and A.2.

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