Subsidies or loans? Evaluating the impact of R & D support programmes

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ABSTRACT

The objective of this study is to compare the effect of different types of public direct support for R & D projects on firms' technological capabilities. We distinguish between low-interest loans and national and European subsidies. Using data on 4407 Spanish firms during the period 2002–2005, we estimate a multivariate probit to analyse the determinants of firms' participation in public R & D programmes and, later, the impact of this participation on firms' R & D activities using two different procedures. Regardless of the methodology employed for the analysis, the results suggest that being awarded any type of direct aid clearly increases the probability of conducting R & D activities. In terms of being supported through a unique instrument, the greatest effect corresponds to the case of European grants, where the impact is more than three times larger than the one of loans. As for R & D intensity, the hypothesis of full crowding-out of private R & D is rejected for all types of support. In addition, we find that the impacts of subsidies and loans reinforce each other when they are jointly awarded to SMEs. However, for large firms we cannot rule out the existence of crowding-out effect between subsidies and loans.

1. Introduction

In the tradition of the economic literature, public support of research, development and innovation (R & D & I) activities is mainly justified by the existence of market failures (Hall, 2002; Hall and Lerner, 2010). The 'public good' nature of knowledge prevents full appropriation, which pushes private R & D & I investment below the socially optimal level. In addition, innovating companies may suffer from a financing deficit due to the presence of information asymmetry and moral hazard. Private financers may be reluctant to lend when the investment is concentrated essentially on intangible assets. This situation results in a higher cost of financing with respect to ordinary investment and a lower level of private external funding of R & D & I activities. These market failures would be greater for small firms and technology-intensive start-ups (Hall, 2002). Through aid programs, public agencies implicitly certify these companies, reducing the information asymmetries and helping these firms to face financial difficulties.

Public intervention could also have negative effects. Public support would displace private R & D spending if awarded firms reduce their own R & D investment beyond the level that would have been performed without the aid (Zúñiga-Vicente et al., 2014). Innovation policy could be captured by permanent R & D performers, and politi-

cians or interests groups may seek to allocate subsidies to benefit themselves (Lerner, 2002), selecting firms based on their likely success, regardless of a low marginal contribution of public aid.

Taking this into account, there is a great deal of empirical evidence on the impact of public aid on private R & D (see David et al. (2000), Zúñiga-Vicente et al. (2014), and Becker (2015), for a review). The variety of empirical methodologies used for this assessment is wide, including specific techniques to control for potential endogeneity of public support, non-linearities and firm heterogeneity (Wallsten, 2000; Busom, 2000; Lach, 2002; Duguet, 2004; González et al., 2005; González and Pazó, 2008; Czarnitzki and Licht, 2006; OECD, 2006; Clausen, 2008; Takalo et al., 2013). Many of these studies infer that direct support generates larger additionality at the extensive margin (share of R & D performers) than at the intensive margin (R & D intensity of actual performers). However, most papers consider only one programme in their analyses and this fact makes it difficult to accurately compare the impacts among funding systems, which can differ in their objectives, the national or supranational character of the supporting entity and the funding scheme (Blanes and Busom, 2004). In this sense, it seems reasonable that their evaluation also provides different results.

Three exceptions are the papers by García and Mohnen (2010), Czarnitzki and Lopes-Bento (2014) and Liu and Rammer (2016). In all

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cases, the empirical analysis is based on microdata from the Community Innovation Survey (CIS). The first one compares the impact of public support from the central government and the European Union (EU) on the innovation of Austrian firms, using the third wave of the CIS, which covers the years 1998-2000. To measure the effectiveness of these programmes, the authors propose a structural model of the endogeneity of innovation and of public support for it. The estimation of this model by the method of asymptotic least squares suggests that receiving central government support increases the intensity of R & D by 2.3 percentage points and yields a 2.5 percentage point increase in the share of sales of new to firm products. However, EU support is never significant once national support is taken into account.

The study by Czarnitzki and Lopes-Bento (2014) also offers a comparison of the impact of national and European funding on innovation intensity and performance. The empirical analysis is based on the German part of the CIS for seven waves but, as the data can only be used as pooled cross-sections, to face the endogeneity problem, they apply a variant of a non-parametric matching estimator. In terms of innovation input, their results provide evidence that getting funding from both sources displays the highest impact, while EU subsidies have higher effects when the firm receives funding from only one source. As for innovation performance, funding from both sources again yields higher sales of market novelties and patent applications, but in this case the impact of national funding is superior when only one type of grant is obtained.

Liu and Rammer (2016) analyse the effectiveness of regional, national and European funding programmes implemented in Germany on both product and process innovations and on export performance of small and medium-sized enterprises (SMEs). Using also a panel dataset from the German part of the CIS from 2001 to 2014, they find that public financial support contributes to higher innovation outputs, which in turn translate into higher export success in later years. But this relation only holds for certain sources of public funding and certain types of innovation output.

To contribute to this literature, in this paper we investigate the role of two specific dimensions of supporting schemes: the national or supranational character of the financing agency, which is usually associated with the national or international character of the R & D project, and the magnitude of reimbursement implied in design of the public support. In particular, to our knowledge, no previous empirical research exists comparing the effects of public subsidies and loans on private R & D. With this objective, we analyse the effect of participation within three different public funding programmes on the technological performance of Spanish firms. Specifically, we consider public programmes based on low-interest loans versus national and European innovation subsidies and we distinguish between their effects on extensive and intensive margins. We also contribute to the literature by studying the existence of possible differences in the treatment effects between small and medium-sized enterprises (SMEs) and large firms.

For this purpose, we integrate two data sets. The first one is provided by the Centre for the Development for Industrial Technology (CDTI). This public organism grants financial help of its own to companies and facilitates access to third-party funds for the execution of both national and international research and development projects. During the period 2002 to 2005, the CDTI awarded zero-interest loans that could reach 60% of the total budget of the R & D project, with a period of repayment of up to 10 years.

The second database is provided by the National Institute of Statistics (INE) and corresponds to a sample of innovative firms from the Spanish Technological Innovation Survey (the Spanish version of the CIS). From this database we obtain the information about public subsidies for innovation activities from the different levels of government. Overall, we compile a homogeneous sample that consists of an

unbalanced panel of 13,546 observations and 4,407 firms for the period 2002 to 2005. Specifically, 2,185 of them have received some type of public support for their R & D projects during the period.

The factors taken into account to apply for a low-interest loan from the CDTI or for a national or European subsidy can differ. However, some of them may be the same as those that affect the firm's R & D decision. This fact can generate a bias in the impact of these funding instruments on the innovative performance of firms if the CDTI or other public domestic and foreign organisms award firms with a better technological profile.

To deal with this selection problem, in this paper we follow two different methodologies. Firstly, we use a Heckman's treatment effect model. The first stage in this model consists of the estimation of a multivariate probit model to study the determinants of each of the three schemes of public support. In the second stage, we analyse how this participation affects the R & D intensity of the firms. Secondly, we complement the study by performing an econometric matching technique. This procedure allows us to test whether there is substitutability or complementarity among the different public funding policies.

Our results confirm that, regardless of the methodology employed for the analysis, the three instruments are effective to stimulate the extensive margin. As for the intensive margin, the hypothesis of full crowding-out of private R & D is also rejected for all types of support. In addition, the impacts of subsidies and loans reinforce each other when they are jointly awarded to SMEs. However, for large firms we cannot reject the hypothesis of crowding-out effect between subsidies and CDTI loans.

The rest of the paper is organised as follows. In Section 2, we highlight how some characteristics of support programmes can justify their different impact on firms' R & D activities. In Section 3, we summarize the main features of innovation policy in Spain regarding financial support. In Section 4, we describe the empirical model and the data. Section 5 shows the estimates and discusses the results. Finally, we present key conclusions in Section 6.

2. The link between innovation impact and programme features

Assessing the impact of public support of firms' R & D projects on R & D & I activities requires a clear understanding of the design of public programmes. Although the general design of an R & D programme is likely to have an impact on innovation, it is difficult to clearly associate certain design features of R & D programmes with (not directly intended) innovation (European Commission, 2009).

Among innovation policy instruments, the type of public intervention more devoted to the reduction of the gap between the social and the private return of R & D investments is financial support, which can be direct, through subsidies or low-interest loans, or indirect, mainly through R & D tax credits.

The three public programmes analysed in this paper are different types of direct financial support. In all cases, to obtain the aid the firm must submit an application that is rated by the agency mainly in terms of its R & D excellence. However, supporting schemes differ in two specific dimensions: the national versus supranational level of the programme and the reimbursable character of the aid. As for the first aspect, why should we expect a different impact of R & D subsidies depending on the government level of the supporting organism? There are at least three reasons.

First of all, the design of R & D programmes can differ between public agencies of different levels of governance, especially when they have specific objectives. Although the main justification for public intervention is the correction of market failures, the aims of public support can also consist of stimulating specific groups such as R & D champions (picking-the-winners strategy), SMEs with major financial