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Another cluster premium: Innovation subsidies and R&D collaboration networks

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ABSTRACT

This paper investigates the allocation of R&D subsidies with a focus on the granting success of firms located in clusters. On this basis it is evaluated whether firms in these clusters are differently embedded into networks of subsidized R&D collaboration than firms located elsewhere. The theoretical arguments are empirically tested using the example of the German biotechnology firms' participation in the 6th EU-Framework Programmes and national R&D subsidization schemes in the early 2000s.

We show that clusters grant firms *another premium* to their location, as they are more likely to receive funds from the EU-Framework Programmes and hold more favorable positions in national knowledge networks based on subsidies for joint R&D.

1. Introduction

A rich literature argues theoretically and shows empirically that innovation activities cluster in space (Baptista, 2000; Maskell and Lorenzen, 2004; Asheim et al., 2006). Such clusters are regarded as loci of innovation due to their ability to endogenously generate and diffuse knowledge (Saxenian, 1994; Audretsch and Feldman, 1996a,b; Baptista and Swann, 1998; Malmberg and Maskell, 2002). Due to favorable knowledge generation, production, and demand conditions being located in clusters yields a "premium" (Spencer et al., 2010).

In addition to the above, we claim that clusters also profit from public R&D subsidization policies in two ways. Firstly, they are more likely to receive R&D subsidies. Secondly, they are better embedded into networks of subsidized R&D collaboration. With the first point, the study contributes to the stream of literature investigating the allocation of R&D subsidies (cf. Busom, 2000; Czarnitzki and Fier, 2003; Czarnitzki et al., 2007; Zuín˜iga Vicente et al., 2014), which is however rarely looking at geographic aspects. With the second point, the work adds to the growing literature on modeling and analyzing the embeddedness of organizations into networks of subsidized R&D collaboration (Maggioni et al., 2007; Scherngell and Barber, 2009, 2011; Broekel and Graf, 2012). While this literature has a strong geographical background, it has paid less attention to the allocation dimension of R&D subsidies and how this relates to clusters. Accordingly, the present paper brings together different literature streams that have rarely crossed each other and have not been investigated within the same framework.

The theoretical arguments are empirically tested using the example of the German biotechnology industry in the early 2000s and by comparing firms in and outside (technology) clusters. We consider funds from the 6th EU-Framework Programmes (EU-FP) and national R&D subsidization schemes. On this basis, we investigate the allocation of funds and the embeddedness of firms into networks of R&D collaboration emerging from these. By comparing subsidization schemes provided by two different administrative levels the study contributes to the literature on networks of subsidized R&D collaboration, which for the most parts evaluates R&D subsidization programs in isolation of other schemes.

Our empirical results support the existence of an additional premium to being located in a cluster: Firms in clusters are more likely to be supported by policies aiming at excellence and international collaborative R&D. They also hold more prominent positions in national networks of subsidized R&D collaboration granting better and easier access to knowledge diffusing therein.

The paper is structured as follows. In the subsequent section, we briefly review the literature on cluster and innovation policies, which is related to the discussion on networks of subsidized R&D collaboration. On this basis, hypotheses are derived. Section 3

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presents the empirical approach, the data on the German biotechnology industry, and information on R&D subsidies. The results are presented and discussed in Section 4. Section 5 concludes the paper.

2. Theory and research questions

2.1. Cluster premium

There are numerous definitions and theories of clusters. In the present paper, we understand a cluster being a "*non-random geographical agglomeration of firms with similar or highly complementary capabilities*" (Maskell and Lorenzen, 2004; p. 1002), whereby, "*...similar and related firms [. . .] form the basis of a local milieu that may facilitate knowledge spill-overs and stimulate various forms of adaptation, learning, and innovation*" (Malmberg and Maskell, 2002, p. 433).

It is shown that firms in clusters experience stronger growth and higher innovation (diffusion) rates (Audretsch and Feldman, 1996a,b; Baptista and Swann, 1998; Baptista, 2000) than those outside clusters. These positive effects of cluster emerge from advantageous regional conditions such as Marshallian localization externalities (Asheim et al., 2006), local competition (Porter, 2000), socio-cultural or institutional embeddedness (Armin and Thrift, 1994), or favorable conditions for localized learning processes (Malmberg and Maskell, 2002).[1] However, firms inside clusters do not benefit equally because relations and exchange processes are not uniform within clusters (Boschma and Ter Wal, 2007).

The specific conditions within clusters may however also induce negative externalities, which reduce cluster firms' performance. First, there are negative effects caused by local competition. High demand for scarce resources lowers profit rates (Stuart and Sorenson, 2003a,b), which in turn increases the failure rates of cluster firms and decreases their growth rates (Glenn et al., 2000). In addition, firms are subject to an inherent danger of "*knowledge drain*" when competent employees leave the firm to join local competitors. Secondly, regional concentration (as it is the case in clusters) may cause a negative technological or economic lock-in, as it decreases the probability of radical innovations (Grabher, 1993). Firms will stick to apparently successful routines, specializations and collaboration, while changes and opportunities emerging in new markets and technologies remain unnoticed (Martin and Sunley, 2003).

Hence, while being located in a cluster may not be beneficial in all instances (see, e.g., Stuart and Sorenson, 2003a,b; Brixy and Grotz, 2004) the notion "cluster" is generally related to yielding a premium on sales and profit growth of firms (Spencer et al., 2010).

It is worth noting that the importance of clustering in the form of traditional Marshallian externalities and for innovation has been found robust across different sectors and geographical contexts, such high-tech in Silicon Valley (Saxenian, 1994) and Cambridge (Keeble et al., 1999); biotech in Boston (Porter et al., 2005); ICT in Sophia Antipolis (Longhi, 1999); as well as in mid/low-tech traditional supplier-based clusters in Europe (see Senberger and Pyke, 1992; Becattini, 1990, 1984; Brusco, 1982), and the new industrial clusters emerging in developing economies (see among others Schmitz and Nadvi, 1999; Caniels and Romijn, 2003; Lorenzen and Mudambi, 2012).

In addition, we argue that there exist additional benefits of being located in a cluster, which relate to today's R&D subsidization policies that are presented in the following.

[1] Note that the cluster-related advantages are not static in nature and vary in strength along cluster life cycles (Audretsch and Feldman, 1996a,b; Pouder and St. John, 1996).

2.2. Innovation policies and scientific evaluation

2.2.1. Effects of R&D subsidies

The justification for public support to R&D is based on the argument that private investments in R&D are below a social optimum. A sub-optimal level of R&D is realized since the individual marginal returns of investments in R&D are not aligned with the social marginal return. Uncertainty, high risk involved in research, and the impossibility of fully appropriating the benefits of these investments, are argued to discourage private investments (Nelson, 1959; Arrow, 1962). These arguments are backed by rich empirical evidence, whereby most empirical studies focus on input and output additionalities that is, they assess the impact of subsidies on R&D efforts (input) or economic performance (output). For instance, Girma et al. (2008) show that subsidies induce additional employment and Czarnitzki and Hussinger (2004) report positive effects on firms' patenting (output additionalities). Zuín˜iga Vicente et al. (2014) review the literature with respect to input additionality. They conclude that most empirical evidence suggests a stimulation of R&D efforts by subsidies, which implies that the market failure can be (at least partly) corrected by subsidization. However, these authors also point out that more recent studies rather find no or only weak effects of R&D subsidies.

2.2.2. Allocation of R&D subsidies

The literature also addresses the allocation of R&D subsidies meaning who applies and who is granted R&D subsidies, whereby the most decisive factor for the allocation is naturally the design of R&D subsidization programs. For instance, the EU-Framework Programmes (FP) explicitly aim at building excellence in research (Luukkonen, 2000). This translates into the type of firms that (in addition to universities and research organizations) are most likely to receive grants, which are primarily large firms from R&D intensive sectors (Marín and Siotis, 2008). R&D subsidization schemes are however very diverse in their objectives: some are targeted to support specific groups of organizations (SMEs, innovators, non-R&D intensive firms, etc.). Others are restricted to participants from specific regions. It matters who is initiating such programs in this respect. For instance, national policies frequently apply more inclusive approaches, as most (federally organized) countries seek to stimulate a convergence in regional development.

In addition to the design of initiatives and awarding policies, the willingness and capability of organizations to participate in these programs impacts the likelihood of applying for subsidies. Other factors that matter in this respect are the presence in foreign markets, their absorptive capacities, number of business units, the intensity of linkages to universities, reviewer ratings, and previous experience, whereby significant heterogeneity exists between industries (Busom, 2000; Blanes and Busom, 2004; Barajas and Huergo, 2010).

2.2.3. Collaborative R&D as additional dimension to R&D subsidies

The above brief review summarizes the traditional and most prominent view on R&D subsidies in the literature, which is based on the idea that R&D subsidies are granted to a single organization conducting R&D. However, the justification for public subsidization of R&D has been recently extended by the argument to also overcome market failures in the context of knowledge access and exchange (Lundvall, 1992; Nelson, 1993; Malerba, 2004). Newer policies therefore subsidize the production of knowledge and seek to enhance its diffusion by supporting the formation of inter-organizational collaboration in R&D in order to reduce system failures (Woolthuis et al., 2005). The underlying rational is the same as for subsidizing knowledge production: the diffusion of knowl-