



# Does governmental venture capital spur invention and innovation? Evidence from young European biotech companies



Fabio Bertoni<sup>a,\*</sup>, Tereza Tykvová<sup>b,1</sup>

<sup>a</sup> Department of Economics, Finance and Control and Research Center on Entrepreneurial Finance (ReEntFin) of EMLYON Business School, 23 Avenue Guy de Collongue, 69134 Ecully, France

<sup>b</sup> Institute for Financial Management – Chair of Corporate Finance at the University of Hohenheim, Wollgrasweg 49, 70599 Stuttgart, Germany

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## ABSTRACT

This paper explores whether and how governmental venture capital investors (GVCs) spur invention and innovation in young biotech companies in Europe. To gauge invention we focus on the simple patent stock at the company level, while innovation is proxied by the citation-weighted patent stock. Our findings indicate that GVCs, as stand-alone investors, have no impact on invention and innovation. However, GVCs boost the impact of independent venture capital investors (IVCs) on both invention and innovation. We conclude that GVCs are an ineffective substitute, but an effective complement, of IVCs. We also distinguish between technology-oriented GVCs (TVCs) and development-oriented GVCs (DVCs). We find that DVCs are better at increasing firm's inventions, and that TVCs, combined with IVCs, support innovations.

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## 1. Introduction

The latest statistics by the European Venture Capital Association show that, in 2013, about 40% of all funds raised by venture capital investors (VCs) in Europe came from governments and that, since 2009, taxpayer's money has systematically been the single largest source of funds to VCs in the continent (EVCA, 2014). Part of this money is directly managed by national and regional public authorities by means of dedicated investment vehicles: governmental VCs (GVCs). Nearly every country in Europe, and many of its regions, set up a GVC. While the specific objectives and structure of these investment vehicles may vary, their underlying aim is to compensate the scarcity of private VC investments, support regional development and promote innovation (Bottazzi et al., 2004; Tykvová, 2006). Have these funds been successful in supporting inventions and innovations in Europe? This paper is a first attempt to answer this question in the context of the biotechnology industry.

VCs are perceived by governments as a key ingredient for achieving the objectives set by the Europe 2020 political

agenda, especially in terms of innovation and growth (European Commission, 2011). The relationship between innovations and venture capital has been the subject of an extensive literature. On one hand, the research suggests that VCs are attracted by innovative companies (Baum and Silverman, 2004; Engel and Keilbach, 2007; Hirukawa and Ueda, 2011). On the other hand, the literature shows that inventive and innovative activity is positively affected by the presence of VCs (Arqué-Castells, 2012; Bertoni et al., 2010b; Kortum and Lerner, 2000; Popov and Roosenboom, 2012).

Most of these studies, however, only look at the dominant organizational form of VC: independent VCs (IVCs). IVCs are organized as limited partnerships in which the investment process is run by a management company (the general partners) independently from the ultimate investors (the limited partners). Their aim is to generate financial returns, part of which (the carried interest) remunerates the general partners (Sahlman, 1990). Conversely, GVCs are generally not organized as limited partnerships, their management company is not independent from the ultimate investor (the government), their objectives are not limited to financial returns and their remuneration is usually fixed (Cumming and MacIntosh, 2006; Jääskeläinen et al., 2007). Because IVCs and GVCs differ substantially in terms of objectives, skills and acquaintances, we argue that their impact on companies' inventive and innovative activity will differ.

We will focus on five research hypotheses. First, we will examine whether GVC-backed companies give rise to more corporate

\* Corresponding author. Tel.: +33 4 78 33 70 03.

E-mail addresses: [Bertoni@em-lyon.com](mailto:Bertoni@em-lyon.com) (F. Bertoni),

[Tereza.Tykvova@uni-hohenheim.de](mailto:Tereza.Tykvova@uni-hohenheim.de) (T. Tykvová).

<sup>1</sup> Research Associate, ZEW Mannheim, L 7,1, 68161 Mannheim, Germany. Tel.: +49 711 459 24500.

inventions and innovations than non-VC-backed companies. As invention and innovation often figure explicitly (or implicitly) among the objectives of GVCs, we expect GVC-backed companies give rise to more inventions and innovations than non-VC-backed companies.

Second, we will investigate whether GVCs and IVCs contribute to a different extent to corporate inventions and innovations. On one hand, GVCs might give rise to more inventions in their portfolio companies than IVCs, because a GVC has a longer time-horizon and a stronger orientation to invention, and thus may be more willing to devote resources to risky exploratory activities that give rise to inventions (Sonnek, 2006). On the other hand, compared to their governmental counterparts, IVCs may have better acquaintances, incentives and skills at their disposal to provide companies with resources and support (Bottazzi et al., 2008; Jääskeläinen et al., 2007; Luukkonen et al., 2013), making IVCs more effective than GVCs in spurring inventive and innovative activity.

Our third hypothesis postulates that GVCs and IVCs are complements in their contribution to invention and innovation. To pursue inventive activity, companies need to combine a long-term orientation to invention and innovation and a rich set resources and capabilities. We argue that this is the case when a company is invested by both a GVC and an IVC. On one hand, an IVC may add a significant amount of resources to a GVC-backed company. On the other hand, the presence of a long-term investor like a GVC may increase the ability of an IVC-backed firm to pursue long-term innovation strategies (Hoskisson et al., 2002). A GVC will also add, albeit to a lesser extent, non-duplicate resources to an IVC-backed company. This is because GVCs and IVCs have access to different networks of contacts, have different skills and experience and support differently their portfolio companies (Luukkonen et al., 2013). Accordingly, we expect to observe more inventions and innovations in companies where GVCs and IVCs coinvest than in companies with only one investor type.

Our fourth and fifth hypotheses focus how GVCs differ in their impact on invention and innovation depending on their investment objectives. We distinguish between two types of GVCs: technology-oriented GVCs (TVCs), which have the explicit objective of fostering innovation, and development-oriented GVCs (DVCs), which have economic development as an investment objective. TVCs are organizations with the objective of fostering high-tech companies and innovation in a specific region (e.g., Biom AG Munich, Germany) or at the national level (e.g., ANVAR, France) or GVCs associated to technology transfer offices of universities or research centers (e.g., ISIS Innovation, UK). DVCs, instead, are typically organizations that have the objective of sustaining the economic development at the regional (e.g., SRIW, Belgium) or at the national level (e.g., CDC Capital Investissement, France). The mandate to support invention and innovation, which is explicit for TVCs, is only implicit for DVCs, because invention and innovation contribute to economic development. Therefore, we expect that TVCs will support invention and innovation more than DVCs (Hypothesis 4) and that syndicates between TVCs and IVCs will be more beneficial than syndicates between DVCs and IVCs (Hypothesis 5).

To analyze these hypotheses, we employ a novel database that includes 665 European biotechnology start-ups and young companies, 125 of which are VC-backed, and explore how GVCs affect their patent stock development. The focus on the biotechnology industry reduces the importance of factors (e.g., differences in the determinants of venture capital backing and in the use and valuation of patent) that could not be easily controlled for if we considered a multitude of different industries (Cohen et al., 2000). Moreover, in this industry, patents are an important protecting device for inventions (Hall, 2009; Levin et al., 1987). Besides a simple patent stock, which indicates corporate invention, we also examine quality-weighted patent stock. The literature (Hall et al., 2005, among many

others) suggests that quality-weighted patent counts can be used as a proxy for the value of innovation (i.e., invention that is commercially exploited).

Our results on patent stock indicate that, in general, IVC-backed companies generate more inventions than GVC-backed ones. We do not find any significant difference between GVC-backed companies and companies that are not VC-backed. The direct effect of GVCs on invention is thus negligible. However, our analysis suggests that GVCs may be beneficial to invention by complementing the resources provided by IVCs. This result holds for both types of GVCs and, contrary to our expectations, it is larger for DVCs than for TVCs.

We then consider citation-weighted patent stock. The findings confirm that GVC-backed companies do not outperform either IVC-backed companies or non-VC-backed companies. Again, GVC-backed companies do only better than non-VC-backed companies when the GVC syndicates with an IVC. When we distinguish between TVC and DVC, we find a positive effect for TVC–IVC syndicates, but not for DVC–IVC syndicates. Together with the result for the simple patent stock, this finding suggests that DVCs, in syndicates with IVCs, promote inventions, but that most of these inventions are not innovations. This is in contrast to TVCs which, when syndicating with IVCs, are beneficial to both invention and innovation. Our results are robust to different sampling and estimation strategies, the observable and unobservable heterogeneity of portfolio companies and the endogeneity of VC investments.

Our findings add to the literature studying the effectiveness of GVCs. More systematic research in this area is needed (e.g., Lerner, 2009). Many previous works typically focus on one particular government program or one particular country (Alperovych and Hübner, 2014; Avnimelech and Teubal, 2006; Mara, 2011), while our paper includes seven countries. Another contribution of our paper is that we use a micro perspective, while many other works that investigate GVCs impact use a macro perspective and focus on the effect of institutional, legal, cultural and other factors (Groh et al., 2010). Albeit a few recent papers use micro data in a multi-country setting to investigate the effectiveness of GVCs, they focus on issues other than inventions, such as growth (Grilli and Murtinu, 2014) and exit (Brander et al., 2014). We are not aware of any study that would address the effectiveness of GVCs in spurring corporate invention and innovation in this framework. Finally, we add to the literature by discussing how technology-oriented governmental VCs differ from development-oriented governmental VCs in their support of invention and innovation.

The rest of the paper is as follows. Section 2 discusses the theoretical framework. Section 3 gives an overview of our sample. Section 4 describes the results of the empirical analysis. Section 5 provides a discussion and conclusion.

## 2. Theoretical framework

### 2.1. Governmental venture capital and innovation

Invention and innovation require resources that young high-tech companies typically lack, but that VCs may offer (Hall and Lerner, 2010). VCs provide financial resources that relax investment constraints (Bertoni et al., 2010a, 2013). But VCs' support to companies' invention and innovation goes well beyond the mere provision of finance. Portfolio companies profit from VCs' industry-specific expertise (De Clercq et al., 2006). Companies may also benefit from VCs' networks (Fried and Hisrich, 1995) towards potential alliance partners, suppliers and customers when establishing, increasing and reconfiguring their resource base. Networks are particularly important for high-tech companies as an integral part of the detection of opportunities, the securing of resources, as well as the

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