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Do publicly backed venture capital investments promote innovation? Differences between privately and publicly backed funds in the UK venture capital market

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ABSTRACT

This paper examines the link between publicly backed venture capital funds and business innovation in the UK venture capital market. In examining this relationship, the research empirically analyses the characteristics of 4113 investment deals made to 2359 UK based companies. We use patents as a proxy for innovation and find that obtaining investment solely from publicly backed VC funds, reduces the probability of the recipient company to apply for a patent compared with those companies that receive investments from private VC funds. In contrast, the probability of a company to have a patent or have applied for one does not vary significantly between companies that receive investments from both the public and the private sector and those companies that receive investments solely from private VC funds. The results have implications for both policy makers and practitioners and stress the importance of co-investments between publicly backed and private venture capital funds to promote innovation.

1. Introduction

A substantial amount of academic research has been put into the question of the impact of venture capital in the innovation performance of a company (Gompers and Lerner, 2001; Arqué-Castells, 2012; Popov and Roosenboom, 2012). A number of studies have shown that venture-backed firms are responsible for a disproportionate number of patents (which is used as a proxy for innovation) and new technologies, and bring more radical innovations to the market faster than lower growth businesses that rely on other types of finance (see, for example: Kortum and Lerner, 2000; Hellmann and Puri, 2000, 2002; Hall and Lerner, 2010). In fact, research has shown that venture capital has played an important role in the development of some of the most significant scientific inventions and industries of our times (such as personal computers, cellular communications, microcomputer software, biotechnology, and overnight delivery) and high-growth venture-backed firms are also more likely to generate new industries (Bygrave and Timmons, 1992; Timmons and Spinelli, 2003).

Furthermore, the significant impact of venture capital on innovation has long been recognised by policy makers. Government schemes in support of the VC industry are intended to improve business innovation and growth, and close potential funding gaps, particularly for small high-technology start-ups (Sunley et al., 2005) or in particular regions (Mason and Harrison, 2002). Such government-backed schemes[1] aimed in leveraging private money (Sunley et al., 2005; Lerner, 2002), stimulating regional

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[1] Public venture capital initiates are defined as "*programs that make equity or equity-like investments in young firms, or encourage other intermediaries to make such investments*" (Lerner, 2002, p. 2).

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entrepreneurial activity (Mason and Harrison, 1999) and generating R & D spill overs (Lerner, 2002). To this end, governments around the world have taken a strong interest in facilitating access to finance for innovative high-growth companies and several schemes in support of the venture capital industry have been set up to overcome funding gaps (Sunley et al., 2005). The attempts to stimulate the supply of new sources of finance have followed different approaches, from ensuring that each region has access to regional-based VC funds to trying to demonstrate that investors in early stage funds can make robust returns, thereby promoting the private sector venture capital industry (Mason and Harrison, 2003).

Successive UK Governments have introduced several schemes in support of venture capital finance including the Early Growth Funds (EGFs), Regional Venture Capital Funds (RVCFs), University Challenge Seed Funds (UCSFs) and the Enterprise Capital Funds (ECFs). Various evaluations of the Government venture capital schemes have highlighted that UK publicly backed funds have had a negative financial performance and their overall Internal Rate of Return (IRR) was substantial lower than the IRR reported by private funds (NAO, 2009). Furthermore, such funds have had only a marginal impact on business performance (Nightingale et al., 2009). Buzzachi et al. (2013) also found that higher public stakes are significantly correlated with a lower incidence of write-offs and a longer duration for their investments. Nevertheless, public interventions have significantly increased the supply of finance for business seeking equity finance, and the public sector has become considerably more important as an investor in both absolute and relative terms (Mason and Pierrakis, 2013).

Despite their increasing importance and attention by both academics and policy makers, little is still known about the impact of publicly backed venture capital funds on innovation. Some of the most informative studies are the ones by Kortum and Lerner (2000) and Brander et al. (2014). Kortum and Lerner (2000) measured the role of VC in innovation using patents as a proxy variable for business innovation while Brander et al. (2014) expanded the existing literature on the relationship between venture capital and patenting by including an additional parameter in this relationship, which is the source of venture capital (public or private). In particular, the latter study provides strong evidence on the role of government VC in stimulating innovation. Additionally, it showed that enterprises with moderate government venture capital support outperform enterprises with only private venture capital support and those with extensive government venture capital support, both in terms of value creation and patent creation. Another study by Bertoni and Tykvová (2015) explored whether governmental venture capital investors (GVCs) spur invention and innovation in young biotech companies in Europe and found that GVCs, as stand along investors, have no impact on invention and innovation but boost the impact of independent venture capital investors (IVCs) when they invest together. Based on these theoretical premises, this research investigates the likely impact of the UK based publicly backed venture capital funds on business innovation.

In this paper we attempt to shed more light on the government backed venture capital funds (GVCs) and business innovation nexus by using a combination of commercial databases and publicly available information. This allows us to construct a unique database of 4113 individual investments and observe several characteristics of the VC backed companies such as amounts received, funding source, funding rounds and patent grants or applications. Importantly, we are able to distinguish between private and government backed venture capital investments and capture potential industrial and geographical differences. Hence, our work goes beyond the existing literature by analysing the relation between government backed venture capital investments and innovation using a much larger sample of UK based companies,[2] focusing on the regional heterogeneity of the UK market. In this way, it reveals new characteristics of the venture capital communities in the UK and contributes to the debate about the potential impact of VC in economic development and innovation proxied by patents.

The remainder of the paper is structured as follows: Section 2 provides a background of the study and derives the hypotheses. Section 3 describes the data. In Section 4 the empirical findings are discussed. Finally, Section 5 provides concluding remarks and further research directions.

2. Literature review and hypothesis development

2.1. Patents and venture capital

A large body of literature suggests that venture capital plays a central role in the emergence of new industries by funding and supporting innovative companies which later dominate these industries. Indeed, Lerner and Watson (2008) argue that the venture capital model is more effective in commercialising scientific discoveries than the corporate sector, despite the latter's large expenditure on R & D. Venture capital investment speeds the development of companies, enabling them to transform ideas quickly into marketable products and become industry leaders through first mover advantages (Zhang, 2007). Against this interpretation of the results found in the literature cited above is the work of Hirukawa and Ueda (2011) which argued that this is one-sided interpretation and there may be an opposite causality: arrivals of significant innovation opportunities stimulate new firm start-ups to exploit such opportunities and these start-ups demand VC because venture capitalists are complements to such firms that VC spurs growth and innovation of new firms.

In fact, there are two distinctive streams of literature dealing with the relationships between venture capital and patents, namely on the role of patents as driver of VC investments (Kortum and Lerner, 2000; Kaplan et al., 2009; Haeussler et al., 2009; Hirukawa and Ueda, 2011) and on the impact of VC investments in stimulating patent creation (Kortum and Lerner, 2000; Gompers and

[2] Brander et al. (2014) used the number of investments made to 60 UK publicly backed companies while this research uses a much larger sample of 1467 publicly backed investments.