



Venture capital as a catalyst to commercialization[☆]

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ABSTRACT

We find that the public funding of academic research and venture capital have a complementary relationship in fostering innovation and the creation of new firms. Using panel data on metropolitan areas in the United States, from 1993 to 2002, our analyses reveal that the positive relationships between government research grants to universities and research institutes and the rates of patenting and firm formation in a region become more pronounced as the supply of venture capital in that region increases. Our results remain robust to estimation with an instrumental variable to address potential endogeneity in the provision of venture capital. Consistent with perspectives that emphasize the importance of an innovation ecosystem, our findings point to a strong interaction between private financial intermediation and public research funding in promoting entrepreneurship and innovation.

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1. Introduction

Governments around the world devote vast sums to the support of research and development (R&D). In 2008 alone, for example, OECD nations spent roughly \$253 billion on these activities (OECD, 2009). But large though it is, even that number understates the true level of public support because it includes neither the budgets of developing nations nor the implicit subsidies imparted through the favorable tax treatment of research expenditures and of non-profit institutes and universities. The justification for allocating such extensive public resources to laboratories and universities, and to the support of research and development elsewhere, stems largely from a belief that the ideas and inventions emerging from this research lead to new and improved products and to more effi-

cient and higher quality manufacturing, and thus to an acceleration in economic growth (Bush, 1945; Malakoff, 2000).

Even casual observation, however, suggests that the ease with which these ideas and inventions flow from laboratories and universities into companies and society varies widely across regions. Some places, such as Boston and Silicon Valley, seem to enjoy a steady stream of innovations moving from research centers, such as MIT and Stanford, into both startups and existing companies. But other areas, such as Atlanta, appear far less successful (Powell et al., 2002). Despite being home to Emory, the Georgia Institute of Technology and the Centers for Disease Control and Prevention, few would consider the Southern city a hotbed of entrepreneurial activity or of biotechnology.

What accounts for these differences? Entire research programs have tried to answer this question (e.g., Etzkowitz and Leydesdorff, 2000; Furman et al., 2002). Our approach here attempts not to provide a complete answer, but rather to investigate one piece of the puzzle. In particular, we explore the extent to which the local availability of venture capital might act as a catalyst to commercialization.

A number of factors might lead one to question the importance of venture capital. Startups could obtain funding from elsewhere. Capital is mobile and can, in principle, flow into and out of regions in search of profitable opportunities. Public research funding could also presumably substitute for venture capital, to the extent that it

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too can support product development (Kortum and Lerner, 2000; Wallsten, 2000). Established firms, moreover, might absorb the knowledge produced by academic research, precluding any need to involve startups in the commercialization process (e.g., Cohen et al., 2002).

But there are also several reasons to believe that a local venture capital community might serve as a critical catalyst to moving innovations from the laboratory into the factory and on to consumers. While the public funding of research at universities and research institutes has generally been targeted toward the support of basic research, venture capital and other forms of early stage investing finance the applied research necessary to move those innovations out of the lab (Bygrave and Timmons, 1992). Even once a technology has been proven, commercialization often requires the development of a means of manufacturing it efficiently and of deploying it safely. And, though in principle capital flows readily from one place to another, identifying emerging technologies and verifying their value often demands that early-stage investors play an active role, building relationships with universities, research institutions, and the scientists and engineers employed by them (Sorenson and Stuart, 2001).

To determine whether venture capital plays a critical role in commercialization, we estimated the effects of venture capital and federal research grants to universities and non-profit research institutes on innovation and entrepreneurship – measured through patents and business starts – using a panel data set of metropolitan areas in the United States from 1993 to 2002. Our models controlled for stable regional differences and for variation over time at the national level. To address the fact that venture capital firms might actively allocate resources to regions rich in promising technologies, we also estimated the effects using an instrumental variable (IV). Institutional investors adjust their commitments to venture capital on a regular basis to maintain optimal asset allocation ratios, and they tend to invest these funds locally. Hence, the returns to local institutional investors on their investment portfolios provide a valid instrument for the local supply of venture capital (Samila and Sorenson, 2011).

Our results reveal an interplay between the public funding of academic research and venture capital in innovation and entrepreneurship. Though the local provision of venture capital has direct effects on the number of patents awarded to inventors in a region and to the number of new business establishments, its effectiveness in producing both outcomes increases with the local supply of public research funding to universities and research institutes. By contrast, in the absence of a local venture capital community, the government funding of academic research appears to have little, if any, effect on either patenting or firm founding. Further exploration of these relationships moreover revealed that the efficacy of public funding in producing patents and firms depends on its source, with funding from the National Science Foundation (NSF) and the Department of Defense (DoD) having the largest effects. We discuss some of the possible factors that may account for these differences in Section 4.

In essence, our findings reveal a strong complementarity between venture capital and the public funding of research and development. Most directly, our results suggest that regions, such as Atlanta, rich in academic research but poor in entrepreneurial capital could benefit from policies to promote the development of a local venture capital community. More broadly, we lend quantitative empirical support to the growing literature suggesting that innovation requires an entire ecosystem to support it. Though the various perspectives, such as the triple helix (Etzkowitz and Leydesdorff, 2000), national innovation systems (Lundvall, 1992; Freeman, 1995), regional innovation systems (Cooke et al., 1997), and regional institutions and networks (e.g. Powell et al., 2002) differ in their details, all of them forward a notion that government,

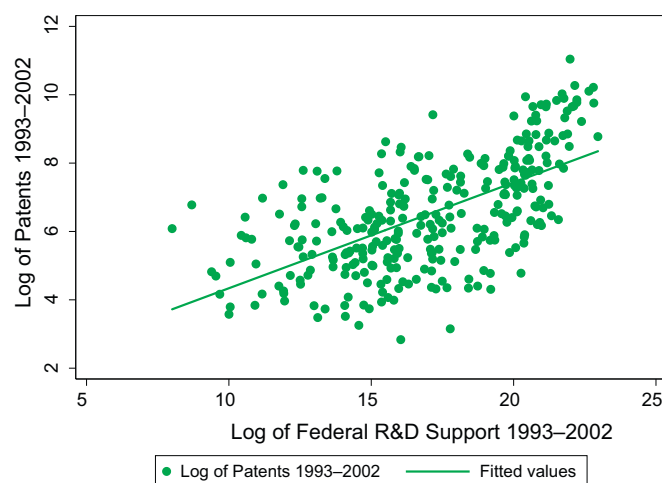


Fig. 1. Patenting by federal research support for MSAs.

educational institutions, and industry play complementary roles. Comparing and quantifying the importance of the relationships proposed by these perspectives has nevertheless been difficult because no two systems are quite alike in all of their elements. Our approach offers a middle ground. By investigating pairs of relationships – in this case, between the public support for research and the private provision of financial capital – one can consider seriously the complementarity between pieces of these systems while still maintaining the analysis at a level amenable to quantification and statistical analysis.

2. Technology commercialization

An important – if not the – justification for the public support of research has been the belief that the fruits of such research result in inventions and innovations that accelerate economic growth. Consistent with that belief, research has generally found positive relationships between research expenditures within a region and economic activity. For example, Adams (1990) found that the number of academic publications predicted future growth in the productivity of the manufacturing sector in the United States. Or, at a more micro level, Bottazzi and Perl (2003) estimated that a doubling in R&D expenditures in a region in Europe resulted in an 80–90% increase in patenting in that region.

But these estimates represent only averages. Behind them lies a great deal of variation in the effectiveness with which regions convert these research inputs into economic outputs. Consider regions within the United States. Figs. 1 and 2 plot the number of patents and firm starts in each Metropolitan Statistical Area (MSA) over the decade from 1993 to 2002 as a function of the amount of federal support universities and research institutes in those same regions received over the period. The graphs reveal clear and strong positive relationships between public research funding and innovation and entrepreneurship. But as one can tell from the dispersion around the regression lines, regions also vary considerably in the effectiveness with which they translate research dollars into patents and firms – in other words, in their ability to commercialize technologies.

What accounts for these differences? As with any complex phenomenon, a whole host of factors undoubtedly contributes to this variation in the ability of regions to move technologies out of the lab and into products and services. Here, we examine one potentially important factor – the local availability of venture capital – in detail and estimate the extent to which it might account for these differences.

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