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journal homepage: [www.elsevier.com/locate/jfec](http://www.elsevier.com/locate/jfec)Strategic alliances, venture capital, and exit decisions in early stage high-tech firms<sup>☆</sup>Umit Ozmel<sup>a</sup>, David T. Robinson<sup>b,\*</sup>, Toby E. Stuart<sup>c</sup><sup>a</sup> *Purdue University, Krannert School of Management, United States*<sup>b</sup> *Duke University and National Bureau of Economic Research, United States*<sup>c</sup> *Haas School of Business, University of California, Berkeley, United States*

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## ABSTRACT

We study the trade-offs that biotech start-ups face in the private equity market when they choose between raising firm-level capital from venture capitalists or project-level capital from strategic alliance partners. Increased alliance activity makes future alliances more likely, but future VC activity less likely. In contrast, venture capital (VC) activity makes both future alliance and future VC activity more likely. Both types of private capital raise the hazard of going public. Acquisition as an alternative to initial public offering is made more likely by increased VC activity, but the link between acquisition probabilities and alliance activity is less clear-cut. These results highlight both the importance of alliance partners in resolving asymmetric information problems in the capital acquisition process and the potential conflict of interest between different sources of private equity.

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## 1. Introduction

Early-stage fund-raising decisions are critical to the growth and survival of nascent companies. This is especially true in high-technology sectors. Start-up companies in these sectors not only require large capital injections but also face a number of strategically distinct alternative sources of capital in private capital markets. In particular,

while venture capital (VC) is very active throughout the sector, many high-tech companies at the same time rely heavily on inter-firm commercialization agreements (strategic alliances) for funding. Both types of funding are especially important sources of private capital for biotechnology firms (Lerner and Merges, 1998, and Stuart, Hoang, and Hybels, 1999).

In this paper, we explore how these alternative funding sources in the private capital market interact with one another. We first ask how venture capital and strategic alliance funding complement or substitute for one another in the private capital market. Then we ask how these funding sources affect exit outcomes. Because acquisition activity is common in this sector, we ask how choices in the private capital market affect the going public decision as well as how they affect the possibility that a start-up company is acquired.

A major hurdle to empirical work in this area is the dearth of data on private firms. Here, we develop a novel panel containing 1,899 privately held biotechnology

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start-up companies that both received venture funding and participated in alliance activity, but to varying degrees. The data begin at a company's birth, and record the funding histories of the firms in question, as well as prevailing market conditions, at the time the firm receives its initial funding and at the time of the focal funding event. This allows us to estimate the effect that strategic alliance and venture funding activity have on the probability that a firm goes public or is acquired at a particular time as a function of the time since its last funding event and other factors.

Our results demonstrate the interplay between the two types of private equity capital and their joint impact on exit decisions. First we explore the interaction of venture and alliance funding in the private equity market. Here we observe an asymmetry. Obtaining more funding through strategic alliances lowers the probability that a start-up company receives another round of venture financing but raises the probability that it engages in subsequent alliance activity. In contrast, more venture activity increases both the hazard of future venture activity and the future of additional alliance activity.

More generally, these findings reflect two competing forces at work. The typical alliance contract in this setting affords project-level decision rights and monitoring provisions to the alliance partner (Robinson and Stuart, 2007a). This creates potential for conflicts of interest with venture capitalists (VCs), whose company-level investments create exit motives that could be at odds with the intentions of the alliance partner, and whose company-level control and cash flow rights could be at odds with the (typically project-level) decision rights of the alliance partner. The opposing force is the complementary role that VCs and alliance partners play in resolving the asymmetric problems that firms face when they go public. Our results indicate that strategic alliance partners play a critical role in resolving asymmetric information, in spite of the fact that alliance contracts often include terms that diminish the attractiveness of a potential investment to VC funders.

Next we explore the role that alliances and venture capital play on the decision to go public or be acquired. It is well established that firms with more venture funding are at greater risk of going public. What is surprising, however, is the fact that strategic alliance activity also has a high, if not greater, impact on the hazard of going public.

Increased VC activity unambiguously raises the hazard of being acquired. Alliances also play an important role in shaping acquisition outcomes. An increase in the number of a start-up company's previous alliances raises the hazard of being acquired. One explanation for this effect is that being linked tightly to an alliance partner can raise the hazard of being acquired because that company becomes a potential acquirer through the alliance process. Another explanation is that an active alliance history indicates that the focal start-up company is more likely to have intellectual capital that is valued by acquirers.

Any attempt to establish a causal link between private capital market behavior and the later-stage exit decisions must deal with a variety of endogeneity concerns. First, a

link between past behavior and exit outcomes could reflect unobserved heterogeneity in a start-up's characteristics that drives preferential selection into the private capital market. To partially control for this, we allow for unobserved company-level heterogeneity by including frailty parameters in the hazard rate estimation. (This is discussed in detail in Section 3.) Frailty parameters guard against the possibility that time-invariant differences across start-ups drive their attractive as private equity recipients or candidates for exit events.

It is important to acknowledge, however, that frailty parameters in hazard models, which are effectively firm-level random effects, cannot absorb time-varying firm-level heterogeneity. We take additional steps to control for time-varying differences across firms by collecting data that allow us to measure whether the start-up company has products in clinical trial stages with the Food and Drug Administration (FDA) at the time of the funding event. We also control for the start-up's previous patenting activity. These time-varying measures allow us to partially control for the factors such as the quality of the company's scientists or the state of its research portfolio, which would be known to funders but difficult for the econometrician to observe. Nevertheless, in the absence of an instrumental variables specification or a natural experiment, we must caution against attaching causal interpretations to our findings given the possible unobserved heterogeneity that could remain.

Our paper is related to a number of works that explore the determinants of the going public decision. Pagano, Panetta, and Zingales (1998) examine this question in a sample of private Italian firms. They find that larger, more profitable companies go public. In recent work, Chemmanur, He, and Nandy (2010) find a similar relation between profitability, performance, and going public in US Census of Manufactures data, and they also show that IPOs are more likely among market leaders in more concentrated, and less opaque, industries. Our work compliments these findings by focusing on performance in private capital markets, instead of product market performance, as drivers of the going public decision. In that regard, our paper builds on Lerner (1994), which also examines the going public decision among biotech start-ups, but focuses on the role of the venture capitalist in timing access to the public capital market. The venture capitalist's role as facilitator could stem from professionalizing the start-up firm (Hellmann and Puri, 2002), from providing access to financial capital (Gompers and Lerner, 1999) and other portfolio companies with complementary assets (Lindsey, 2008), or from certifying the quality of the start-up (Carter and Manaster, 1990; Hsu, 2004; Megginson and Weiss, 1991). Recent work by Hsu (2006) uses a small sample of private technology start-ups receiving funding from the Small Business Innovation Research program and shows that the start-ups receiving funding from VC firms are more prone to engage in commercialization strategies. These studies show that VCs add value to start-ups in various ways as well as certifying the quality of start-ups and, consequently, increase the quality and future prospects of the start-ups. Because such start-ups are more likely to do an IPO, VC funding should increase the likelihood of an IPO.

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