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Venture capital and the investment curve of young high-tech companies☆

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ABSTRACT

We explore how and when venture capital (VC) alleviates the financial constraints of portfolio companies. Using a sample comprising 128 VC-backed companies and 233 non-VC-backed companies identified by propensity score matching, we estimate an error-correction model by accounting for the fact that the investment curve may be U shaped because of capital market imperfections. Our findings show that VC leads the investment curve to flatten in portfolio companies, which indicates an alleviation of financial constraints. This effect, however, is economically and statistically significant only after companies receive a follow-on round of VC financing. Because follow-on rounds, on average, do not involve larger amounts invested but have stronger informative content than initial rounds of investment, we interpret this result to indicate the importance of VC certification for the alleviation of financial constraints in portfolio companies. Evidence regarding the access to credit by VC-backed companies confirms this interpretation of the results.

1. Introduction

In this study, we explore how and when venture capital (VC) alleviates the financial constraints of young high-tech portfolio companies. These companies typically have a limited availability of internally generated cash flow and are also severely exposed to frictions in capital markets that inhibit the access to other forms of external financing (Berger and Udell, 1998). Accordingly, young high-tech companies are exposed to financial constraints that restrain their growth and investment (Carpenter and Petersen, 2002a,b).

Several works in the literature have studied whether VC alleviates the financial constraints of portfolio companies. Overall, the empirical evidence indicates that VC reduces young high-tech companies' financial constraints (Bertoni et al., 2010, 2013; Engel and Stiebale, 2014). However, the literature is silent about how and when these financial constraints are eased. Accordingly, we aim to shed light on these issues.

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With respect to *how* VC may alleviate the financial constraints of portfolio companies, two channels must be considered. The first, and most obvious, is the injection of capital into the company. Companies receive substantial financial resources from VC investors (the average capital injection per round of financing in our sample is 4.484 million Euro), and this money can be used to exploit investment opportunities regardless of the availability of external capital. The second channel is more subtle but is no less important: VC certification. Because of their screening capabilities, VC investors certify their portfolio companies by conveying a signal about their quality to capital markets (Hsu, 2004; Lee and Wahal, 2004; Megginson and Weiss, 1991; Nahata, 2008). Companies that receive VC certification should have easier access to capital markets and thus less exposure to financial constraints. The literature has not explored which of these two channels is most important for VC-backed companies, a limitation that we aim to overcome with this paper.

A related research question is, *when* does VC alleviate the financial constraints of portfolio companies? In this work, we distinguish between initial and follow-on VC investment rounds. While initial and follow-on rounds differ only marginally in terms of the amount of capital injected,[1] they differ dramatically in terms of certification. VC investors decide whether to participate in a follow-on round based on information about the entrepreneur and the investment opportunity that is richer than the information available in the first round (Bergemann and Hege, 1998; Gompers, 1995). Being based on more complete information, a follow-on round is much more informative about the quality of a company than an initial round. Accordingly, differences in the effect of VC on financial constraints across rounds of investment are driven more by certification than by capital injection.

To study how and when VC relaxes the financial constraints of young high-tech companies, we analyze how and when VC changes the shape of their investment curve (IC), which is the relationship between capital investment and the availability of internal capital. Cleary et al. (2007) show that the IC is U-shaped and that its convexity is proportional to the severity of financial constraints deriving from capital market imperfections. Accordingly, by comparing the convexity of the IC between VC-backed and non-VC-backed companies, we may infer the extent to which VC relaxes the financing constraints of portfolio companies.

We estimate an error-correction model (ECM) for capital investment in which we allow the IC to be convex, and allow its shape to differ between VC-backed and non-VC-backed companies. In an augmented version of the model, we also distinguishing between companies in their initial round of VC and companies that have received follow-on rounds of financing. Our sample comprises 128 companies that received VC from independent VC firms, and 233 non-VC-backed companies that are identified by using propensity score matching. The sample companies, which are extracted from the VICO database (Bertoni and Martí Pellón, 2011), are based in six European countries (Belgium, Finland, France, Italy, Spain, and the UK), are independent at founding, operate in high-tech sectors, and were younger than 10 years at their first round of VC.

We summarize our findings as follows. First, when pooling initial and follow-on rounds of financing, we find weak evidence that the IC of VC-backed companies is less convex than the IC of non-VC-backed companies. However, when we distinguish between rounds of financing, we find that the effect of VC is statistically significant once invested companies receive a follow-on round. Moreover, our findings indicate that the amount injected has limited impact on the level of investment in VC-backed companies. Collectively, our results suggest that the effect of VC on the financial constraints of portfolio companies is mostly driven by certification.

The results are robust to changes in the specification, changes in the estimation methodology, and the inclusion of additional controls for growth opportunities. We also rule out two alternative explanations for our results: (i) that companies use capital injections to build a cash buffer that shelters them against shocks in cash flow and (ii) that age is a confounding factor driving the lower convexity of the IC in follow-on rounds. Finally, we show that VC-backed companies have better access to other forms of external financing (notably, long-term financial debt) after they receive VC, particularly after these firms receive a follow-on round of financing. This evidence is consistent with the notion that VC certification is important in reducing financial constraints.

In summary, we contribute to the literature in three ways. First, we show that, contrary to the implicit assumption in the extant literature (e.g., Manigart et al., 2003; Bertoni et al., 2010, 2013; Engel and Stiebale, 2014), the effect of VC on the financial constraints of portfolio companies is not immediate and is economically and statistically significant only after a company receives a follow-on round. Second, we show that certification drives the effect of VC on financial constraints and that capital injections, by contrast, have a limited impact on investment. Third, we overcome another important limitation in the extant literature on the impact of VC on the investments of portfolio companies, which typically assumes that the IC is linear. We show that the linear specification of the IC is misspecified in our sample, because of the substantial fraction of companies with negative cash flows. Our results indicate that the IC of young high-tech companies is U-shaped, suggesting that studies on the financial constraints of such companies should refrain from using a linear specification.

The paper proceeds as follows. In Section 2, we outline our theoretical framework. In Section 3, we illustrate the methodology that is used in the empirical analysis. In Section 4 we describe the sample and provide some descriptive evidence regarding ICs and VC financing for the sample companies. In Section 5, we report the results of the econometric models and provide robustness tests and additional evidence to support our interpretation. Finally, in Section 6, we summarize our main findings and suggest avenues for future research.

2. Theoretical framework

2.1. Financial constraints and corporate investment

If capital markets were frictionless, the distinction between internal capital and external capital would be irrelevant, and all sources of financing would have the same cost. When frictions are introduced into capital markets, internal and external capital

[1] Initial and follow-on rounds do not substantially differ in terms of the absolute capital injection (in our sample, on average, 4.276 million Euro are invested in initial rounds, and 4.694 million Euro are invested in follow-on rounds) and, relative to the size of the company, the capital injection is actually smaller in follow-on rounds.