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Optimal Syndication Decision of Corporate Venture Capital and Venture Capital Firms*

Andreas Frick and Hannes Maxim†

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Abstract

Venture capital and corporate venture capital firms are driven by high financial returns through the sale of ownership stakes. Additionally, corporate venture capital firms maximize the profits of their parent companies by generating innovation advantage. Despite this, both intermediaries can join syndicates to obtain more information about their potential investments. We examine a model to show the differences between the syndication decisions of these two investor types. We find that corporate venture capital firms finance more projects without a syndicate in comparison with venture capital firms. To reinforce our theoretical results, we conduct a survey about the German private equity market. The empirical evidence support our main theoretical findings.

Keywords: Corporate venture capital; Venture capital; Syndication; Screening

JEL Classification Numbers: G24; M13

1 Introduction

Venture capital firms (VCs) are specialized intermediaries that solve finance problems of high-risk young firms. Tyebjee/Bruno (1984) remark on the essential role of venture capital in the entrepreneurial process. Beside these independent VCs, there are investors called corporate venture capital firms (CVCs). Every CVC is structured as a subsidiary of an incumbent company, such as Google (Google Ventures), BMW (BMW i-Ventures) and Commerzbank (CommerzVentures and main incubator) and can be seen as an external R&D approach. CVCs identify entrepreneurial

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firms for their parent companies for high financial returns but also for innovation advantage, like a window on new technologies or growth areas.¹ Lerner (2013) points out that CVCs are faster, cheaper and more flexible than traditional R&D to support an established company for technology change. Chemmanur/Fulghieri (2013) also note that CVCs have growing importance as an alternative to the traditional form of venture capital in nurturing young firms. However, in past research little attention has been paid to corporate venture capital investments.

We define CVCs as corporate investors, that pursue both innovation and monetary goals. The innovation benefits of corporate venture capital give rise to competitive advantage for the large companies.² In contrast, independent VCs drive only substantial financial returns through the sale of ownership stakes.

Before closing an investment VCs and CVCs usually spend a significant amount of effort evaluating the quality of their investment opportunities. Young (2012) and Dushnitsky/Lenox (2005) remark that – viewed from the perspective of adverse selection and moral hazard theory – caution is warranted on the investor side. There is a large information problem between the ventures and the VCs and CVCs respectively. Thus to make the right decision, both investors use detailed screening processes to generate comprehensive information about the entrepreneurial firms.

Moreover, Lerner (1994) suggests that syndication allows intermediaries to receive additional information in order to decide whether to invest in young firms or not. This means that two or more investors select and finance a young firm simultaneously. Empirical observations suggest that syndication is the rule rather than the exception in the context of venture capital. Sharifzadeh/Walz (2012), for instance, observe a sample of 238 financing rounds in 112 young firms and show that 86 % of the investments are syndicated.

The main goal of our paper is to examine the syndication decisions of VCs and CVCs. We analyse the optimal syndication strategies of corporate investors and investors who make investments merely for financial returns. Hellmann (2002) stresses that identifying the main differences between these investor types is central to an understanding of entrepreneurial finance. Moreover, with the growing success of young innovative firms this decision problem becomes increasingly relevant for both intermediaries.³ In this regard, we formulate the following research question: Do

¹See for other corporate venture capital aims Winters/Murfin (1988) and Sykes (1990).

²Siegel/Siegel/MacMillan (1988) note that innovation benefits are the primary motivation for incumbent firms to found such a subsidiary. See also Sykes (1990) and McNally (1997). On the other side Block/MacMillan (1993) and Chesbrough (2002) suggest that CVCs balance financial and innovation benefits.

³In the same way, this paper is motivated by Chemmanur/Fulghieri (2014) and their article about

corporate venture capital firms and venture capital firms choose different syndication strategies if both intermediaries can seek syndicates to obtain additional information about young firms?

Our main findings are: CVCs finance more projects without a syndicate in comparison with venture capital firms because they want to exclude other corporate investors from the innovations. Hence, they undertake more investments at an earlier point in time than VCs. This behaviour leads to a portfolio with a lower quality in terms of the expected cash flow. However, the parent company can reach a competitive advantage and participate in the innovations. The impact of nonfinancial support also results in CVCs with very low reputation joining more syndicates than highly reputed CVCs.

To support these results, we have conducted a survey about the German private equity market. Our study includes data on several VCs and CVCs. In the same way as in our model, the empirical results indicate that corporate investors choose syndication less than traditional VCs. CVCs also invest after a shorter period of time as VCs.

The theoretical section of our paper includes two different cases. First we consider an independent VC. We assume this intermediary can conclude a contract with a young firm without any need to exclude other investors from the project. Moreover, the VC can seek a syndicate as an additional screening step. The cooperation with other intermediaries allows the VC to generate more information about the young firm. According to the empirical results of Tyebjee/Bruno (1984), the screening results affect the expected profit of the investments. In our model, the VC compares the expected cash flow of each screening trial and chooses the strategy with the highest expected profit.

In the second case, we show the effects of competition in the model. We consider two CVCs that are founded from established companies and faced with a competition to finance an entrepreneurial firm.⁴ The incumbent firms operate in the same market. Therefore, both CVCs want to exclude the other CVC from the innovations of the young firms, so that the parent company maintains a competitive advantage and participates in the innovations. In the model, only one CVC can conclude a contract with a young entrepreneurial firm due to the innovation competition. This assumption bases on the empirical results of Sharifzadeh/Walz (2012), who show that CVCs cooperate with VCs by the majority of the time. Only a small number

promising topics for future research in the field of entrepreneurial finance and innovation.

⁴For example, RWE and E.ON are two incumbents firms in the German energy sector, which have founded CVCs.

of CVCs syndicate with other subsidiaries of incumbent companies. Thus, we assume both corporate investors can seek a syndicate with other intermediaries, with the exception of the rival CVC. Moreover, Yang et al. (2009) point out that the ability to select high quality ventures increase if the corporate investor syndicates with independent VCs. This is consistent with our assumption that CVCs can work together with such partners and share experience to choose young firms with a high probability of success.

An important part of corporate venture capital is the nonfinancial support provided by the investors.⁵ CVCs compete not only on the price of equity, but also with the level of support that they can provide. Hellmann (2002) points out that a new venture succeeds or fails depends on this nonmonetary value-added. We consider only one type of support: reputation. Potential customers can view an investment by a subsidiary of an incumbent company as a signal which reduces information asymmetries. In our model every young firm is more willing to choose the CVC with the higher reputation if both investors offer a contract at the same time.

This paper is closely related to the work of Brander et al. (2002). Besides presenting data for venture capital investments in Canada, they consider a theoretical model of the benefits of syndication. The authors examine two hypotheses with their model that justify an investor syndicate. The selection hypothesis suggested by Lerner (1994) is based on the idea that even after its own screening, a VC might be unsure about the perspective of a new project and might prefer the opinion of another investor. On the other hand, value-added hypothesis suggested by Brander et al. proposes that syndicates might add value to the young firms, which are part of their portfolio. In contrast, our paper explores not only VCs but also corporate investors. We focus on the assumptions of Lerner's selection hypothesis and show the difference between the behaviour of VCs and CVCs.

The work of Hellmann (2002) is also related. He considers a theoretical model of venture capital investments. A corporate investor competes with an independent VC to finance a young firm. Hellmann notes that corporate venture capital investments are influenced if the activities of the new venture can be seen as a complement or a substitute for the established firm. He also shows that nonfinancial support has a great impact on the selection of investors by the entrepreneurial firms. We use this result for our model and consider in the second case two CVCs with different reputations as an indirect type of nonfinancial assistance. However, we focus on syn-

⁵Naturally, nonfinancial support is also an important aspect of traditional venture capital. In our model we can neglect this aspect for the VC due to the lack of competition.

dication decisions and examine a competition between corporate investors, whereas Hellmann considers primarily a competition between a CVC and a VC.⁶

The remainder of the paper is organized as follows: In the next section we introduce the theoretical model. Section 3 presents the analysis. In Section 4, we formulate the main theoretical findings as hypotheses. Section 5 offers a brief description of our survey about the German private equity market. In Section 6, we discuss the hypotheses with our empirical results and provide some concluding remarks. The Appendix includes the proof for the equilibria in mixed strategies.

2 Model

We assume a risk-neutral world with no discounting. An entrepreneur (E) without wealth wants to start a new project. At time t_1 E is trying to raise funds and nonmonetary support. Only one venture round takes place.⁷ If E does not find an investor in this round, the project fails. Without loss of generality, it requires an investment of L and yields a nonnegative cash flow. Throughout the paper we assume that L is sufficiently low and hence the investors are willing to finance E.⁸ If the return is zero, then the capital is lost. The investor's problem is to investigate the project and decide whether to accept or reject it.

We distinguish between two cases. First, similar to Brander et al. (2002), only one VC investigates a new project. This purely financial investor decides either to reject or to invest alone or to cooperate with other intermediaries and invest as a syndicate. In the second case, we expand the setting of Brander et al. by considering two corporate investors, CVC_i with $i=1,2$. The parent companies of the CVCs are competitors in one branch and seek competitive advantage with their subsidiaries. To highlight this competition, we assume that the young entrepreneurial firm can only be financed by one of the CVCs. This CVC invests either alone or through a syndicate with other investors.

We assume that the VC (CVC_i) cannot make any transfer payments at time t_1 and simply buy the young firm, due to an adverse selection problem ex-ante. Therefore, no investor can buy the venture without any screening up-front. Sim-

⁶Other corporate venture capital literature that include useful references are Basu et al. (2011), Benson/Ziedonis (2009) and Ivanov/Xie (2010). For some references for syndication, see Sah/Stiglitz (1986) and Admati/Pfleiderer (1994). For some references for screening, see MacMillan et al. (1987) and Kaplan/Strömberg (2001).

⁷Therefore, we can neglect the capital structure of the new venture. Admati/Pfleiderer (1994) analyse the relevance of capital structure in venture capital contracts. They show that VC will hold constant equity stake, if the young firm undertakes several financing rounds.

⁸Additionally, following Hellmann (1998), we assume that the participation constraint of the E is always satisfied.

ilar to Hellmann (1998), all intermediaries have symmetric information. Figure 1 illustrates the decision structure of the VC (CVC_i).

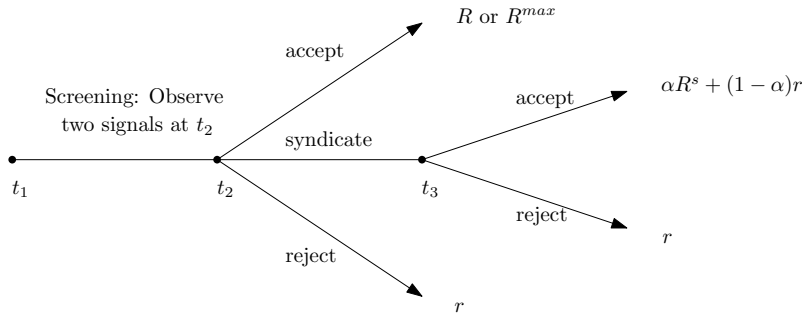


Figure 1: Decision-making structure of the VC (CVC_i)

The screening process starts at time t_1 and consists of two independent trials: The VC (CVC_i) systematically screens the project based on different criteria. Each trial yields a binary signal at t_2 . It can only take two possible values, positive (good) or negative (bad). We assume the values occur with a probability of $\frac{1}{2}$. Therefore, at t_2 three cases can occur for each intermediary: First, the VC (CVC_i) obtains zero positive signals with a probability of $\frac{1}{4}$, second, it observes two positive signals with a probability of $\frac{1}{4}$, and third, one positive signal is received with a probability of $\frac{1}{2}$.

At time t_2 , depending on the screening results, the VC (CVC_i) chooses between three different actions: rejection, acceptance and seeking syndication. We assume that the VC (CVC_i) rejects the young entrepreneurial firm if it receives zero positive signals. The available capital is invested in an alternative, risk-free investment which generates the expected cash flow r . According to Chan (1983), we consider r as the opportunity cost of investment and it is assumed that these investments are available in infinitely elastic supply. Furthermore, we assume that if the VC (CVC_i) observes two positive signals, it accepts the young entrepreneurial firm which yields the expected cash flow $R^{max} > r$. Consequently, our analysis limits the case where the two initial signals of the lead investor differ. We calculate the decision plan depending on the expected value of one positive signal R .

If the VC (CVC_i) has one positive screening result, the intermediary decides either to accept or to syndicate. If the VC (CVC_i) accepts, it invests and gains the expected payoff $R \in (r, R^{max})$.⁹ If the VC (CVC_i) seeks syndication, then additional intermediaries, e.g. other venture capitalists, are requested. These investors evaluate the project and at time t_3 , they suggest to reject or accept. We assume the syndicate accepts the project with a probability of $\frac{1}{2}$, which generates an expected cash flow

⁹Obviously, if $R < r$ the investor could also reject the project after receiving one positive signal. We exclude this case. The expected payoff R of one positive signal is bounded above by R^{max} .

of $R^s \in (r, R^{max}]$ for the syndicate at time t_3 . In the case of syndication, the VC (CVC_i) is referred to as the lead investor. This investor finances the main part of the project, while the other investors of the syndicate provide the remaining amount. The lead investor reaches an exogenous share $\alpha < 1$ of the expected cash flow R^s . The rest of the original potential investment is invested in the alternative and will yield the expected return $(1 - \alpha)r$. If the syndicate rejects E , the VC (CVC_i) invests the total funds in the alternative.¹⁰

The expected cash flow of investing in the project depends only on the screening results of each investor.¹¹ We write R as $R = \pi \cdot q$, where π is a verifiable return and q the probability of success which increases by the number of positive signals. Similar to Hellmann (1998), the probability of success, q represents different risks, like technology risk, development risk, the risk of market acceptance or the probability of winning a patent race. Similar to Brander et al., (2002) we assume the following order of the expected cash flows throughout the paper:

$$r < R < R^s \leq R^{max}.$$

Gompers (2002) and Gompers/Lerner (1998) show that CVCs yield nearly the same returns as VCs if the investments are related to the core business of the incumbent firm. Because of this, we neglect the innovation impact for the incumbent firm in our model. Thus, the expected payoffs of the VC and CVCs are equal for a given number of positive signals.

Consider the case with two CVCs. We assume that the corporate investors provide the same financial support but differ in their nonmonetary assistance in the form of reputation.¹² The longer a CVC operates in the market and the better the track record of the investor is, the higher the reputation they have. Our model allows for this heterogeneity and if both CVCs accept the project at the same time, t_2 or t_3 , then the investor with the higher reputation has a higher probability to conclude a contract. Without loss of generality, we assume the exogenous parameter $\theta_1 \in [\frac{1}{2}, 1]$ represents the contract probability of CVC_1 . Thus, CVC_2 conclude a contract with

¹⁰The syndication can be interpreted as independent third trial which yields a third signal for the investors. Depending on this the VC (CVC_i) finally decides to accept it as a syndicated project or to reject it. The VC (CVC_i) observes a positive third signal with a probability of $\frac{1}{2}$ and a bad signal with a probability of $\frac{1}{2}$.

¹¹Therefore, we assume that the CVCs can not update their expected payoff by using the screening results of the competitor.

¹²For simplification we consider only reputation as nonfinancial support. Hellmann (2002) remark that venture capital investments include a number of such activities. These assistance are large subtle so that they cannot be contracted upon. Therefore, we focus only on reputation, because it can be viewed as an indirect nonfinancial support, which requires no contractual conditions.

the probability $\theta_2 = (1 - \theta_1)$ if both CVCs accept the project at the same time. For simplification, we call θ_1 reputation which is common knowledge.¹³ In the case of syndication, we assume that the VC (CVC_i) is always the lead investor and holds the majority of the shares. The other shares are widely dispersed and held by several investors. Therefore, only the reputation of CVC_i is relevant. If one CVC invests in the project, the rival CVC has to invest in the alternative.

3 Optimal syndication choice

The lead intermediary compares the expected payoffs from the available actions. Following the assumptions, we maintain throughout the following analysis that the corresponding intermediary receives one positive signal out of two signals and the expected payoff is in the interval

$$r < R < R^s.$$

We examine the optimal decisions of the different types of intermediary, VC or CVC, separately.

Optimal syndication choice of venture capital firms

In the first case, we consider one VC. It chooses between acceptance and seeking syndication. The following proposition presents the conditions when seeking syndication has a higher expected payoff.

Proposition 1 *Assume, at t_2 the VC receives different signals and $R \in (r, R^s)$. Seeking syndication with the shareholding α is optimal if and only if the expected payoff of outright acceptance R fulfills the following condition:*

$$R < R_{VC},$$

whereas

$$R_{VC} \equiv \frac{\alpha}{2}R^s + \left(1 - \frac{\alpha}{2}\right)r.$$

Otherwise outright acceptance is optimal.

Proof. The VC yields one positive signal and one negative signal. The VC compares the expected cash flow from immediate acceptance at t_2 and syndication at t_3 .

¹³If θ_1 is 0.5 then the CVCs are homogeneous.

Immediate acceptance results in the expected return of R at t_2 due to the absence of competition.

If the VC chooses syndication, the project is accepted with a probability of $\frac{1}{2}$ at t_3 . Therefore, syndication results in the following expected cash flow:

$$\frac{1}{2}(\alpha R^s + (1 - \alpha)r) + \frac{1}{2}r$$

$$\frac{\alpha}{2}R^s + \left(1 - \frac{\alpha}{2}\right)r$$

The VC chooses syndication if the expected return is higher than the expected return from immediate acceptance:

$$R < \frac{\alpha}{2}R^s + \left(1 - \frac{\alpha}{2}\right)r \quad (1)$$

We define result (1) as follows:

$$R_{VC} \equiv \frac{\alpha}{2}R^s + \left(1 - \frac{\alpha}{2}\right)r \quad (2)$$

■

The optimal choice depends on the probability of positive syndication decision and the share α . The first term represents the potential gain of seeking syndication, whereas the second one delivers the potential loss.

Optimal syndication choice of corporate venture capital firms

In the second case, we calculate the decision plans of the two CVCs. CVC_i has no information about the screening results of its opponent. Both CVCs choose simultaneously between three different actions: rejection, acceptance and seeking syndication. The following Lemmata present the conditions when CVC_i seeks syndication after receiving different signals at t_2 .

Lemma 2 *Assume, at t_2 CVC_i with reputation θ_i receives different signals and $R \in (r, R^s)$. α is the shareholding of CVC_i by investing in a syndicated project. If the rival accepts the project with one positive signal at time t_2 (assumption I) the best response of CVC_i given the expected payoff R is*

$$BR_i^I [R] = \begin{cases} \text{syndication} & , \text{ if } R < R_{CVC_i}^I \\ \text{acceptance} & , \text{ if } R \geq R_{CVC_i}^I, \end{cases}$$

where

$$R_{CVC_i}^I \equiv \frac{\alpha}{2(3\theta_i + 1)}R^s + \left(1 - \frac{\alpha}{2(3\theta_i + 1)}\right)r.$$

Proof. Assume that CVC_1 with reputation θ_1 receives one positive signal out of the initial trials. We assume that CVC_2 will accept the project with one or two positive signals at time t_2 . Two positive signals occur with a probability of $\frac{1}{4}$ and one positive signal occurs with a probability of $\frac{1}{2}$. Only one CVC can conclude a contract with the young entrepreneurial firm. Hence, CVC_1 yields R with a probability of θ_1 or r with a probability of $(1 - \theta_1)$. If CVC_1 accepts the young entrepreneurial firm at t_2 with one positive signal, the decision results in the following expected cash flow:

$$\begin{aligned} & \frac{3}{4}(\theta_1 R + (1 - \theta_1)r) + \frac{1}{4}R \\ &= \frac{(3\theta_1 + 1)}{4}R + \frac{3(1 - \theta_1)}{4}r. \end{aligned} \quad (3)$$

If CVC_1 chooses syndication, CVC_2 yields two positive signals and accepts the project with a probability of $\frac{1}{4}$ at t_2 . In the same way, CVC_2 yields one positive signal and one negative signal and accepts the young entrepreneurial firm with a probability of $\frac{1}{2}$ at t_2 . Therefore, CVC_1 yields r with a probability of $\frac{3}{4}$, because it is not possible to close a contract with the young firm at t_3 .

CVC_2 yields zero positive signals and rejects the project with a probability of $\frac{1}{4}$ at t_2 . In this case, CVC_1 yields $\alpha R^s + (1 - \alpha)r$ or r with a probability of $\frac{1}{2}$. Overall, CVC_1 yields the following expected return:

$$\begin{aligned} & \frac{3}{4}r + \frac{1}{4} \cdot \frac{1}{2}(\alpha R^s + (1 - \alpha)r + r) \\ &= \frac{\alpha}{8}R^s + \left(1 - \frac{\alpha}{8}\right)r. \end{aligned} \quad (4)$$

CVC_1 seek syndication if the expected return is higher than the expected cash flow of immediate acceptance:

$$\begin{aligned} & \frac{(3\theta_1 + 1)}{4}R + \frac{3(1 - \theta_1)}{4}r < \frac{\alpha}{8}R^s + \left(1 - \frac{\alpha}{8}\right)r \\ \Leftrightarrow & R < \frac{\alpha}{2(3\theta_1 + 1)}R^s + \left(1 - \frac{\alpha}{2(3\theta_1 + 1)}\right)r. \end{aligned} \quad (5)$$

We define result (5) as follows:

$$R_{CVC_1}^I \equiv \frac{\alpha}{2(3\theta_1 + 1)}R^s + \left(1 - \frac{\alpha}{2(3\theta_1 + 1)}\right)r.$$

Analogously, suppose CVC_2 with reputation $\theta_2 = (1 - \theta_1)$. This delivers

$$R_{CVC_2}^I \equiv \frac{\alpha}{2(3(1 - \theta_1) + 1)} R^s + \left(1 - \frac{\alpha}{2(3(1 - \theta_1) + 1)}\right) r.$$

■

Lemma 3 *Assume, at t_2 CVC_i with reputation θ_i receives different signals and $R \in (r, R^s)$. α is the shareholding of CVC_i by investing in a syndicated project. If the rival seeks syndication with one positive signal at time t_2 (assumption II), the best response of CVC_i given the expected payoff R is*

$$BR_i^{II} [R] = \begin{cases} \text{syndication} & , \text{ if } R < R_{CVC_i}^{II} \\ \text{acceptance} & , \text{ if } R \geq R_{CVC_i}^{II}, \end{cases}$$

where

$$R_{CVC_i}^{II} \equiv \frac{\alpha(2 + \theta_i)}{2(3 + \theta_i)} R^s + \left(1 - \frac{\alpha(2 + \theta_i)}{2(3 + \theta_i)}\right) r.$$

Proof. Assume that CVC_1 with reputation θ_1 receives one positive signal out of the initial trials. We assume that CVC_2 will accept the project only with two positive signals at time t_2 . Two positive signals arise with a probability of $\frac{1}{4}$. CVC_2 seeks syndication if it receives different signals which arises with a probability of $\frac{1}{2}$. CVC_1 has one positive signal and compares the expected payoffs of outright acceptance and seeking syndication. Only one CVC can conclude a contract with the young entrepreneurial firm. Hence, CVC_1 yields R with a probability of θ_1 or r with a probability of $(1 - \theta)$. Outright acceptance leads to the following expected payoff:

$$\begin{aligned} & \frac{1}{4} (\theta_1 R + (1 - \theta_1) r) + \frac{3}{4} R \\ & = \frac{(3 + \theta_1)}{4} R + \frac{1 - \theta_1}{4} r. \end{aligned} \tag{6}$$

If CVC_1 chooses syndication, CVC_2 yields two positive signals and accepts the project with a probability of $\frac{1}{4}$ at t_2 . Therefore, CVC_1 yields r with a probability of $\frac{1}{4}$ because it is not possible to close a contract with the young firm at t_3 .

CVC_2 yields zero positive signals and rejects the project with a probability of $\frac{1}{4}$ at t_2 . In this case, CVC_1 syndicates and yields $\alpha R^s + (1 - \alpha)r$ or r with a probability of $\frac{1}{2}$.

CVC_2 yields one positive signal and one negative signal with a probability of $\frac{1}{2}$ at t_2 . Both CVCs seek syndication. The syndicate of CVC_1 rejects the project with a probability of $\frac{1}{2}$ and CVC_1 yields r . If the syndicate of CVC_1 accepts, the

expected payoff of CVC_1 depends on the decision of the syndicate of CVC_2 . If both syndicates accept, CVC_1 yields $\alpha R^s + (1 - \alpha)r$ with a probability of θ or r with a probability of $(1 - \theta)$. Overall, CVC_1 yields the following expected cash flow:

$$\begin{aligned}
& \frac{1}{4}r + \frac{1}{4} \cdot \frac{1}{2} (\alpha R^s + (1 - \alpha)r + r) + \frac{2}{4} \left[\frac{1}{2}r + \frac{1}{2} \cdot \frac{1}{2} (\alpha R^s + (1 - \alpha)r) \right] \\
& \quad + \frac{2}{4} \left[\frac{1}{2} \cdot \frac{1}{2} (\theta_1 (\alpha R^s + (1 - \alpha)r) + (1 - \theta_1)r) \right] \\
& = \frac{5}{8}r + \frac{2}{8}\alpha R^s + \frac{2}{8}(1 - \alpha)r + \frac{2}{8}\theta_1\alpha R^s + \frac{1}{8}(1 - \alpha)\theta_1r + \frac{1}{8}(1 - \theta_1)r \\
& = \left(\frac{2}{8}\alpha + \frac{2}{8}\theta_1\alpha \right) R^s + \left(\frac{5}{8} + \frac{2}{8}(1 - \alpha) + \frac{1}{8}(1 - \alpha)(1 - \theta) + \frac{1}{8}(1 - \theta_1) \right) r \\
& = \frac{\alpha(2 + \theta_1)}{8}R^s + \left(1 - \frac{\alpha(2 + \theta_1)}{8} \right) r. \tag{7}
\end{aligned}$$

The expected cash flow of immediate rejection is r which is less than (6) and (7). Therefore, rejection is not optimal. CVC_1 chooses seeking syndication if the expected return is higher than the expected cash flow of immediate acceptance:

$$\begin{aligned}
& \frac{(3 + \theta_1)}{4}R + \frac{(1 - \theta_1)}{4}r < \frac{\alpha(2 + \theta_1)}{8}R^s + \left(1 - \frac{\alpha(2 + \theta_1)}{8} \right) r \\
& R < \frac{\alpha(2 + \theta_1)}{2(3 + \theta_1)}R^s + \left(1 - \frac{\alpha(2 + \theta_1)}{2(3 + \theta_1)} \right) r. \tag{8}
\end{aligned}$$

We define result (8) as follows:

$$R_{CVC_1}^{II} \equiv \frac{\alpha(2 + \theta_1)}{2(3 + \theta_1)}R^s + \left(1 - \frac{\alpha(2 + \theta_1)}{2(3 + \theta_1)} \right) r.$$

Analogously, suppose CVC_2 with reputation $\theta_2 = (1 - \theta_1)$. This delivers

$$R_{CVC_2}^{II} \equiv \frac{\alpha(2 + (1 - \theta_1))}{2(3 + (1 - \theta_1))}R^s + \left(1 - \frac{\alpha(2 + (1 - \theta_1))}{2(3 + (1 - \theta_1))} \right) r.$$

■

Existence of pure strategy equilibria

Lemmata 2 and 3 show the optimal strategies of both CVCs given rivals strategy. Next, we analyse three cases depending on the reputation value θ_i . The following propositions demonstrate under which conditions equilibria exist.

Proposition 4 *Assume, at time t_2 both CVCs receive different signals, $R \in (r, R^s)$ and the reputation of CVC_1 is $\theta_1 \in \left[\frac{1}{2}, \frac{2(3 - \sqrt{3})}{3} \right]$. α is the shareholding of the lead*

investor by investing in a syndicated project. We have the following order:

$$R_{CVC_1}^I \leq R_{CVC_2}^I \leq R_{CVC_2}^{II} \leq R_{CVC_1}^{II}.$$

Depending on R there exist different equilibria:

- If $R \geq R_{CVC_2}^{II}$ both CVCs will accept the project.
- If $R < R_{CVC_2}^I$ both CVCs will seek syndication.
- If $R_{CVC_2}^I \leq R < R_{CVC_2}^{II}$ both CVCs will either seek syndication or accept the project.

Proof. First, $R_{CVC_1}^I, R_{CVC_2}^I, R_{CVC_2}^{II}$ and $R_{CVC_1}^{II}$ are linear combinations of r and R^s . Considering only the terms of R^s is sufficient to prove the order. For $\theta_1 \in \left[\frac{1}{2}, \frac{2(3-\sqrt{3})}{3}\right]$ the following inequations hold:

$$\frac{\alpha}{2(3\theta_1 + 1)} \leq \frac{\alpha}{2(3(1 - \theta_1) + 1)} \leq \frac{\alpha(2 + (1 - \theta_1))}{2(3 + (1 - \theta_1))} \leq \frac{\alpha(2 + \theta_1)}{2(3 + \theta_1)}.$$

Second, in respect to Lemma 2, given the rival accepts the project with one positive signal, outright acceptance is the best response of CVC_i if $R \geq R_{CVC_i}^I$. For $R \geq R_{CVC_2}^I > R_{CVC_1}^I$ both CVCs will accept the project, neither of them have an incentive to deviate one-sided. Analogously, Lemma 3 shows both intermediaries will seek for syndication if $R < R_{CVC_2}^{II} < R_{CVC_1}^{II}$. Thus, these two ranges of R overlap in the interval $[R_{CVC_2}^I, R_{CVC_2}^{II}]$, where therefore two Nash equilibria exist. Consider, with $\theta = \frac{2(3-\sqrt{3})}{3}$ follows $R_{CVC_2}^I = R_{CVC_2}^{II}$. Figure 2 illustrates the situation with an overlapping range.

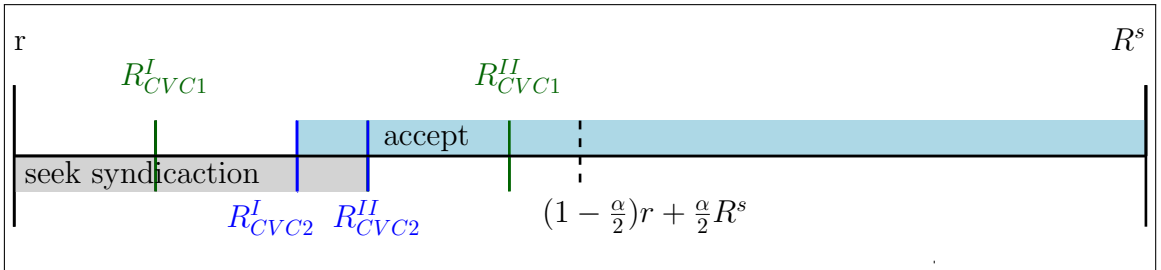


Figure 2: Nash Equilibria: $\theta_1 \in \left[\frac{1}{2}, \frac{2(3-\sqrt{3})}{3}\right]$

■

Proposition (4) shows that if the CVCs are homogeneous ($\theta_1 = \frac{1}{2}$) or if one CVC has a slightly higher reputation, that either one or two Nash equilibria exist. If

R is not in the interval $[R_{CVC_2}^I, R_{CVC_2}^{II})$ there is one equilibrium each with both CVCs seeking syndication or both CVCs accepting the project. Otherwise, if the expected payoff is in the interval, two Nash equilibria exist. A higher reputation difference decreases the interval range. Until the interval reduces to a single point ($R_{CVC_2}^I = R_{CVC_2}^{II}$) when $\theta_1 = \frac{2(3-\sqrt{3})}{3}$, i.e. only one equilibrium exists.

Proposition 5 *Assume, at time t_2 both CVCs receive different signals, $R \in (r, R^s)$ and the reputation of CVC_1 is $\theta_1 \in \left(\frac{2(3-\sqrt{3})}{3}, \frac{\sqrt{69}-3}{6}\right]$. α is the shareholding of the lead investor by investing in a syndicated project. We have the following order:*

$$R_{CVC_1}^I < R_{CVC_2}^{II} < R_{CVC_2}^I \leq R_{CVC_1}^{II}.$$

Depending on R there exist different equilibria:

- If $R \geq R_{CVC_2}^I$ both CVCs will accept the project.
- If $R < R_{CVC_2}^{II}$ both CVCs will seek syndication.
- If $R_{CVC_2}^{II} \leq R < R_{CVC_2}^I$ no equilibrium in pure strategies exist.

Proof. First, $R_{CVC_1}^I, R_{CVC_2}^I, R_{CVC_2}^{II}$ and $R_{CVC_1}^{II}$ are linear combinations of r and R^s . Considering only the terms of R^s is sufficient to prove the order. For $\theta_1 \in \left(\frac{2(3-\sqrt{3})}{3}, \frac{\sqrt{69}-3}{6}\right]$ the following inequations hold:¹⁴

$$\frac{\alpha}{2(3\theta_1 + 1)} < \frac{\alpha(2 + (1 - \theta_1))}{2(3 + (1 - \theta_1))} < \frac{\alpha}{2(3(1 - \theta_1) + 1)} \leq \frac{\alpha(2 + \theta_1)}{2(3 + \theta_1)}.$$

Second, in respect to Lemma 2, given the rival accepts the project with one positive signal, outright acceptance is the best response of CVC_i if $R \geq R_{CVC_i}^I$. For $R \geq R_{CVC_2}^I > R_{CVC_1}^I$ both CVCs will accept the project, neither of them have an incentive to deviate one-sided. Analogously, Lemma 3 shows both intermediaries will seek for syndication if $R < R_{CVC_2}^{II} < R_{CVC_2}^I$.

Thus, in this case the two ranges of R do not overlap. For $R_{CVC_2}^{II} \leq R < R_{CVC_2}^I$ no equilibrium in pure strategies exists. Suppose CVC_2 chooses to accept, then the best response of CVC_1 is seeking syndication. Following Lemma 3, CVC_2 has the incentive to deviate and to seek syndication, too. In response to this, CVC_1 's best response is changed to accepting the young firm. Consequently, there exists an equilibrium in mixed strategies if $R \in [R_{CVC_2}^{II}, R_{CVC_2}^I)$. The mixed equilibrium strategy of CVC_i is to accept the project after one positive signal at time t_2 with

¹⁴Compared to Proposition 4 the benchmarks of CVC_2 switch the order.

probability σ_i . See Appendix A for the calculation of σ_i . Figure 3 illustrates the changed order and the equilibria.

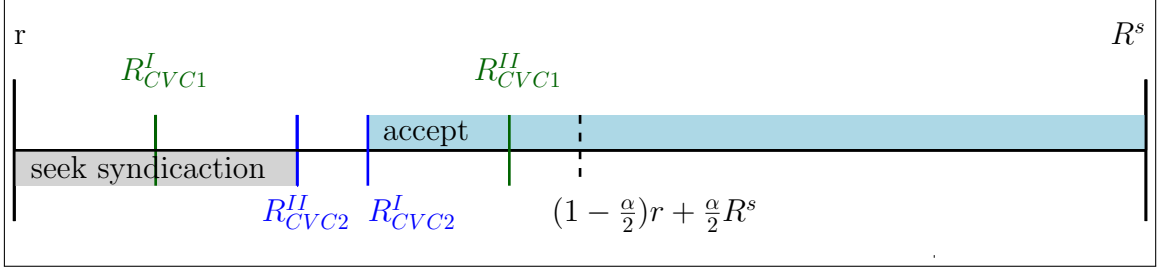


Figure 3: Nash Equilibria: $\theta_1 \in \left(\frac{2(3-\sqrt{3})}{3}, \frac{\sqrt{69}-3}{6} \right]$

■

Proposition (5) presents a highly reputable CVC_1 . The expectation of CVC_2 to close a contract for the project in a tie-break-situation is low. Therefore, CVC_2 has an incentive to choose a different action than CVC_1 to increase its probability of closing a contract. Consequently, in the interval $R_{CVC_2}^{II} \leq R < R_{CVC_2}^I$ no equilibrium in pure strategies exists. Both CVCs will choose a mixed strategy. Like in Proposition 4, a high (low) expected payoff R at time t_2 leads to both CVCs will accept (seek syndication).

Proposition 6 *Assume, at time t_2 both CVCs receive different signals, $R \in (r, R^s)$ and the reputation of CVC_1 is $\theta_1 \in \left(\frac{\sqrt{69}-3}{6}, 1 \right]$. α is the shareholding of the lead investor by investing in a syndicated project. We have the following order:*

$$R_{CVC_1}^I < R_{CVC_2}^{II} < R_{CVC_1}^{II} < R_{CVC_2}^I.$$

Depending on R different equilibria exist:

- If $R \geq R_{CVC_2}^I$ both CVCs will accept the project.
- If $R < R_{CVC_2}^{II}$ both CVCs will seek syndication.
- If $R_{CVC_1}^{II} \leq R < R_{CVC_2}^I$ CVC_1 will accept the project and CVC_2 will seek a syndicate.
- If $R_{CVC_2}^{II} \leq R < R_{CVC_1}^{II}$ there exists no equilibrium in pure strategies.

Proof. First, $R_{CVC_1}^I, R_{CVC_2}^I, R_{CVC_2}^{II}$ and $R_{CVC_1}^{II}$ are linear combinations of r and R^s . Considering only the terms of R^s is sufficient to prove the order. For $\theta_1 \in \left(\frac{\sqrt{69}-3}{6}, 1 \right]$

the following inequations hold:

$$\frac{\alpha}{2(3\theta_1 + 1)} < \frac{\alpha(2 + (1 - \theta_1))}{2(3 + (1 - \theta_1))} < \frac{\alpha(2 + \theta_1)}{2(3 + \theta_1)} < \frac{\alpha}{2(3(1 - \theta_1) + 1)}.$$

Second, respect to Lemma 2, given the rival accepts the project with one positive signal, outright acceptance is best response of CVC_i if $R \geq R_{CVC_i}^I$. For $R \geq R_{CVC_2}^I > R_{CVC_1}^I$ both CVCs will accept the project, neither of them have an incentive to deviate one-sided. Analogously, Lemma 3 shows both intermediaries will seek for syndication if $R < R_{CVC_2}^{II} < R_{CVC_1}^{II}$.

Considering $R \in [R_{CVC_1}^{II}, R_{CVC_2}^I)$, following the best response strategy CVC_1 will certainly accept the project if $R \geq R_{CVC_1}^{II} > R_{CVC_1}^I$. Anticipating this CVC_2 will follow its best response function BR^I , i.e. for $R < R_{CVC_2}^I$ CVC_2 will seek syndication. This interval appears for $\theta > \frac{\sqrt{69}-3}{6}$ and becomes larger by increasing the reputation θ_1 . Similar to Proposition (5) there exists an interval without an equilibrium in pure strategies. In this case both CVCs have an incentive to deviate one-sided. We calculate an equilibrium in mixed strategies, where CVC_i accepts the project after one positive signal at time t_2 with probability σ_i . See Appendix A for the calculation of σ_i . Figure 4 illustrates the equilibria.

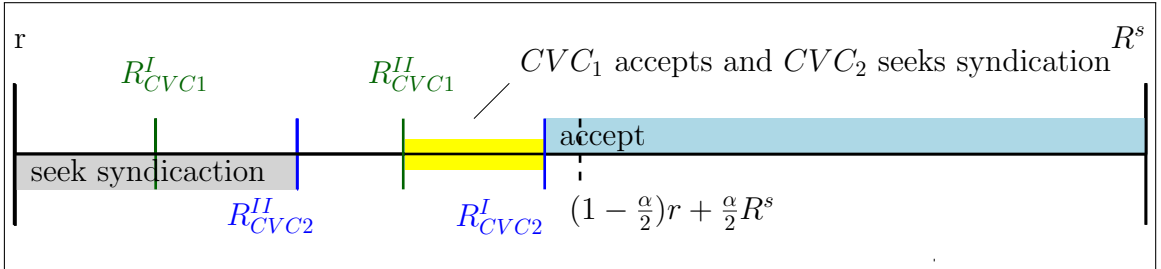


Figure 4: Nash Equilibria: $\theta_1 \in \left(\frac{\sqrt{69}-3}{6}, 1\right]$

■

Proposition (6) represents the setting if CVC_1 has a very high reputation. Consequently, CVC_2 has a very low probability of conducting a contract at a tie-break-situation. Different to Propositions (4) and (5) one equilibrium appears where both CVCs choose different actions, i.e. CVC_1 accepts and its rival seeks for syndication. Like in Propositions (5) no situation with two Nash equilibria exists.

4 Comparison of corporate venture capital and venture capital firms

In the following, we examine the difference between the syndication decision of VCs and CVCs. The results are formulated as hypotheses, which we discuss with our

empirical data in Section 6.

Proposition (1) shows that purely financial investors cooperate with other investors, if $R < R_{VC}$. In comparison with VCs, corporate investors follow their best response function BR_i^I and BR_i^{II} . Depending on reputation θ_1 , we distinguish between three different cases if the investor is a CVC. Figure 5 summarizes the optimal syndication decisions of both intermediary types.

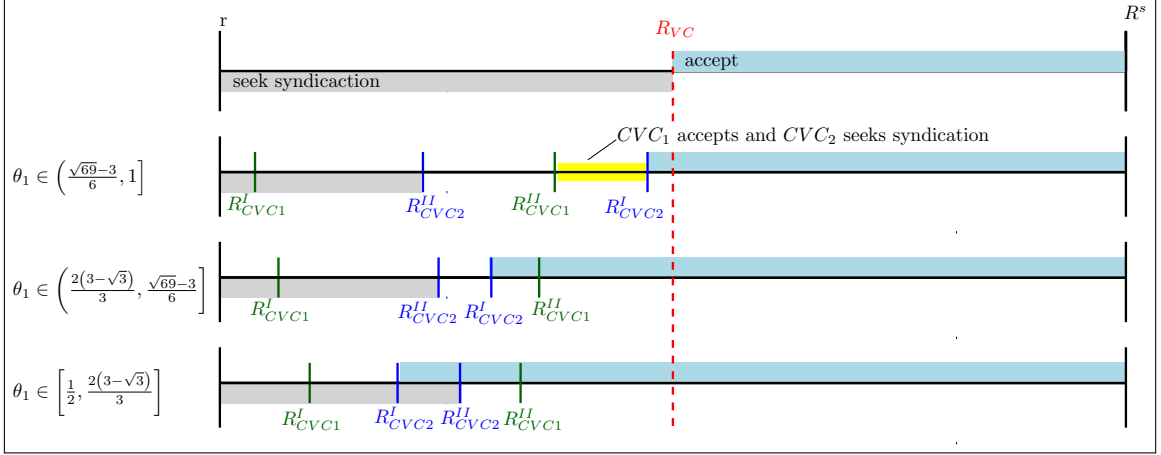


Figure 5: Syndication decision of corporate venture capital and venture capital firms

It can be seen that CVCs syndicate less projects in comparison with VCs. As a result, they accept more projects with a lower expected cash flow immediately. The more the reputations of the CVCs become homogeneous ($\theta_1 \rightarrow \frac{1}{2}$), the lower the benchmark for immediate acceptance is. Moreover, CVCs with a very high reputation ($\theta_1 \in \left(\frac{\sqrt{69}-3}{6}, 1\right]$) syndicate less than those with a lower reputation. Intermediaries with a very low reputation ($\theta_2 \rightarrow 0$) accept immediately only young firms with a high expected payoff. Our model shows that such CVCs behave more like a purely financial investor. They choose more syndicates to generate additional information about a potential venture. However, this does not imply that CVCs with a very low reputation have the same opportunity to close a contract with a young firm as a VC. Rivals with a very high reputation always win the tie-break. Therefore, the only possibility to finance a young firm is given if the sophisticated competitor rejects a project.

Hypothesis 1. CVCs finance more projects without a syndicate in comparison with VCs.

Moreover, CVCs conclude a contract at an earlier point in time more often than VCs, because they syndicate less investments. [Recall that Figure 1 illustrates the

timeline of the model.] For a given expected payoff, CVCs invest more often at time t_2 , whereas VCs wait until t_3 . They seek to generate additional information about a young firm before they close a contract. If the reputation of a CVC is very high ($\theta_1 \rightarrow 1$), the interval for acceptance increases. Thus, the intermediary finances more projects at t_2 . However, if two corporate investors have nearly the same reputation ($\theta_1 \rightarrow \frac{1}{2}$), both of them accept more investments at t_2 . The interval for syndication increases only if a CVC has a very small reputation ($\theta_2 \rightarrow 0$). But it is still smaller than the syndication interval for purely financial investors.¹⁵

Hypothesis 2. CVCs finance more projects at an earlier point in time as VCs.

5 Data

The theoretical model of our paper shows different insights into the syndication decision of CVCs and independent VCs. As a result we have formulated two hypotheses in the previous section. To check these hypotheses we conduct a survey about the German private equity market. The main empirical findings are presented in this section of the paper.

Especially for corporate venture capital, there is little recent empirical research with a focus on Germany. One reason for this fact is that the venture capital market is comparatively young. Therefore, only a small number of CVCs exist.¹⁶ According to the BVK (2015a) nearly 37 CVCs operate in the market.¹⁷ The data used for our study was collected in an online survey with 8 VCs and 7 CVCs by the authors. Both investor types finance 657 ventures in total which enable careful conclusions about the German venture capital market.

Investment sectors

Figure 6 illustrates the relevant investment sectors of both investor types. The surveyed VCs focus on the computer and communication industry, whereas CVCs prefer to invest in the chemicals, pharma and biotechnology or e-commerce sector. In contrast to the last empirical studies about corporate venture capital, a new investment area is the FinTech sector in Germany. FinTech means modern technologies for enabling financial services, such as internet-based technologies or mobile payments (VCs: 28.6 % and CVCs: 25.0 %).

¹⁵If a CVC has a $\theta_i = 0$ the syndication interval is equal for both investor types.

¹⁶Schween (1996) examines 12 CVCs, Mackewicz&Partner (2003) analyse 31 CVCs, while We-

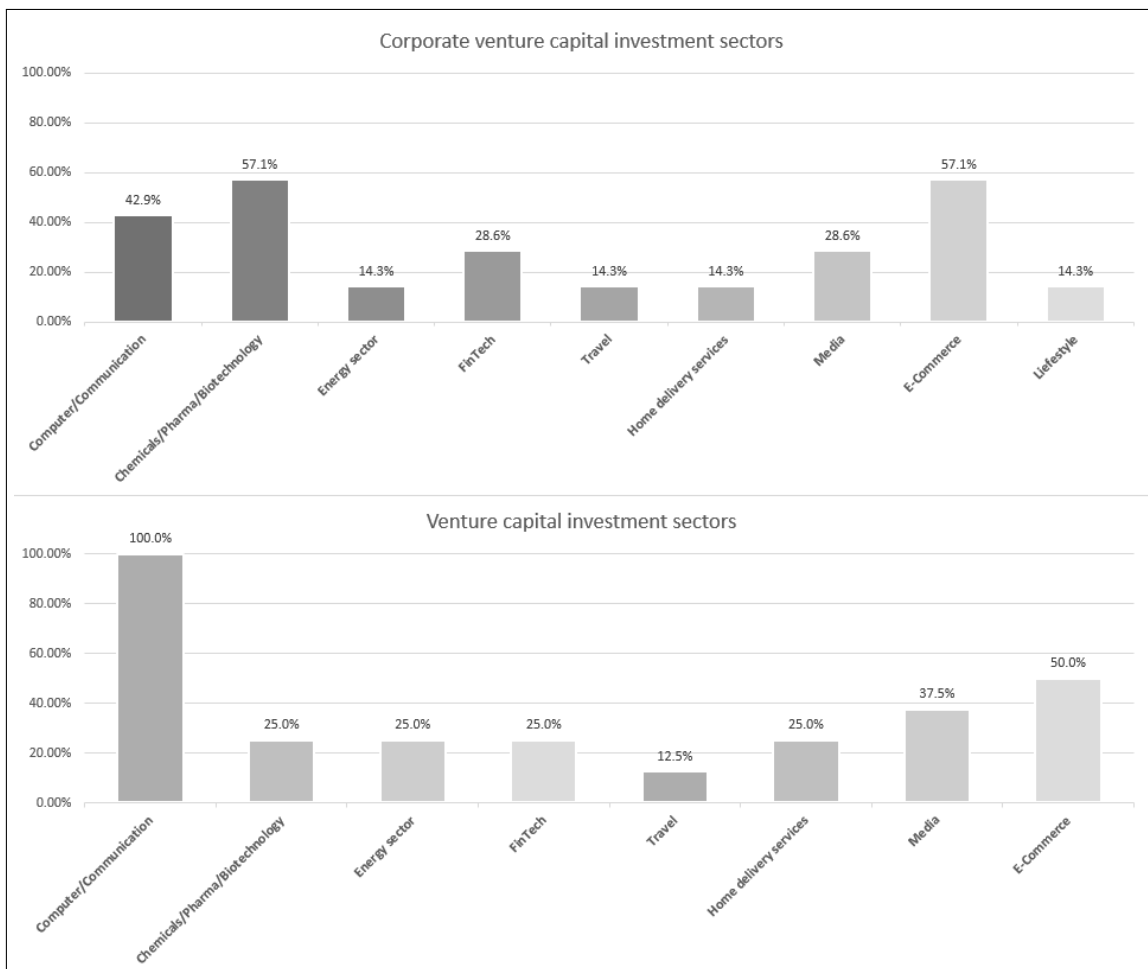


Figure 6: Relevant investment sectors of venture capital firms (N=8) and corporate venture firms (N=7)

Investor characteristics

The surveyed VCs provide more financial capital than CVCs. It can be seen on the average maximum level of finance capital which is 2 mio € higher for the purely financial investors. Table 1 shows that result. The mean of the venture capital investments (68 ventures) is also higher than the mean of the investments of the corporate investors (16 ventures). But the financing stages are nearly the same. Both investors finance most frequently young firms which have already introduced their products on the market and henceforth need money for expansion (VCs: 31.0 % and CVCs: 24.3 %). So, they put more weight on less risky investments and neglect the risk-fraught seed stage.

ber/Weber (2003) studied 20 CVCs.

¹⁷The German Private Equity Association (BVK) contain almost all German VCs and CVCs.

Table 1: Investor characteristics

	Venture capital firms N=8			Corporate venture capital firms N=7		
	Count	Mean	SD	Count	Mean	SD
Max. capital	-	8.8 mio €	3.4 mio €	-	6.8 mio €	2.9 mio €
Investments	546	68	30	111	16	5
Stage:						
• Seed	61	8	8	4	1	1
• Start-up	139	17	23	10	2	2
• First stage	142	18	25	10	2	2
• Expansion	169	21	34	27	8	4
• Bridge	34	4	8	2	2	1

Table 2 includes specific information on the CVCs. Most of the corporate investors pursue financial goals (3 CVCs) or balance financial and innovation goals (3 CVCs). Moreover, it can be seen that the ventures and the parent company of the CVCs have nearly the same branch.

Table 2: Specific characteristics of the CVCs

	Venture capital firms N=8		Corporate venture capital firms N=7	
	Count	Mean	Count	Mean
Primary goals:				
• Financial goals ¹	-	-	3	-
• Innovation goals ²	-	-	1	-
• Both goals are balanced	-	-	3	-
Venture branch: ³	-	-	-	3.1

¹ High ROI.

² Identification of new products and technologies, secure markets etc.

³ A value of 5 means that the branch of the ventures and the parent company are exactly the same.

Screening

Table 3 reports the screening duration of the investors. The surveyed CVCs analyse young firms over a shorter time period than the VCs. 83.4 % of the corporate investors evaluate the quality of their investment opportunities for no more than 4 months, whereas only 25.0 % of the VCs need the same amount of time.

Table 3: Screening duration

	Venture capital firms N=8		Corporate venture capital firms N=7	
	Count	Percentage	Count	Percentage
Screening duration:				
• 1 up to 2 months	-	-	1	16.7
• 3 up to 4 months	2	25.0	5	66.7
• 5 up to 6 months	6	75.0	1	16.7

We also examined the screening trials of the investors. Generally, a distinction is made between three different steps: initial screening, due diligence and investment negotiation. In our survey, VCs and CVCs show nearly the same screening behaviour. Table 4 shows this result. Most of the projects are rejected after the first trial. Therefore, only 14.6 % of the VC candidates and 19.0 % of the CVC candidates reach the more extensive and costly due diligence. Very few young firms enter into negotiations. Also at this stage, potential ventures may be refused because both partners are unable to reach an agreement.

Table 4: Screening trials

	Venture capital firms N=8		Corporate venture capital firms N=7	
	Mean	SD	Mean	SD
Rejection:				
• Initial screening	85.3 %	13.4 %	81.4 %	21.4 %
• Due Diligence	9.8 %	8.7 %	11.0 %	12.0 %
• Negotiation	4.6 %	11.5 %	7.5 %	3.6 %

Syndication

Another point is the syndication decision of the intermediaries. Purely financial investors will join a syndicate rather than CVCs. 71.4 % of all venture capital investments are syndicated, whereas only 63.2 % of all corporate venture capital investments are syndicated. Table 5 gives the details of this circumstance. Corporate investors have syndicated more often with VCs than with other corporate investors and business angels. Moreover, they prefer to work as co-investors. Only 30.9 % of all syndicates are started as a lead investor. If CVCs join a syndicate they will have 1 to 2 partners. Purely financial intermediaries also like to join a syndicate with other VCs rather than with CVCs and business angels. In the same way, they

prefer to cooperate with 1 to 2 investors. But it is more likely that VCs syndicate as a lead investor (67.84 %).

Table 5: Syndication decision

	Venture capital firms N=8		Corporate venture capital firms N=7	
	Count	Percentage	Count	Percentage
Syndicates	390	71.4	70	63.2
Lead Investor	263	67.4	22	30.9
Syndication partners: ¹				
• VCs	8	100.0	7	100.0
• CVCs	6	75.0	5	71.4
• Business Angels	6	75.0	5	71.4
• Others ²	3	37.5	1	14.3
Number of partners: ¹				
• 1 up to 2 partners	7	87.5	6	85.7
• 3 up to 4 partners	3	37.5	3	42.9
• > 5 partners	1	16.7	1	14.3

¹ Multiple answers possible.

² Incubators and accelerators.

6 Discussion and concluding remarks

Do corporate venture capital firms and venture capital firms choose different syndication strategies if both intermediaries can seek syndicates to obtain additional information about young firms? To answer this question we examined the syndication decision of corporate and purely financial investors. First we analysed the optimal strategy of both investors with a theoretical model. A central insight is that CVCs syndicate less investments in comparison with VCs. Moreover, they finance more entrepreneurs at an earlier date. These findings are formulated as two hypotheses, which we discuss together with our empirical data in this section.

Discussion of the hypotheses

Consistent with Hypothesis 1, we find through our survey that CVCs reject a syndicate and invest alone in a entrepreneurial project more often than VCs [Recall Table 5.]. It should be noted that this hypothesis relies on the assumption of an innovation competition between the corporate investors. Our empirical results do not confirm this aspect. In contrast to Sharifzadeh/Walz (2012), a high share of

our surveyed CVCs syndicate with other corporate investors [Recall Table 5.]. One reason for this fact could be the focus of the corporate investors. Only one survey participant primarily pursues innovation goals [Recall Table 2.]. Hence, syndicates between different CVCs are possible due to the absence of an innovation competition. Moreover, another reason could be the small size or newness of the venture capital market in Germany.¹⁸ Therefore, corporate investors may also choose to syndicate with other CVCs because of the lack of adequate alternatives.

The empirical findings are also consistent with Hypothesis 2. The surveyed CVCs require a shorter time period to accept a project than the independent VCs [Recall Table 3.]. Therefore corporate investors undertake an investment at an earlier stage. In the same way, it should be noted that this hypothesis is based on the assumption that CVCs do not syndicate with other corporate investors. An explanation for the empirical results could be the investment focus. Our surveyed CVCs finance predominantly young firms with the same business background as their parent company [Recall Table 2.]. Thus, corporate investors may have a time advantage for the screening due to their specialisation.

Implications for managerial practice

Our theoretical section provides an additional insights for the investment managers of CVCs. Corporate investors, which are new in the corporate venture capital sector, have a low reputation in terms of financing new ventures. Therefore, they do not have the same opportunity to close contracts with suitable projects. Sophisticated rivals always win a tie-break. Our model shows that CVCs with a very low reputation choose the same strategy as purely financial investors. Hence, to realise first investments in young firms and to build up reputation to win a tie-break, the investment managers should rather join a syndicate than invest in a new project alone.

Limitations and future research

Future theoretical research on syndication might investigate the importance of innovation goals, beside the financial returns, for the optimal syndication decision of corporate investors. For the empirical side it could be appropriate to extend the

¹⁸According to the BVK (2015b, 2015c), traditional VCs invested 645.7 million Euros in 727 new ventures while CVCs invested 75.4 million Euros in 41 young firms in Germany in 2014 .

sample by using investors outside of Germany or interviewing young firms and not the intermediaries.

Appendix

Equilibria in mixed strategies

Proposition 7 *Assume, at time t_2 both CVCs receive different signals, $R \in (r, R^s)$ and the reputation of CVC_1 is $\theta_1 \in \left(\frac{2(3-\sqrt{3})}{3}, \frac{\sqrt{69}-3}{6} \right]$. α is the shareholding of the lead investor by investing in a syndicated project. The following order consists of:*

$$R_{CVC_1}^I < R_{CVC_2}^{II} < R_{CVC_2}^I \leq R_{CVC_1}^{II}.$$

If $R_{CVC_2}^{II} \leq R < R_{CVC_2}^I$ an equilibrium in mixed strategies exists.

Proof. The following matrix presents the expected payoffs of both CVCs due to the innovation competition. [Recall that corporate investors follow their best response function BR_i^I and BR_i^{II} .]

CVC_2		
	accept	seek syndication
CVC_1		
accept	$(1 - \theta_1)R + (\theta_1)r$	r
	$\theta_1 R + (1 - \theta_1)r$	R
seek syndication	R	$R^s \left(\frac{1}{4} + \frac{1-\theta_1}{4} \right) + r \left(\frac{1}{2} + \frac{\theta_1}{4} \right)$
	r	$R^s \left(\frac{1}{4} + \frac{\theta_1}{4} \right) + r \left(\frac{1}{2} + \frac{1-\theta_1}{4} \right)$

Suppose CVC_2 choose each action with the probability σ_2 . Then the expected payoff of CVC_1 for acceptance is

$$ER_a^1 = \sigma_2 ((1 - \theta_1)R + (\theta_1)r) + (1 - \sigma_2) R.$$

By seeking syndication CVC_1 expects

$$ER_s^1 = \sigma_2 r + (1 - \sigma_2) \left(\frac{1}{2}r + \frac{1}{2}R^s + \frac{1}{2}\theta_1 R^s + \frac{1}{2}(1 - \theta_1)r \right).$$

To calculate the probability σ_2 which make CVC_1 indifferent between accepting or seeking syndication, the following equation $ER_a^1 = ER_s^1$ have to hold:

$$\begin{aligned} \sigma_2((1 - \theta_1)R + (\theta_1)r) + (1 - \sigma_2)R = \\ \sigma_2 r + (1 - \sigma_2) \left(\frac{1}{2}r + \frac{1}{2} \frac{1}{2}R^s + \frac{1}{2} \frac{1}{2}\theta_1 R^s + \frac{1}{2} \frac{1}{2}(1 - \theta_1)r \right). \end{aligned}$$

This delivers the probability σ_2 ,

$$\begin{aligned} \sigma_2 &= \frac{\left(\frac{1}{2}r + \frac{1}{2} \frac{1}{2}R^s + \frac{1}{2} \frac{1}{2}\theta_1 R^s + \frac{1}{2} \frac{1}{2}(1 - \theta_1)r\right) - R}{\left(\frac{1}{2}r + \frac{1}{2} \frac{1}{2}R^s + \frac{1}{2} \frac{1}{2}\theta_1 R^s + \frac{1}{2} \frac{1}{2}(1 - \theta_1)r\right) - ((1 - \theta_1)R + (\theta_1)r) - R - r} \\ &= \frac{\left(\frac{1}{2}r + \frac{1}{2} \frac{1}{2}R^s + \frac{1}{2} \frac{1}{2}\theta_1 R^s + \frac{1}{2} \frac{1}{2}(1 - \theta_1)r\right) - R}{\left(\frac{1}{2}r + \frac{1}{2} \frac{1}{2}R^s + \frac{1}{2} \frac{1}{2}\theta_1 R^s + \frac{1}{2} \frac{1}{2}(1 - \theta_1)r\right) - \theta_1 R - (1 - \theta_1)r}. \end{aligned} \quad (9)$$

Notice, $R \geq \theta_1 R - (1 - \theta_1)r \quad \forall \theta_1$, i.e. $\sigma_2 \in [0, 1]$. Analogously, σ_1 is calculated which makes CVC_2 indifferent between accepting or seeking syndication. In the equilibria in mixed strategies, CVC_1 accepts with probability of σ_1 and CVC_2 chooses acceptance with a probability of σ_2 .

■

Analogously, an equilibrium in mixed strategies exists if $\theta_1 \in \left(\frac{\sqrt{69}-3}{6}, 1\right]$. The same chain of arguments holds as in the proof of Proposition 7.

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