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Essays on Corporate Venture Capital

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Abstract

This dissertation consists of three essays that address important issues in the field of corporate venture capital (CVC). In the first essay, I examine the link between CVC and the real options theory using a formal, model-based approach. In the second essay, I conduct a conjoint experiment to investigate the decision-making behavior of entrepreneurs when they receive financing offers from corporate investors. In the third essay, I draw from survey data to explore general factors that affect the attitude of angel investors towards CVC units. This dissertation contributes to the literature on CVC and more generally, to the scholarly fields of entrepreneurial finance, entrepreneurship and innovation, and strategic management. First, I show analytically when and why CVC units differ from independent venture capital investors with regard to their investment behavior and deliver new explanations for former empirical findings. Second, I demonstrate that entrepreneurs deem the access to complementary resources most important when considering to partner with corporate investors, and that central personal characteristics of entrepreneurs affect their financing decisions. Third, I deliver evidence that crucial factors, such as the perceived social capital of CVC units, affect the attitude of angel investors towards CVC units. In each essay, I discuss the various theoretical and managerial implications of my work and provide researchers and corporate executives with new knowledge on the topic of CVC.

Chapter 1

Introduction

1.1 Background

“BMW and Embark share a common vision for mobility in big cities. BMW i Ventures’ investment in Embark will help our two innovative companies explore ways to work together in the coming years, especially in the area of intermodal mobility.” *Ulrich Quay, Managing Director at BMW i Ventures, an investment arm of BMW Group* (BMW, 2012)

“In a changing financial landscape, figo has established itself as a reliable partner and has built up a fantastic FinTech ecosystem around itself. We look forward to supporting their growth and also learning from the innovation they are driving.” *Ankur Kamalia, Managing Director at DB1 Ventures, an investment arm of Deutsche Börse Group* (Deutsche Börse, 2016)

Such investment relationships between established corporations and start-up companies often seem paradoxical at first sight. Why do incumbent firms invest in external start-up companies that potentially disrupt their industries by setting new technological standards or by completely changing the way business is done in the near future? Why do entrepreneurs collaborate with those industry giants they often regard as bureaucratic, non-entrepreneurial players with questionable interests when it comes to investments in start-up companies? The present dissertation sets out to shed light on these and further questions surrounding the phenomenon of direct minority equity investments of established corporations in external start-up companies, which are commonly subsumed under the term corporate venture capital (CVC) (Gompers & Lerner, 2000). With a global investment volume of approximately 30 billion U.S. dollars per year (CB Insights, 2017), CVC plays a substantial role in the promotion of young, entrepreneurial firms today. The following paragraphs introduce the conceptual back-

ground of this dissertation and give an overview of the evolution of CVC over the past decades.

In times of rapid technological change involving Schumpeterian market environments (Schumpeter, 1942), scholars expect only those firms, which constantly innovate, to achieve economic success and survive in the long run (Arrow, 1962; Schumpeter, 1942). Newly emerging technologies, such as artificial intelligence and blockchain, as well as the ongoing digitalization (KPMG, 2017), require established corporations to continually renew their capabilities and adjust their business models in order to keep pace with ever-changing market environments (Teece, Pisano, & Shuen, 1997). Facing these external pressures, established corporations take different actions to remain innovative and, thus, maintain their market position (Sharma & Chrisman, 1999).

Some of these actions have an internal focus, such as investments in research and development (R&D) programs (Dushnitsky & Lenox, 2005a). Another internally focused attempt to spur innovation is the creation of entirely new corporate entities within the existing organizational domain, where corporate employees pursue an innovative activity (Maine, 2008). Scholars refer to such initiatives as internal corporate venturing (Sharma & Chrisman, 1999). However, large corporations do not usually provide the ideal environment for innovative activities, as they are often characterized by rigid organizational structures and processes (Hannan & Freeman, 1984), a low risk propensity (Benner & Tushman, 2002), and missing incentives for corporate employees to engage in truly innovative behavior (Teece, 2007).

Due to these organizational shortcomings and owing to the fact that crucial knowledge often resides beyond corporate boundaries, established corporations have opened their innovation processes for external ideas (Chesbrough, 2006). A substantial portion of the external innovative potential that incumbent firms seek to access is accrued in start-up companies (Weiblen & Chesbrough, 2015), i.e., young, entrepreneurial firms that have been formed by individual or teams of entrepreneurs in order to seize an opportunity that is usually based on a novel technology or business model (Arthurs & Busenitz, 2006). One way to engage with start-up companies is to support them financially in the form of CVC and in exchange have the opportunity to learn about their innovations. Such externally focused venturing activities of established corporations are commonly referred to as external corporate venturing (Sharma & Chrisman, 1999). Other modes of external corporate venturing include joint ventures, licensing agreements, and strategic alliances (Ceccagnoli, Higgins, & Kang, 2018; Keil, Maula, Schildt, & Zahra, 2008). Established corporations increasingly rely on CVC activities to spot, monitor, and harness innovative technologies and business models developed by young, entrepreneurial firms (e.g., Dushnitsky, 2012).

CVC represents a specific form of venture capital (VC) (Gompers & Lerner, 2000). The broad concept of VC refers to “equity or equity-linked investments in young, privately held companies, where the investor is a financial intermediary who is typically active as a director, an adviser, or even a manager of the firm” (Gompers & Lerner, 2000, p. 21). The predominant players in the VC industry are independent venture capital (IVC) investors, i.e., traditional VC firms that conduct high-risk, and possibly high-reward, investments in entrepreneurial firms (Ivanov & Xie, 2010). Although CVC and IVC appear conceptually similar, they represent two distinct forms of risk capital (Chemmanur, Loutskina, & Tian, 2014; De Clercq, Fried, Lehtonen, & Sapienza, 2006). The differences between CVC and IVC have informed numerous studies in this field (e.g., Chemmanur et al., 2014; Gompers & Lerner, 2000; Ivanov & Xie, 2010) and play a crucial role in this dissertation. To give the reader a better understanding of the differences between CVC and IVC, I elaborate on their main characteristics in the subsequent paragraphs, especially on their organizational structure and main objectives.

First, IVC investors are typically organized as partnerships in which professional fund managers (i.e., general partners) invest the funds of several passive investors (i.e., limited partners), such as pension funds or wealthy individuals (De Clercq et al., 2006; Ivanov & Xie, 2010). The funds managed by IVC investors commonly have a maximum life span of ten years and the fund managers receive an annual management fee as well as a share of the profits (usually referred to as ‘carried interest’) (De Clercq et al., 2006). By contrast, CVC investments are usually conducted by dedicated corporate departments or fully-owned subsidiaries, where the parent corporation acts as the only sponsor and direct reporting line (Gompers & Lerner, 2000; Ivanov & Xie, 2010). CVC units are responsible for managing the entire investment process, i.e., for selecting appropriate investment targets, negotiating contractual terms, supporting and monitoring portfolio firms, as well as implementing an exit strategy (Asel, Park, & Velamuri, 2015). However, there is a large disparity among incumbent firms in how they organize and manage their CVC programs (Weiblen & Chesbrough, 2015). These initiatives may, for example, also be operated by core business units or internal R&D units which conduct investments in entrepreneurial firms in addition to other responsibilities (Dushnitsky, 2012). It should be noted that corporate investments in externally managed funds, e.g., in IVC funds, are not considered as CVC in this dissertation, which is in accordance with prior studies (e.g., Chesbrough, 2002).

Second, CVC units and IVC investors differ with regard to their objectives (Chemmanur et al., 2014; Ivanov & Xie, 2010). As opposed to IVC investors, who are solely interested in maximizing the financial return on their investments (Ivanov & Xie, 2010),

most established corporations also pursue strategic objectives by means of CVC investing (e.g., Hellmann, 2002; MacMillan, Roberts, Livada, & Wang, 2008). Following the general definition of Hellmann (2002), strategic venture investing typically involves “an investor that owns some asset whose value is affected by the new venture” (p. 287). The most frequently stated strategic objectives relate to the enhancement of corporate innovative capabilities and include obtaining a window into new technologies, learning about new opportunities and markets, and developing new products (e.g., MacMillan et al., 2008). However, CVC programs serve purposes beyond the acceleration of corporate innovative capabilities. Established corporations also conduct investments in entrepreneurial firms to promote complementary technologies or business models, thus supporting their existing businesses (Chesbrough, 2002; Hellmann, 2002), among other objectives. Although CVC units primarily invest for strategic reasons, they are usually also required by their parent corporations to meet financial objectives, e.g., to achieve a minimum internal rate of return (MacMillan et al., 2008).

The distinct characteristics of CVC units, in particular their organizational structure and objectives, are associated with certain opportunities and risks for this investor group. CVC units may have access to crucial resources of their parent corporations, e.g., large-scale marketing and distribution channels as well as technical knowledge (Chemmanur et al., 2014), which may render them attractive partners for start-up companies (Katila, Rosenberger, & Eisenhardt, 2008) or other investor groups (Keil, Maula, & Wilson, 2010). However, due to their belonging to a large, established corporation, CVC units may be subject to corporate bureaucracy and, hence, not be able to make decisions in a timely manner (Bleicher & Paul, 1987; Chesbrough, 2000; Siegel, Siegel, & MacMillan, 1988). Furthermore, CVC units may also find themselves in situations in which the interests of their portfolio firms do not comply with those of their parent corporations, e.g., when portfolio firms seek additional support from other, competing incumbent firms (Ivanov & Xie, 2010; Park & Steensma, 2012). Also, because established corporations often aim at maintaining pay equality within their organizations (e.g., Dushnitsky & Shaver, 2009), CVC units do not often offer their investment managers the high-powered incentive schemes that prevail in the VC industry and, thus, are not able to attract and retain talented investment professionals (Gompers & Lerner, 2000). I discuss these and related issues of CVC units, as well as their implications for start-up companies and other investor groups that collaborate with CVC units, in this dissertation.

Because CVC units are an important component of their parent corporations’ innovation strategy as outlined before, I now delve into their exact role in the innovation process. Incumbent firms set up CVC units as a means to tap into the external en-

trepreneurial ecosystem (Dushnitsky, 2012). The term entrepreneurial ecosystem refers to “combinations of social, political, economic, and cultural elements within a region that support the development and growth of innovative startups and encourage nascent entrepreneurs and other actors to take the risks of starting, funding, and otherwise assisting high-risk ventures” (Spigel, 2017, p. 50). By entering the entrepreneurial ecosystem through CVC programs, established corporations aim to harness innovative technologies and business models developed by entrepreneurial firms (Dushnitsky, 2012). Their CVC activities also give incumbent firms the opportunity to build ties to other players in the entrepreneurial ecosystem, such as IVC investors and angel investors (Fast, 1981). Angel investors are wealthy individuals who invest parts of their fortune in entrepreneurial firms to achieve a high financial return, as well as for non-financial reasons (e.g., supporting young entrepreneurs) (Avdeitchikova, Landström, & Månsson, 2008; Morrissette, 2007).

CVC programs aim to interact with the external innovation environment and, thus, to assimilate external knowledge (Keil, Autio, & George, 2008; Schildt, Maula, & Keil, 2005). For this reason, such activities are often associated with the ‘open innovation’ paradigm, which refers to firms’ attempts to open their internal innovation processes for external ideas (Chesbrough, 2006). CVC units play a crucial role in coordinating the exchange of resources, in particular the transfer of knowledge, between corporate units and external entrepreneurial firms (Birkinshaw, von Basten Batenburg, & Murray, 2002; Keil, Autio, & George, 2008). For this reason, scholars also referred to CVC units as “knowledge brokers” (Keil, Autio, & George, 2008, p. 1477). Figure 1.1 depicts the role of CVC units as the link between their parent corporations and the external entrepreneurial ecosystem.

Before presenting the current state of research in the following section, I briefly expand on the historical development of CVC and its current role in the promotion of entrepreneurial firms. There is a consensus in the literature that corporate investors became an integral part of the mostly U.S.-based VC industry in the 1960s (Chemmanur et al., 2014; Gompers & Lerner, 2000; Sykes, 1986). Over the subsequent decades, CVC investment volumes showed significant variations that were strongly correlated with the investment volumes of IVC investors (Gompers & Lerner, 2000). In particular, researchers identified three major waves of CVC investment activities in the past, which peaked in the 1970s, 1980s, and early 2000s, respectively. The ups and downs of corporate investment programs were mainly triggered by economic fluctuations, regulatory changes, and technological advancement (Gompers, 2002; Gompers & Lerner, 2000). Due to the growing investment volumes since around 2010, scholars refer to the current period as the fourth wave of CVC (Chemmanur et al., 2014; Dushnitsky, 2012).

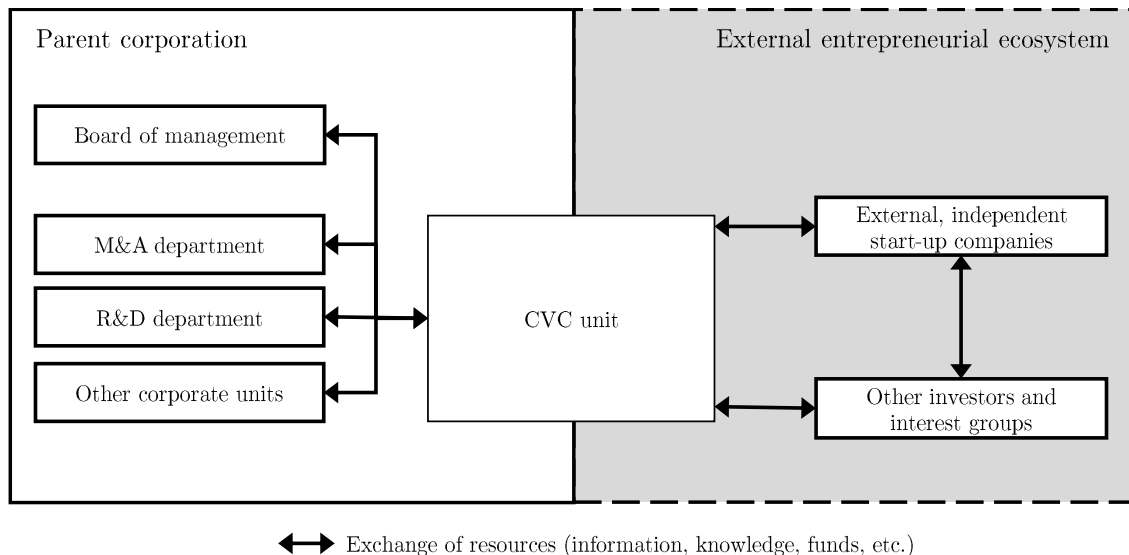


Figure 1.1: The resource-brokering function of CVC units.

Although exact investment data is often unavailable due to the private nature of the VC industry, researchers estimated that CVC investment volumes represented approximately 10.0% of the overall VC investment volume over the years (Chemmanur et al., 2014; Dushnitsky, 2012). Since around the year 2010, yearly CVC expenditures have increased substantially and currently account for roughly 20.0% of the global VC investment volume, thus exceeding 30 billion U.S. dollars per year (BCG, 2018; CB Insights, 2017; Chemmanur et al., 2014). The U.S. constitutes the most important country for CVC investments with vibrant regions, such as Silicon Valley, and many major corporate investors, including Google, Intel, and Salesforce (CB Insights, 2017). While about 50.0% of all CVC deals are being made in the U.S., other regions, specifically Asia (29.0%) and Europe (20.0%), are gaining importance (CB Insights, 2017).

It was not until the 1990s that established corporations headquartered in Germany started their first CVC programs, with Siemens and Deutsche Telekom being among the pioneering firms (Weber & Weber, 2005). As compared to the U.S., the investment volume was only moderate in this region in the 1990s and 2000s (Weber & Weber, 2005). Yet, in a recent survey conducted in Germany, around 20.0% of the participating start-up companies indicated that they have received CVC financing (KPMG, 2017), which corresponds to the global market share of corporate investors in the CVC investment volume. Moreover, in an internet search conducted as part of this dissertation, I found that half of the 30 major corporations listed in the German share index (DAX 30) already run dedicated CVC programs. Some German firms even ranked among the most active corporate investors world-wide in 2017, including Robert Bosch, BMW, and Bertelsmann (CB Insights, 2018). Due to the relatively young stage of CVC in

Germany and the attention it is starting to raise among German practitioners and researchers, I consider this region as an ideal setting to further explore this topic.

The subject of CVC has not only become an important component of the external venturing activities of established corporations over the past decades, it has also evolved to a scholarly field in its own right (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). The next section presents an overview of the most relevant academic work on CVC.

1.2 Current state of the literature

A considerable amount of academic research has been carried out on the subject of CVC to date and scholars from different domains of business research have contributed to the rich, yet still growing, body of literature (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). In particular, articles on the subject of CVC have been published in leading academic journals in the fields of entrepreneurship and innovation (e.g., Basu, Phelps, & Kotha, 2011, 2016; Dushnitsky & Lenox, 2005b, 2006; Park & Steensma, 2013), strategic management and organizational research (e.g., Benson & Ziedonis, 2009; Dokko & Gaba, 2012; Dushnitsky & Shapira, 2010; Dushnitsky & Shaver, 2009), and finance (e.g., Benson & Ziedonis, 2009; Chemmanur et al., 2014; Hellmann, 2002), among other fields of study.

Although the vast majority of articles on the subject have been published during the last two decades, some notable research on CVC was conducted already in the 1980s and early 1990s. This early research was predominantly exploratory and relied on interviews and surveys (Siegel et al., 1988; Sykes, 1990), as well as small statistical samples (Sykes, 1986) and a few case examples (Hardymon, DeNino, & Salter, 1983). During this period, scholars used prescriptive research approaches that aimed to provide corporate executives with guidance on how to organize CVC programs and benefit from such activities (Bleicher & Paul, 1987; Siegel et al., 1988; Sykes, 1990; Winters & Murfin, 1988).

While in the 1990s the number of academic articles on the subject of CVC was limited (e.g., McNally, 1994, 1995; Schilit, 1998), a strong surge in research output has been observed since around the year 2000. Due to the availability of commercial databases, scholars began to apply rigorous statistical methods on large empirical samples and used longitudinal designs (Dushnitsky, 2012). Moreover, scholars turned towards deductive research approaches and tested hypotheses derived from established theories, including the real options theory, the institutional theory, learning theories, and the resource-based view of the firm (Basu, Wadhwa, & Kotha, 2016). In the paragraphs

that follow, I first present the literature that takes the perspective of established corporations and their CVC units and then proceed with the literature that focuses on the perspective of start-up companies that receive financing from corporate investors.

A large body of literature focuses on the viewpoint of established corporations and has thus far investigated *why* they engage in start-up financing, *how* they operate these activities and *which outcomes* can be achieved with CVC programs (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). Beginning with research on the motivations and antecedents of corporate start-up financing programs, Fast (1981) recognized that an important driver of such activities are strategic, rather than financial, objectives. Investments in external entrepreneurial firms expose incumbent firms to new technologies and nascent industries (Fast, 1981). Following this pioneering work, scholars further explored the strategic motivations behind corporate start-up financing activities.

Sykes (1990) found that “identify[ing] new opportunities” and “develop[ing] business relationships” (p. 41) ranked among the most important strategic objectives of the surveyed CVC programs. More recent surveys found that corporate executives aim to obtain a “window on new technologies”, “support[ing] existing businesses” and “seek[ing] new directions” through their CVC activities (MacMillan et al., 2008, p. 9). Established corporations also use CVC investments to promote entrepreneurial firms with complementary technologies or business models in order to increase their own revenues and profits (Chesbrough, 2002), to spot and observe potential acquisition candidates (Benson & Ziedonis, 2009, 2010), and to build relationships with IVC investors (Ernst & Young, 2009).

Although these surveys provide valuable insights into the objectives of CVC programs, a number of studies have looked more systematically at the antecedents of CVC investments by analyzing industry- and firm-level parameters empirically (Basu, Wadhwa, & Kotha, 2016; Dushnitsky, 2012). Dushnitsky and Lenox (2005a) found that firms with a higher cash flow and a higher absorptive capacity are more likely to engage in CVC investing. Furthermore, they reported that incumbent firms invest more in industries with weak intellectual property protection and high technological ferment, as well as in industries where certain complementary capabilities are particularly important. Basu et al. (2011) corroborated these results and showed that firms in dynamic industries, which are characterized by a high rate of technological change, competitive pressure, and weak appropriability, are more likely to perform CVC investments. Sahaym, Steensma, and Barden (2010) delivered evidence that industries with higher R&D expenditures experience higher CVC activity. According to their results, this relationship is particularly strong when industries grow fast and are subject to techno-

logical change. Da Gbadji, Gailly, and Schvienbacher (2015) showed that incumbent firms are more likely to pursue CVC activities if they are based in countries with a flourishing market for early-stage investments.

Gaba and Meyer (2008) analyzed contagion effects within the IT sector and demonstrated that the initiation of CVC programs is triggered by within-population factors (e.g., geographic proximity to other CVC-investing firms) and cross-population factors (e.g., geographic proximity to a region with vibrant VC activity, such as Silicon Valley). Recently, the relation between corporate governance characteristics and CVC has been explored by Anokhin, Peck, and Wincent (2016). They found that the structure of the board of management, the CEO function, and the level of institutional ownership impact firms' CVC activity. These studies aimed to improve our understanding of the reasons *why* incumbent firms engage in CVC investing. The next paragraphs review the literature on *how* corporate investors perform these activities.

The initiation of a CVC program necessitates the choice of an organizational structure for such an investment activity (Asel et al., 2015; Battistini, Hacklin, & Baschera, 2013). Scholars examined the different organizational forms of CVC activities, ranging from direct investments performed by internal business units to externally managed funds. Winters and Murfin (1988) emphasized CVC units that are organized as subsidiaries and argued that setting up a formal subsidiary signals a commitment to start-up financing activities as well as creates organizational distance from corporate structures and interests. Following their argument, this increases the acceptance of CVC units among entrepreneurs or more generally, in the VC community. Keil, Autio, and George (2008) regarded CVC investments as a form of “disembodied experimentation” (p. 1477), i.e., experimentation with new technologies and business models outside corporate boundaries. The results of their qualitative study suggest that, on the one hand, CVC units organized as fully-owned subsidiaries are protected from corporate structures and interests. On the other hand, CVC units that are isolated from their parent corporations may not be able to act as effective intermediaries between corporate business units and start-up companies and may, thus, fail to ensure knowledge transfer between them (Keil, Autio, & George, 2008).

Another crucial aspect that is directly related to the organization of CVC units and has triggered attention among researchers is the compensation of the investment personnel (e.g., Dushnitsky & Shaver, 2009). Because established corporations usually seek to maintain pay equality (Block & Ornati, 1987), CVC units do not often offer their investment managers the attractive, performance-based compensation schemes that prevail in the VC industry. As a consequence, they are potentially not able to attract skilled and experienced investment managers (Gompers & Lerner, 2000). Indeed, as

early studies suggest (Block & Ornati, 1987) and more recent reviews of the literature conclude (Dushnitsky, 2012), many incumbent firms do not offer performance-oriented pay. Moreover, compensation schemes may ultimately affect the way CVC investment managers perform investments (Dushnitsky & Shapira, 2010; Hill, Maula, Birkinshaw, & Murray, 2009). Specifically, Dushnitsky and Shapira (2010) demonstrated that under performance-oriented compensation schemes, corporate investment personnel invest in younger start-up companies and make these investments with fewer syndication partners, both of which point towards a higher risk propensity.

Next to the antecedents and organization of CVC programs, scholars explored the investment patterns of CVC units, including how they source deals and how they manage investment relationships with start-up companies (e.g., Asel et al., 2015). Birkinshaw et al. (2002) provided insights into the deal sourcing behavior of CVC units and showed that they rely mainly on referrals from other VC investors, followed by referrals from entrepreneurs as well as from corporate employees. Several other studies came to similar results (e.g., Siegel et al., 1988; Sykes, 1990; Winters & Murfin, 1988). Interestingly, Siegel et al. (1988) found that more autonomously organized CVC units rely on IVC investors as the primary deal source, while tightly controlled CVC units view their own corporate departments as an important source of new deals.

Furthermore, researchers found that CVC units usually conduct their investments in syndicates with IVC investors (Anokhin, Örtqvist, Thorgren, & Wincent, 2011; Baierl, Anokhin, & Grichnik, 2016; Dushnitsky & Shapira, 2010; Hill et al., 2009), although they noticed that a CVC unit may want to avoid investment syndicates “in a venture where retaining exclusivity may enhance the parent corporation’s freedom to appropriate value from the investment” (Hill et al., 2009, p. 22). Keil et al. (2010) demonstrated that CVC units can achieve central positions in VC syndication networks when they leverage complementary resources of their parent corporations. Central network positions are especially attractive because they offer investors access to high-quality deals and reputable investment partners (Keil et al., 2010). Turning to the post-investment behavior of CVC units, Masulis and Nahata (2009) showed empirically that CVC units whose parent corporations are competitors to their portfolio companies are assigned less board seats. Also, prior research has demonstrated that social interaction between CVC units and start-up companies during the investment relationship is more likely to occur when their businesses are complementary (Dushnitsky, 2012; Maula, Autio, & Murray, 2009).

Several studies have examined *which outcomes* can be achieved with CVC programs from the perspective of established corporations (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). Dushnitsky and Lenox (2005b) showed that

CVC investing has a positive effect on the innovative capabilities of incumbent firms, measured in terms of citation-weighted patenting rates, and that this effect is strongest in industries with weak intellectual property protection. Wadhwa, Phelps, and Kotha (2016) found an inverted U-shaped relationship between the corporate investors' portfolio diversification and firm innovation. An earlier study of Wadhwa and Kotha (2006) yielded similar results. Dushnitsky and Lenox (2006) demonstrated that CVC activities add value to incumbent firms and that the marginal value contribution of CVC increases when corporate investors perform such investments explicitly for strategic, rather than financial, reasons. In their study, the value added from CVC activities was measured by Tobin's Q, which is defined as a firm's market value divided by its book value. In a similar study, Yang, Narayanan, and De Carolis (2014) found an U-shaped relationship between the diversification of CVC units' portfolios and firm value creation.

Hill et al. (2009) delivered evidence that the adoption of certain practices of IVC investors, such as performance pay, independent decision-making, syndicated and staged investments, and industry specialization, is associated with higher financial and strategic performance of CVC units. While much work was done to capture the strategic value of CVC investing (e.g., Dushnitsky & Lenox, 2005b, 2006), Allen and Hevert (2007) concentrated on the financial performance of CVC programs. Their study unveiled that the financial returns of the examined CVC units were, on average, lower than their parent corporations' cost of capital. The authors argued that, despite this inferior financial performance, established corporations sustain these start-up financing programs for strategic reasons. In this vein, Gompers and Lerner (2000) found that, as compared to IVC investors, CVC units invest at a premium, which may diminish their financial performance. Having summarized the research that examines the perspective of established corporations and their CVC units, I now concentrate on the research that focuses on the perspective of entrepreneurial firms.

A relatively small number of studies have examined the perspective of start-up companies regarding CVC (Basu, Wadhwa, & Kotha, 2016). Scholars have drawn a mixed picture of the benefits of receiving CVC financing for entrepreneurial firms (e.g., Chemmanur et al., 2014; Ivanov & Xie, 2010). Prior research has acknowledged that CVC units may provide start-up companies with unique opportunities by giving them access to complementary resources, such as technical support and marketing and distribution channels (e.g., Chemmanur et al., 2014; Ivanov & Xie, 2010). However, researchers have also recognized that these benefits must be weighted against the perceived costs of receiving CVC, which include the involvement in corporate bureaucracy (e.g., lengthy approval processes) and potential conflicts of interests (e.g., misappropriation concerns

of start-up companies) (e.g., Basu, Wadhwa, & Kotha, 2016).

Indeed, prior empirical work found evidence for this trade-off logic. When the perceived benefits are high, e.g., when access to complementary resources is crucial for start-up companies' success, they are more likely to receive CVC financing (Katila et al., 2008). In contrast, when the perceived costs outbalance the potential benefits, e.g., when incumbent firms and start-up companies act in the same industry and conflicts of interest are likely to arise, entrepreneurial firms then refrain from receiving CVC financing (Dushnitsky & Shaver, 2009). Taken together, start-up companies tend to favor CVC units as their financing source when they are in need of resources (Katila et al., 2008) and when their business models are complementary to those of the investing firms (Basu, Wadhwa, & Kotha, 2016; Dushnitsky, 2012).

Several studies have been carried out on the performance effects of CVC for entrepreneurial firms. Gompers and Lerner (2000) were the first to investigate this question systematically and found that CVC-backed start-up companies are more likely to pursue an initial public offering (IPO) and less likely to be liquidated than start-up companies that are not backed by corporate investors. Their results suggest that the benefits of receiving CVC financing are particularly strong when the businesses of the respective established corporations and start-up companies are related, i.e., when there is a strategic fit between them. The study of Park and Steensma (2012) corroborated these results. Ivanov and Xie (2010) further showed that start-up companies that are financed by CVC receive higher valuations at their IPO, again, subject to the strategic fit between the start-up company and the investing incumbent firm. Further, Chemmanur et al. (2014) demonstrated that entrepreneurial firms that receive CVC are more innovative in the years following their IPO, measured in terms of patent citations. Park and Steensma (2013) showed that CVC-backed start-up companies file more patent applications than start-up companies that only receive IVC financing. A more recent study by Alvarez-Garrido and Dushnitsky (2016) arrived at similar results.

Lastly, scholars investigated the topic of CVC using formal, model-based research approaches (Dushnitsky, 2012). Prior analytical work has demonstrated that entrepreneurs opt for CVC financing when their businesses are complementary to the assets of the respective strategic investor (Hellmann, 2002). Researchers also showed analytically that firms increase their CVC expenditures when the level of competition increases (Fulghieri & Sevilir, 2009), that they use such programs to promote complementary businesses (Riyanto & Schwienbacher, 2006), and that competitive dynamics may induce established corporations to invest early in a start-up company's lifecycle (Norbäck & Persson, 2009). Moreover, the model of De Bettignies and Chemla (2008) has demonstrated that CVC programs or more generally, corporate venturing activities, may help

to attract and retain highly talented managers. However, such model-based analyses are underrepresented in the literature and future empirical work would benefit from further formal approaches that make testable predictions (Dushnitsky, 2012).

Prior studies have made valuable contributions in advancing our knowledge on the subject of CVC. However, there are considerable research gaps, and recent literature reviews call for further research in new directions, which I present in detail below (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). The next section explains at which points the present dissertation enters the academic debate on this topic. In particular, it introduces the research objectives as well as the research approaches of this dissertation.

1.3 Research objectives and approaches

In order to advance research in the field of CVC, this dissertation aims to close three important research gaps identified by a thorough review of the existing literature. The research gaps were addressed in separate research projects, which resulted in three different essays (Essays I-III). In the following, I give an overview of the research objectives and approaches of the essays.

Essay I aims at improving our knowledge of the link between CVC and the real options theory (Trigeorgis, 1993). In this essay, I explore inferences about the decision-making behavior of CVC units that can be drawn from a real options-based model framework. The essay thereby follows a call for more formal work in the field of CVC that may guide future empirical research (Dushnitsky, 2012). The real options theory comprises the application of financial option pricing theory to investment decisions involving real assets (Copeland & Antikarov, 2001). This approach offers several advantages over traditional valuation methods, such as the discounted cash flow (DCF) method, because it incorporates and values the managerial flexibility inherent to most real-world investment projects (Brandão, Dyer, & Hahn, 2005; Trigeorgis, 1993). Taking account of managerial flexibility is particularly relevant when investments are staged and decision-makers can alter the course of projects based on new insights into their value, gained over time (e.g., Bowman & Moskowitz, 2001). Examples of staged investments in real assets treated in the literature are those in oil drillings, mine operations, and R&D projects, as well as investments in start-up companies (e.g., Bowman & Moskowitz, 2001; Trigeorgis, 1993).

Although scholars have recognized the different real options inherent to CVC investments, prior empirical research linking CVC and the real options theory is based on generic inferences drawn from this theory, e.g., that the real option value of CVC in-

vestments increases in uncertain markets (Basu et al., 2011; Tong & Li, 2011). Such general approaches do not take into account the specific strategic considerations of corporate investors, such as learning about new technologies (Schildt et al., 2005), business stealing effects (Hellmann, 2002), and expected synergies derived from later acquisitions of portfolio firms (Benson & Ziedonis, 2009, 2010). The basic premise of Essay I is, therefore, that the real options theory has more explanatory power than currently acknowledged in CVC literature.

This premise lays the ground for the following research question: What inferences can be drawn from a real options-based model framework about the decision-making behavior of CVC units in a staged-financing setting? The unit of analysis is the dyadic investment relationship between a CVC unit and a start-up company, where the CVC unit makes sequential investment decisions by simultaneously taking account of financial and strategic objectives as well as different risk drivers typically involved in the financing of young, entrepreneurial firms. The essay employs a formal, model-based approach and builds on the real options theory as well as on CVC and staged financing literatures. Essay I not only aims to explain past empirical findings in the field of CVC, but also to make empirically testable predictions.

Essay II addresses another important research gap. The research to discover reasons entrepreneurial firms opt to receive CVC financing strongly focuses on industry- and firm-level effects (Basu, Wadhwa, & Kotha, 2016; Dushnitsky, 2012). Research at the individual level is scarce (Drover et al., 2017). In particular, the perspective of individual or teams of entrepreneurs who actually *make* the financing decisions has not been examined thus far. Receiving financing from a corporate investor often implies both opportunities (e.g., complementary resources) and risks (e.g., conflicts of interest) for start-up companies, and it is not properly understood how these aspects of CVC financing influence entrepreneurs' willingness to partner with corporate investors (Basu, Wadhwa, & Kotha, 2016). The research objective of Essay II is, therefore, to shed light on the subtle dynamics involved in individual entrepreneurs' decision-making when they consider CVC financing. The corresponding research question is the following: Which factors drive entrepreneurs' willingness to take financing from CVC units? Hence, the unit of analysis consists of individual entrepreneurs as potential collaboration partners of CVC units.

In order to address this research question, I distinguish conceptually between factors on the supply side of CVC, which pertain to the characteristics of CVC units, and factors on the demand side, which correspond to the characteristics of entrepreneurs and their start-up companies. Drawing from the literature on CVC and from the dynamic capabilities view (Teece et al., 1997), I first derive various supply-side factors that I assume

to influence entrepreneurs' decision-making. They comprise CVC units' (1) operational autonomy, (2) strategic autonomy, and (3) VC experience, as well as the (4) market-related support, (5) R&D-related support, and the (6) exit opportunity provided by CVC units and their parent corporations. With regard to the demand-side factors, I hypothesize that two personal characteristics systematically affect entrepreneurs' willingness to partner with CVC units, namely their level of entrepreneurial self-efficacy (ESE) (McGee, Peterson, Mueller, & Sequeira, 2009) and their risk propensity (Beierlein, Kovaleva, Kemper, & Rammstedt, 2014). In this essay, I employ a deductive research approach, as I develop multiple hypotheses based on existing theoretical frameworks as well as on prior work in the fields of CVC and entrepreneurial behavior.

Essay III investigates the interaction of CVC units with angel investors, who represent a crucial source of financing for early-stage firms (Drover et al., 2017). Previous studies in the field of CVC strongly focus on the directly involved parties, i.e., established corporations and start-up companies, and provide little insight into how CVC units are perceived by other actors in the entrepreneurial ecosystem (Dushnitsky, 2012). Only a few studies have examined the relationship of CVC units and IVC investors, for example, by investigating investment syndicates of these investor groups (e.g., Keil et al., 2010). Considering the relationship of corporate investors with other players in the entrepreneurial ecosystem is particularly important, as scholars regard entrepreneurship as a collective process that necessitates interactions between various key players (Aldrich & Zimmer, 1986).

The basic premise of Essay III is that CVC units may especially benefit from close collaboration with angel investors, as they may pass deal referrals to CVC units and thus help them to gain an early insight into new technologies and business models (Aernoudt & José, 2003; Harrison & Mason, 2000). In other words, frequent interaction with angel investors may help CVC units to meet their strategic objectives. The research question in Essay III asks which factors influence the attractiveness of CVC units as potential (co-)investors from the perspective of individual angel investors. Hence, the unit of analysis in this essay consists of individual angel investors as potential collaboration partners of CVC units. Because the essay draws on existing theory as well as on prior research on CVC and angel investors to build several hypotheses, it uses a deductive research approach. In particular, I use the relationship-building theory developed by Dwyer, Schurr, and Oh (1987) and propose several theoretically-derived factors that I assume to affect the attitude of angel investors towards CVC units.

The next section presents the methodologies that I applied to meet the research objectives outlined in the preceding paragraphs.

1.4 Methodologies

To address the different research questions, I used several distinct methodologies that I considered most appropriate to the nature and scope of the respective research question as well as to the current state of theory and empirical evidence (Edmondson & McManus, 2007; Smith, Gannon, & Sapienza, 1989). The next paragraphs summarize the methodological approaches of the essays.

In Essay I, I employed a combination of real option analysis (ROA) and decision tree analysis to holistically approximate the decision-making behavior of CVC units when conducting staged investments in entrepreneurial firms. I developed a decision-making framework based on prior work on the investment behavior of institutional VC investors (e.g., Bergemann, Hege, & Peng, 2011; Gompers, 1995). It entails a CVC unit's initial decision whether to invest in the focal start-up company or not (Tong & Li, 2011). Following this initial decision, the CVC unit has the opportunity to either expand, defer, or abandon the investment project at the beginning of each of the subsequent periods (Tong & Li, 2011). Moreover, after four periods, the corporate investor has the opportunity to acquire the start-up company (Benson & Ziedonis, 2009, 2010).

In the decision analysis, I used ROA to factor in the market risk involved in the financing of young, entrepreneurial firms and its effect on the value of the various real options outlined above (Smith & Nau, 1995). ROA also allows the smooth integration of different strategic considerations of corporate investors into the analysis, such as corporate learning effects (Schildt et al., 2005) and business stealing effects (Hellmann, 2002), as well as expected synergies derived from a possible acquisition at a later point in time (Benson & Ziedonis, 2009, 2010). Decision tree analysis facilitates the integration of private risks encountered by start-up companies, whereby the term private risk refers to the risk that is idiosyncratic to assets and cannot be hedged via traded securities (Smith & Nau, 1995). The type of private risk covered in the essay is technological risk, as it represents one of the most common kinds of risk envisaged by entrepreneurial firms (Alvarez-Garrido & Dushnitsky, 2016). Following prior studies that examined real-world investment scenarios using ROA and decision tree analysis (e.g., Brandão & Dyer, 2005), I conducted several numerical analyses that illustrate the various implications of the model framework. In the numerical analysis, I benchmarked the decision-making outcomes of the CVC unit under consideration against those of a hypothetical IVC investor that only pursues financial objectives.

In Essay II, I used a metric conjoint experiment in combination with a post-experiment survey in order to study how the proposed factors alter the willingness of entrepreneurs to partner with CVC units. Conjoint experiments have gained popularity in entrepreneur-

ship research and related research areas (Lohrke, Holloway, & Woolley, 2010). They allow scholars to observe entrepreneurs' decision-making behavior exactly when the decisions are made and are, thus, not prone to post hoc rationalization and related issues encountered with other methodological approaches (e.g., Behrens & Patzelt, 2016; Dawson, 2011). In the metric conjoint experiment conducted as part of this essay, the participants made evaluations on a sequence of presented CVC units that showed different investor profiles. The evaluations were made on a two-item Likert-type scale that assessed the entrepreneurs' willingness to partner with the respective CVC unit.

I decomposed the different investor profiles into six attributes, representing the main research variables. The attribute variables corresponded to the CVC units' (1) operational autonomy, (2) strategic autonomy, and (3) VC experience, as well as the (4) market-related support, (5) R&D-related support, and the (6) exit opportunity provided by CVC units and their parent corporations. Each attribute had two possible levels ('high' and 'low' for VC experience and 'yes' and 'no' for the other attributes). These attribute variables were manipulated in the conjoint experiment, resulting in a set of different investor profiles that were presented to the participants. In particular, I used a fractional factorial orthogonal design with 16 investor profiles that differed in the exact combination of the attribute levels.

Each of the $N = 62$ participating entrepreneurs made 16 investor assessments, resulting in a total of $N = 992$ investor assessments. In the post-experiment survey, I assessed the participants' level of ESE and their risk propensity, and asked them to provide background information about themselves and their start-up companies. Because each participant completed several investor assessments in the conjoint experiment, the single assessments were not independent of each other, i.e., the assessments were nested within each participating entrepreneur (Behrens & Patzelt, 2016; Wood, McKelvie, & Haynie, 2014). To deal with the potentially resulting autocorrelation, I applied hierarchical linear modeling (HLM) analysis, a common methodology used to analyze nested data (Aguinis, Gottfredson, & Culpepper, 2013). The HLM technique also allowed the examination of the effects of the participants' level of ESE and risk propensity on their willingness to partner with CVC units, next to the effects of the experimental variables (attributes 1-6 introduced above).

In Essay III, I tapped into a largely unexplored field of CVC research by examining the relationship of CVC units and angel investors. The growing yet independent strands of literature on angel investors and CVC allowed the derivation of different factors that I assumed to influence the attitude of angel investors towards CVC units. However, my research is exploratory with regard to the measures that I used to empirically test the influence of the different factors on the attractiveness of CVC units, as potential

(co-)investors, from the perspective of individual angel investors. I used a survey instrument that questioned the $N = 111$ participating angel investors on various aspects of CVC. The survey comprised eight sections on the topic of CVC, as well as a general section in which the angel investors provided information on their personal background and their investment activity and experience.

The first step of the quantitative analysis was to explore the data set using principal component analysis (PCA). PCA is an effective method to structure and analyze data from survey instruments and has been applied in various previous studies in this field (e.g., Sieger, Gruber, Fauchart, & Zellweger, 2016). In this essay, I used PCA to explore which items could be condensed into single scales that measured the different factors of interest. In the second step of the quantitative analysis, I set up an exploratory regression model in which one scale measured the independent variable, i.e. the attractiveness of CVC units as perceived by individual angel investors. The other factors, which I derived mainly from the PCA as described above, represented the independent variables.

The results of this dissertation add to the rich body of research on CVC and may guide future scholarly work in this field. The next section outlines the main research results and contributions.

1.5 Research results and contributions

The different model-based and empirical investigations that I conducted as part of this dissertation yield important results that advance our knowledge on the subject of CVC and may serve as a foundation for future research. Below, I provide an overview of the main research results and contributions of the essays.

Essay I enhances our understanding of the interconnection between CVC and the real options theory. The research linking these two concepts is currently shaped by empirical work that draws general conclusions from the real options theory. The CVC literature lacks a more sophisticated, formal approach that takes into account the various strategic considerations of established corporations (e.g., MacMillan et al., 2008), as well as the different risk drivers that underlie investments in start-up companies (e.g., Alvarez-Garrido & Dushnitsky, 2016). To close this research gap, I developed a model framework that combines ROA and decision tree analysis. Based on the model framework, I investigated how the financial and strategic motives as well as different kinds of risk affect CVC units' decision-making behavior in a staged-financing setting. The key strength of the model is that it provides a fine-grained analysis of how different parameter combinations influence the investment decisions of the CVC unit

under consideration in direct comparison to the decisions made by a hypothetical IVC investor.

The implications shed new light on prior research results in the field of CVC, including why corporate investors pay a premium for equity shares in entrepreneurial firms (Gompers & Lerner, 2000), as well as when and why CVC-backed start-up companies are more likely to go public (Gompers & Lerner, 2000; Ivanov & Xie, 2010). The essay offers various empirically testable predictions that may serve as a base for future empirical research. Next to its various theoretical contributions, the essay provides corporate executives with a decision framework that allows them to properly disentangle financial and strategic aspects of CVC investments as well as the different kinds of risk involved in the financing of start-up companies. Moreover, the essay yields important insights for entrepreneurs into the various facets of receiving CVC financing. In particular, the decision framework not only shows situations in which a corporate investor is advantageous, but also indicates situations in which a corporate investor may be detrimental to the development of a young, entrepreneurial firm. Hence, the implications also assist entrepreneurs in their choice of institutional VC investors.

Essay II adds to the literature on CVC by taking the perspective of individual entrepreneurs. The research to date strongly focuses on industry- and firm-level parameters when investigating start-up companies that opt for corporate investors (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). The literature in this field highly benefits from a closer look at the individuals who actually *make* financing decisions, namely individual entrepreneurs or teams of entrepreneurs (Basu, Wadhwa, & Kotha, 2016). This essay therefore sought to determine the factors that drive individual entrepreneurs' willingness to partner with CVC units in concrete financing scenarios. The results of the metric conjoint experiment and the subsequent HLM analysis unveiled multiple insights into the dynamics involved in the financing decisions of entrepreneurs.

Concerning the effect of the different attributes of CVC units, I found that entrepreneurs place strong emphasis on whether corporate investors are able to provide their investees with complementary market- and R&D-related resources or not. Their willingness to partner also increases when CVC units are operationally and strategically independent from their parent corporation. Moreover, their propensity to take financing from CVC units depends on the VC-related experience that CVC units have accrued, as well as if their parent corporations are willing to acquire their start-up companies at a later point in time. With regard to entrepreneurs' personal characteristics, I provided empirical evidence for the hypothesized direct and moderating effects of two characteristics that play a crucial role in entrepreneurial behavior, namely the ESE (McGee et al., 2009)

and risk propensity (Beierlein et al., 2014) of entrepreneurs.

The essay makes several important contributions to the literature. First, it synthesizes the literatures on CVC and dynamic capabilities (Teece et al., 1997) and shows their clear conceptual link. The empirical results underpin the important role of complementary resources in the formation of inter-organizational relationships (Dyer & Singh, 1998), especially from the perspective of start-up companies (Katila et al., 2008). It also contributes to the growing stream of research that is concerned with the role of personal characteristics in entrepreneurial behavior (e.g., Holland & Shepherd, 2013), in particular by highlighting the role that entrepreneurs' ESE and risk propensity play in their decision-making. Finally, the essay yields important practical implications for corporate executives that are in charge of setting up and managing CVC programs. Specifically, the empirical results were summarized in four practical recommendations on what established corporations can do (and what they cannot do) to effectively increase entrepreneurs' willingness to partner with CVC units.

Essay III broadens the perspective of CVC research by examining the relationship between CVC units and angel investors. I first qualitatively discussed how CVC units may benefit from close interaction with angel investors, for example, how relationships with angel investors could allow CVC units to learn about investment opportunities early on (Harrison & Mason, 2000). I drew from the relationship-building theory of Dwyer et al. (1987) as well as the literatures on CVC and angel investors in order to propose several factors that I assumed to influence the attitude of angel investors towards CVC units. To test the hypothesized effects of the different factors, I gathered data using a survey instrument. The first step was an exploratory analysis of the survey data using PCA. This preliminary analysis yielded interesting insights into how the various survey items interacted with each other and indicated which items could be condensed into single scales that measured the factors mentioned above. The next step was to set up an exploratory regression model that tested the effect of the different factors.

The results demonstrate that the level of social capital, i.e., the network position and reputation (e.g., Sørheim, 2003), that angel investors attribute to CVC units strongly influences their attitude towards them. Furthermore, the perceived attractiveness of CVC units among angel investors is strongly affected by imitation concerns and the presumably high funding requirements associated with this investor group. Moreover, I found that the attitude of angel investors, who have investment experience with corporate investors, is particularly driven by concerns about the organizational setup of CVC units. This essay contributes to our knowledge on how corporate investors are perceived by other major investor groups partaking in the entrepreneurial ecosystem.

Generally, it adds to the literature on angel investors, an important yet underrepresented area in academic research (Drover et al., 2017). The essay yields various practical implications. It provides corporate executives with an improved understanding of the various potential concerns they may encounter when dealing with other investors, such as angel investors.

To conclude, this dissertation makes important contributions to the literature by furthering our understanding of the link between CVC and the real options theory, by investigating factors that drive entrepreneurs' willingness to partner with CVC units, and by examining the relationship between CVC units and angel investors. The next section summarizes the main content and outlines the structure of the dissertation.

1.6 Dissertation structure and overview

This dissertation consists of three essays on CVC, which stem from independent research projects with different research objectives and methodological approaches. Table 1.1 gives an overview of the essays. Due to the independence of the single essays, some key concepts and definitions are provided repeatedly, which gives readers the opportunity to review the essays in a non-consecutive order. Chapter 2 consists of Essay I, which analytically examines the link between CVC and the real options theory. Chapter 3 comprises Essay II, which investigates central factors that drive entrepreneurs' willingness to partner with CVC units. It is followed by Essay III in Chapter 4, which explores the relationship between CVC units and angel investors. Chapter 5 summarizes the research findings of this dissertation and suggests avenues for future research.

Table 1.1: Dissertation overview.

Research topic	Corporate venture capital (CVC)		
	I (Chapter 2)	II (Chapter 3)	III (Chapter 4)
Essay			
Research question	What inferences can be drawn from a real options-based model framework about the decision-making behavior of CVC units?	Which factors drive entrepreneurs' willingness to partner with CVC units?	Which general factors influence the attitude of angel investors towards CVC units?
Related call for research	Dushnitsky (2012)	Basu, Wadhwa, and Kotha (2016)	Dushnitsky (2012)
Unit of analysis	Dyadic investment relationship between a CVC unit and a start-up company	Individual entrepreneurs as potential collaboration partners for CVC units	Individual angel investors as potential collaboration partners for CVC units
Research approach	Formal model framework; quantitative	Deductive reasoning; quantitative; experimental	Deductive reasoning; quantitative
Main theory	Real options theory	Dynamic capabilities view	Relationship-building theory
Methodology	Real option analysis (ROA); decision tree analysis; numerical examples	Metric conjoint experiment; post-experiment survey; hierarchical linear modeling (HLM)	Survey; principal component analysis (PCA); ordinary least squares (OLS) regression
Main contribution	Enhanced understanding of the link between CVC and the real options theory; new explanations for past empirical findings; multiple testable model predictions	New knowledge about the subtle dynamics involved in the decision-making of entrepreneurs when they consider CVC financing	Identification of multiple general factors that influence the attitude of angel investors towards CVC units

Chapter 2

The Survival Rate of Corporate Venture Capital-Backed Start-Up Companies: A Real Options View

Abstract

Corporate venture capital (CVC) investments, that is, direct minority equity investments in external start-up companies, provide established corporations with real options on new technologies and business models. Although scholars have recognized the different real options inherent to such investments, they rely on empirical research designs when exploring the link between CVC and the real options theory. The current literature connecting these domains lacks a model-based approach that takes into account the specific aspects of CVC, such as strategic considerations behind these investments. In order to holistically analyze the decision-making behavior of corporate investors in a staged-financing setting, I propose a model framework that combines real option analysis with features derived from decision tree analysis. I include three important strategic considerations of established corporations in the analysis: learning benefits, business stealing effects, and expected post-acquisition synergies. The analysis provides new explanations for various empirical findings, including when and why CVC-backed start-up companies are less likely to be liquidated than those financed by independent venture capital (IVC) investors. The essay follows a call for more formal work on CVC and offers multiple testable implications that may inform future empirical research. It provides corporate executives with a decision framework that helps to disentangle financial and strategic considerations of CVC investments. The implications may also assist entrepreneurs in their decision-making when facing a trade-off between receiving CVC and IVC financing.

Keywords: corporate venture capital, staged financing, real options

JEL: G11, G24, G31, G34, L26, M13, O31, O32

Author: Julian Ludat

Status: Working paper

2.1 Introduction

A prevalent view in economics and business research is that established corporations have to remain innovative in order to maintain their market position and profitability over time (Arrow, 1962; Schumpeter, 1942). However, established corporations do not usually offer the ideal environment for entrepreneurial spirit and innovative ideas (Hill & Rothaermel, 2003). Among other obstacles to innovation, the high level of bureaucracy as well as the considerable effort and resources required to sustain core business operations may adversely affect established corporations' ability to generate innovations solely internally (Dushnitsky & Lenox, 2005b; Hardyman et al., 1983). Therefore, they have implemented several modes of monitoring, promoting, and absorbing external innovations (Schildt et al., 2005; Sharma & Chrisman, 1999; Weiblen & Chesbrough, 2015). Beside spin-offs, joint ventures, and other external venturing modes, corporate venture capital (CVC) has attracted much attention in business practice and academic research (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012).

CVC refers to direct minority equity investments by established corporations in independent, external start-up companies (Gompers & Lerner, 2000). These investments are predominantly performed by dedicated business units or fully-owned subsidiaries where the parent corporation is the only funding source (Gompers & Lerner, 2000; Ivanov & Xie, 2010). Today, CVC accounts for around 20.0% of the total venture capital (VC) investment volume worldwide (CB Insights, 2017). Corporate investors not only play a substantial role in start-up financing (Chemmanur et al., 2014), but also in later acquisitions (Benson & Ziedonis, 2009, 2010). Previous studies have found that both established corporations and start-up companies may benefit from CVC investments in terms of increasing innovation rates (Chemmanur et al., 2014; Dushnitsky & Lenox, 2005a) and firm values (Dushnitsky & Lenox, 2006; Ivanov & Xie, 2010; Park & Steensma, 2012).

In this essay, I place special emphasis on the objectives that underlie CVC investments. Early research into CVC has recognized that these are different from those pursued by other players in the VC industry (e.g., Rind, 1981; Siegel et al., 1988). As opposed to independent venture capital (IVC) investors, i.e., traditional VC firms that are organized as limited partnerships and whose sole objective is to achieve a high financial return (Chemmanur et al., 2014; Dushnitsky & Shapira, 2010; Park & Steensma, 2012), established corporations' CVC units also pursue strategic objectives (e.g., Chesbrough, 2002). Hellmann (2002) defined a strategic VC investor "as an investor that owns some assets whose value is affected by the new venture" and highlighted that an IVC investor "only pursues financial objectives, while the strategic investor also cares about

the new venture's strategic impact" (p. 287). One of the most frequently quoted strategic objectives is the enhancement of established corporations' innovative capabilities through investments in start-up companies (e.g., Anokhin et al., 2016; Dushnitsky & Lenox, 2005b). As Ivanov and Xie (2010) put it, CVC units "can serve as their parent corporations' eyes and ears for promising technologies and innovations" (p. 132). Although established corporations frequently aim to achieve a minimum financial return (MacMillan et al., 2008), various studies identified strategic objectives, such as obtaining insights into new technologies and business models, as the main driver of CVC investment activities (e.g., MacMillan et al., 2008; Siegel et al., 1988).

Taking into account the financial and strategic objectives of CVC units, I investigate their decision-making behavior in a staged-financing setting. Staged financing is a widely-used instrument in start-up financing that serves to reduce investors' financial risk exposure and helps to overcome agency problems, as it gives the investor the option to abandon an investment project if it performs poorly (Dahiya & Ray, 2012; Gompers, 1995; Hsu, 2010; Sahlman, 1990; Wang & Zhou, 2004). Moreover, the staging of investments frequently offers investors the option to expand their commitment in later financing rounds, as well as the option to defer further investments in order to observe how the investment project develops over time (Tong & Li, 2011). In other words, staged investments in start-up companies entail various real options for CVC units (e.g., Tong & Li, 2011).

Prior studies have recognized the link between CVC and the real options theory (e.g., Basu et al., 2011; Ceccagnoli et al., 2018; Tong & Li, 2011). However, scholars mostly employed empirical research designs that were based on general inferences drawn from the real options theory, for example, that the real option value of CVC investments is higher in uncertain market environments (e.g., Basu et al., 2011; Tong & Li, 2011). These studies did not take into account the specific aspects of CVC, such as the various strategic considerations of corporate investors that may affect the real option value they assign to new investment opportunities (e.g., Chesbrough, 2002). This essay posits that the real options theory has more explanatory power than currently acknowledged in the literature on CVC and, therefore, asks the following research question: Which inferences can be drawn from a real options-based model framework about the decision-making behavior of CVC units in a staged-financing setting?

To address this question, I develop a model framework that combines real option analysis (ROA) with features derived from decision tree analysis in order to holistically approximate the decision-making of CVC units. ROA captures the market value of the multiple real options that are part of a staged-financing process (Smith & Nau, 1995), such as investors' option to expand, defer, or abandon an investment project

(Tong & Li, 2011). Decision tree analysis factors in private risk, i.e., idiosyncratic risk that cannot be hedged via traded securities (Smith & Nau, 1995). The type of private risk that I cover in this essay is technological risk, a common risk that entrepreneurial firms encounter (Alvarez-Garrido & Dushnitsky, 2016). In the model framework, I consider a CVC unit that takes three strategic considerations into account when making intermediary (dis-)continuation decisions: learning benefits (Schildt et al., 2005), business stealing effects (Hellmann, 2002), and expected post-acquisition synergies (Benson & Ziedonis, 2009, 2010). In order to benchmark the investment behavior of the CVC unit under consideration, I include a hypothetical IVC investor that cares only about the financial return on its investments. Based on the proposed model framework, I conduct a numerical examination of different decision-making outcomes of the CVC unit and the IVC investor. Numerical analyses are a common way of demonstrating implications of real options-based model frameworks (e.g., Brandão & Dyer, 2005).

The results of the numerical examination suggest that strategic considerations substantially influence the investment decisions made by CVC units and that they represent a main source of divergence between CVC units and IVC investors. For example, I show scenarios in which the IVC investor exits the investment project as a result of poor financial performance, whereas the CVC unit continues financing the focal start-up company due to strategic benefits. The numerical analyses deliver additional or alternative explanations for various real-world phenomena observed in the context of CVC. These include (1) why corporations often acquire equity shares in start-up companies at a premium (Gompers & Lerner, 2000), (2) why CVC-backed start-up companies are riskier (Chemmanur et al., 2014), and (3) why CVC-backed start-up companies are more likely to go public and less likely to be liquidated than IVC-backed start-up companies (Gompers & Lerner, 2000; Ivanov & Xie, 2010).

The essay follows a call for more formal research on CVC (Dushnitsky, 2012) and yields multiple testable implications that may inform future empirical research in this field. It extends our knowledge of the interconnection between CVC and the real options theory by showing that ROA is capable of integrating the financial and strategic considerations that drive CVC investments. The essay also yields various practical implications. It provides corporate executives with a decision framework that helps to disentangle financial and strategic objectives as well as the different risk drivers involved in the financing of young, entrepreneurial businesses. The implications may also assist entrepreneurs in their investor choice when they experience a trade-off between receiving CVC or IVC financing.

In Section 2.2, I provide an overview on the relevant work on CVC, staged financing, and the real options theory. In Section 2.3, I set up a formal staged-financing framework.

Section 2.4 contains a numerical analysis that shows the various implications of the model framework for the different investor types. Section 2.5 discusses the main findings and implications, as well as provides an outlook for future research.

2.2 Literature review

2.2.1 Corporate venture capital

Initial CVC endeavors date back to the 1960s, when the first large corporations in the U.S. sought to participate in the uplift of the VC industry (Gompers & Lerner, 2000). Ever since their beginnings, CVC and the resulting ties between established corporations and start-up companies have been much debated (e.g., Dushnitsky, 2012). Even the term CVC as such has been judged to be misleading as it combines the terms ‘corporate’ and ‘venture’, which some researchers viewed as incompatible (Siegel et al., 1988). Among other concerns, established corporations were suspected to have a hidden agenda that may turn out to be detrimental to the development of their investees (Dushnitsky & Shaver, 2009). However, previous studies have also emphasized the favorable role CVC units may play in the development of start-up companies (e.g., Ivanov & Xie, 2010; Maula, Autio, & Murray, 2005). Ivanov and Xie (2010) argued that corporate investors can add value to their portfolio companies through “technological and R&D support, product development assistance, manufacturing capacities, and access to marketing and distribution channels” (p. 133).

Recent literature on CVC is shaped by both empirical and model-based work. On the empirical side, Gompers and Lerner (2000) found that CVC-backed start-up companies are more likely to go public and less likely to be liquidated than IVC-backed start-up companies. This effect is especially pronounced when the lines of business of the investing corporation and the start-up company are directly related, i.e., when there is a strategic fit between the companies (Gompers & Lerner, 2000). Ivanov and Xie (2010) added to this result that CVC-backed start-up companies also obtain higher valuations at their IPO when there is a strategic fit with the sponsoring corporation. Chemmanur et al. (2014) demonstrated that CVC-backed start-up companies are more innovative, measured by the number of patents as well as the number of patent citations, than IVC-backed start-up companies. Similar results can be found in the work of Park and Steensma (2013). Chemmanur et al. (2014) delivered evidence that CVC units have a higher failure tolerance than IVC investors. They argued that this is caused by corporations being “more open to experimentation and occasional failure” (p. 2436).

As for established corporations that run CVC programs, Dushnitsky and Lenox (2006)

found that such investments may create firm value and that the positive effect is strongest when a firm explicitly uses its CVC investments to gain a window into new technologies. Ironically, the later acquisition of former portfolio companies may have a negative effect on the sponsoring corporation's firm value, as shown by Benson and Ziedonis (2010). In a similar vein, Benson and Ziedonis (2009) showed that the positive impact of CVC investments on firm value diminishes when the CVC investment volume increases relative to internal R&D expenditures. This finding suggests that CVC programs and internal R&D activities are complements rather than substitutes (Benson & Ziedonis, 2009).

Dushnitsky and Lenox (2005b) found that CVC investments may enhance an established corporation's innovative capability. This holds especially true when the corporation has a high absorptive capacity and when it operates in an environment where the intellectual property of the start-up company is weakly protected. Dushnitsky and Lenox (2005a) investigated industry conditions under which incumbent firms engage in CVC. They found that established corporations invest more when they operate in industries with high technological opportunities and weak intellectual property protection. The study of Basu et al. (2011) unveiled that firms in industries with high technological transformation and competition spend larger amounts on CVC.

Turning to formal approaches, Hellmann (2002) showed analytically that a start-up company prefers a strategic investor, such as a CVC unit, as financing source when its technology is complementary to the strategic investor's assets. In this case, the strategic investor has higher incentives than an IVC investor to provide the start-up company with value-adding support. Riyanto and Schwiendbacher (2006) demonstrated that established corporations use CVC to increase the complementarity between its own products and the products of start-up companies *ex ante* in order to weaken product market competition *ex post*. Fulghieri and Sevilir (2009) showed analytically that established corporations increase their CVC investments when the competition for innovation increases. Next, De Bettignies and Chemla (2008) took an internal perspective and demonstrated that established corporations engage in CVC and other corporate venturing activities in order to attract and retain highly talented managers. Such formal approaches are underrepresented in the literature on CVC (Dushnitsky, 2012). The current essay adds to this strand of literature by examining the decision-making behavior of CVC units in a staged-financing setting using ROA. In the sections that follow, I briefly review the literatures on staged financing and the real options theory.

2.2.2 Staged financing

Investments in start-up companies involve substantial risk (Sahlman, 1990). This is not only caused by uncertainty about their unproven business models and market demand (Tong & Li, 2011), but also by agency problems (Gompers, 1995). As a consequence of their high-risk profile, start-up companies do not usually receive the financing from their investors up front as a lump sum but rather staged in the form of initially small, and then growing, capital infusions that depend on the accomplishment of milestone events agreed ex ante (Chesbrough, 2000; Sahlman, 1990). Sahlman (1990) described staged financing as “the most important mechanism for controlling the venture” (p. 506). Due to the critical role an entrepreneur plays in a start-up company, Neher (1999) argued that a lump-sum investment provides the entrepreneur with massive hold-up power and demonstrated analytically that staged financing helps the investor to mitigate this problem. Similarly, Admati and Pfleiderer (1994) developed a staged-financing model framework and derived an optimal contracting solution for entrepreneurs and investors. Dahiya and Ray (2012) showed that staging helps investors to identify bad projects at an early stage and to only proceed with the promising ones. They found that staged financing with gradually-increasing capital infusions is efficient. The findings of Bergemann et al. (2011) support this view.

Gompers (1995) delivered empirical evidence that key metrics of staged financing, such as the duration and size of single financing rounds, are influenced by expected agency costs. Expected agency costs were assumed to increase in the ratio of intangible to tangible assets, the market-to-book ratio and the asset specificity of the start-up company. Tian (2011) regarded staged financing and monitoring as different modes of governance and provided evidence that the use of the former increases with increasing geographic distance between the investor and the start-up company. Bienz and Hirsch (2012) considered a model where a start-up company can either be financed by milestone financing, with an equity price determined ex ante, or by round-based financing, where the equity price is determined at each round of financing. They showed that milestone financing is more likely when start-up companies have weak bargaining power ex post, i.e., when they lack access to outside investors.

2.2.3 CVC investments as real options

Real option analysis (ROA) refers to the application of financial option pricing theory on real assets (e.g., Amram & Kulatilaka, 1999; Copeland & Antikarov, 2001; Trigeorgis, 1993). As opposed to other standard valuation methods, such as the discounted cash flow method, ROA is able to factor in and value managerial flexibility (e.g., Hsu,

2010; Keeley, Punjabi, & Turki, 1996; Mitchell & Hamilton, 2007; Trigeorgis, 1993). Incorporating managerial flexibility is especially important in corporate decision-making, because real-world projects usually can be altered in multiple ways during their lifecycles, depending on interim information about the projects' performance (e.g., Bowman & Moskowitz, 2001). Due to the staged-financing procedure and the associated sequential decision-making inherent to VC investments as described before, the applicability of ROA on VC investments in general (Hsu, 2010; Li, 2008; Trigeorgis, 1993) and, in particular, on CVC investments (Ceccagnoli et al., 2018; Folta, 1998; Tong & Li, 2011) appears obvious.

To start with, MacMillan et al. (2008) described "taking 'real options' on technologies and business models" (p. 1) as one possible objective of CVC programs. Chesbrough (2002) underlined the "optionlike strategic upside" (p. 8) a CVC investment may entail. Because CVC investments are typically only small in scale, Basu et al. (2011) pointed out that CVC allows an established corporation to diversify its external commitment to new technologies and that the option value of such investments is particularly high in industries with a high rate of technological change. Folta (1998) argued that minority investments, such as CVC investments, give established corporations the option to defer the internal development of a new technology or to defer the possible acquisition of the target firm. However, Folta (1998) also demonstrated conditions under which corporations prefer a direct acquisition over minority investments, for example, when the competition on a new technology is strong.

Tong and Li (2011) viewed CVC investments and direct acquisitions as alternative types of investments. The authors argued that CVC investments involve the option to expand, defer, or abandon an investment project during its life cycle, whereas acquisitions result in less flexibility. Based on predictions derived from ROA, Tong and Li (2011) found empirical evidence that CVC investments are the preferred mode in scenarios with high market uncertainty or a high degree of irreversibility, i.e., when the start-up company's assets have a low resale value. Ceccagnoli et al. (2018) showed that the option value of CVC investments is higher for corporate investors that face higher uncertainty, e.g., when they invest in unfamiliar technological fields.

The literature linking CVC and the real options theory draws from empirical research approaches (e.g., Basu et al., 2011; Ceccagnoli et al., 2018; Tong & Li, 2011). Although these studies have improved our knowledge of the link between these concepts, the current literature lacks a formal analysis that takes into account the specific aspects of CVC, such as the various strategic considerations that drive such investment activities (Chesbrough, 2002). ROA is capable of incorporating situation- and investor-specific factors (Copeland & Antikarov, 2001), and this potential has not yet been fully ex-

exploited in the field of CVC (Ceccagnoli et al., 2018). In the next section, I develop a comprehensive model framework to fill this gap in the literature.

2.3 Combined real option and decision tree analysis

2.3.1 Basic model setup

I consider a CVC unit of an established corporation that has the opportunity to invest in an innovative, technology-based start-up company in $t = 0$. The start-up company has an idea or invention but lacks resources for its implementation. The scheduled development of the start-up company comprises four stages: the initial start-up stage, and the subsequent early stage, expansion stage, and maturity stage (MacMillan et al., 2008). The start-up company incurs total expected implementation costs of K to fully develop its business operations and reach the maturity stage. The CVC unit has the opportunity to gain a share of $s \in (0, 1)$ in the start-up company's equity, but only if it carries the implementation costs. Based on the premises outlined in Section 2.2.2, I assume that both parties agree on a staged financing contract with contingent capital infusions in $t = 0, 1, 2, 3$.

The size of each contingent capital infusion that the start-up company requires to further develop is estimated and agreed upon ex ante based on similar R&D and start-up funding projects in the same sector (Bienz & Hirsch, 2012). The capital infusions amount to k_1 for the start-up stage, k_2 for the early stage, k_3 for the expansion stage, and k_4 for the maturity stage with $\sum_{i=1}^4 k_i = K$ and $k_1 < k_2 < k_3 < k_4$. The latter condition meets the requirement of gradually-increasing capital infusions (Bergemann et al., 2011; Chesbrough, 2000; Dahiya & Ray, 2012; Sahlman, 1990). The initial investment k_1 is required to fully develop the start-up company's product or service and reach the subsequent early stage. During the early stage, the amount of k_2 is required in order to build up the distribution channels and realize the market entry. In the expansion stage, the amount of k_3 is needed to upscale the start-up company's operations, whereas the amount of k_4 is required to proceed to the maturity stage (Gompers, 2002; MacMillan et al., 2008; Sahlman, 1990).

The decision-making of the CVC unit is as follows. In $t = 0$, the CVC unit has to decide whether the initial investment of k_1 shall be made or not. If the investment is not made at this point in time, the investment opportunity terminates. Once the initial investment is made, the CVC unit has the option to expand, defer, or abandon the investment project at each point in time $t = 1, 2, 3$ (Tong & Li, 2011). The option to expand involves another capital infusion, while the option to defer means that the

CVC unit holds the invested capital constant, which implies a “wait-and-see strategy” (Tong & Li, 2011, p. 633). It is crucial to note that the start-up company remains in the same stage when the option to defer is chosen. If the CVC unit chooses the option to abandon, the investment project terminates at the respective point in time and no subsequent investments are possible.

The option to abandon entails the liquidation of the start-up company and the CVC unit receives the accumulated liquidation value LV_t of the start-up company’s assets (Gompers, 1995). The liquidation value in t with $t = 0, 1, 2, 3$ amounts to

$$LV_t = \delta \sum_{i=1}^{\phi_t} k_i. \quad (2.1)$$

The liquidation parameter $\delta \leq 1$ ensures that the liquidation value is always equal to or smaller than the accumulated invested capital (Bienz & Hirsch, 2012; Guo, Lou, & Pérez-Castrillo, 2015). Each capital infusion, thus, partially translates into a certain resale value. For example, the technical equipment of the start-up company can be resold at a fraction of the former purchase price if the start-up company is liquidated. The parameter ϕ_t counts the number of capital infusions until t (including the decision in t) with $\phi_t \in \{1, 2, 3, 4\}$. The inclusion of the parameter ϕ_t is critical, as the investor has the opportunity to defer additional investments. The number of capital infusions does not, therefore, necessarily correspond to the number of the period, e.g., when the CVC unit makes its second investment in $t = 3$.

In $t = 4$, the CVC unit has the opportunity to acquire the start-up company (Benson & Ziedonis, 2009, 2010). Alternatively, the CVC unit may exit the investment project through a trade sale, if the firm remains in the start-up stage, early stage, or expansion stage until $t = 4$, or through an IPO, if the firm reaches the maturity stage by $t = 4$ (e.g., Gompers, 1995; Guo et al., 2015; Wang & Wan, 2013). Figure 2.1 depicts the resulting decision tree.

2.3.2 Real option analysis

The options to invest, expand, defer, and abandon

The total potential market value of the start-up company, which is associated with the achievement of a certain share of the revenues in an existing industry, amounts to M_t . Technically, M_t can be approximated using revenue multiples from comparable companies in the same industry (Friedl, 2003). The exploitation of the market potential is determined by the total level of capital infused by the CVC unit. With each capital

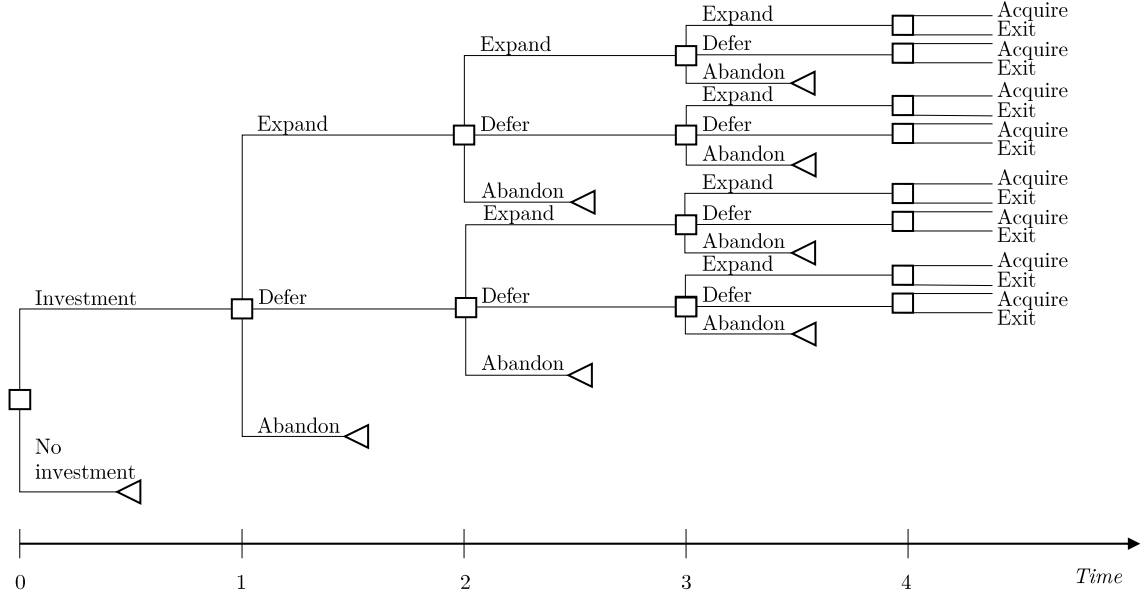


Figure 2.1: Decision tree.

infusion k_{ϕ_t} in $t = 0, 1, 2, 3$, the realized market value increases by $\frac{k_{\phi_t}}{K} M_t$. This implies that the exploitation of the potential market value is proportional to the infused capital. In the start-up stage, the realized market value, i.e., $\frac{k_1}{K} M_t$, is the value of a firm that possesses a technology that is under development and not yet commercially available (MacMillan et al., 2008).

The potential market value of the start-up company is subject to the inherent market risk of its industry. More specifically, M_t is assumed to follow a random process according to the binomial model (Cox, Ross, & Rubinstein, 1979). In each period considered, the market value either moves upwards by the factor u with probability q or downwards by the factor $d = 1/u$ with probability $(1 - q)$. The factors u and d can be written as

$$u = e^{\sigma\sqrt{\tau}} \text{ and } d = e^{-\sigma\sqrt{\tau}}, \quad (2.2)$$

where σ denotes the volatility of M_t , which is constant over time, and τ the time increment between $(t - 1)$ and t with $t = 1, 2, 3, 4$. In the following, I compute the value of the CVC unit's option to expand, defer, or abandon the investment project in $t = 1, 2, 3$, and add the value of these options to the initial value of the investment opportunity in $t = 0$.

First, it is crucial to note that the opportunity to acquire the start-up company in $t = 4$ is currently not modeled as a real option, because it does not involve a predetermined equity price (e.g., Copeland & Antikarov, 2001). Specifically, the established corporation expects that it has to pay the then-current market value of the remaining

equity shares if it opts for acquisition, i.e., that it has to pay $\frac{\sum_{i=1}^{\phi_4} k_i}{K}(1-s)M_4$. Thus, I begin the ROA in $t = 3$ by applying the backward induction method (e.g., Amram & Kulatilaka, 1999; Copeland & Antikarov, 2001; Trigeorgis, 1993). The payoff function of the combined option, i.e., the combination of the options to expand, defer, and abandon in $t = 3$ is

$$O_3 = \max \left\{ \frac{k_{\phi_3}}{K} sM_3 - k_{\phi_3}, 0, \delta \sum_{i=1}^{\phi_3} k_i - \frac{\sum_{i=1}^{\phi_3} k_i}{K} sM_3 \right\}. \quad (2.3)$$

The first term depicts the option to expand, which technically represents a call option on the share of s in the further exploitation of the start-up company's potential market value. As described in Section 2.3.1, the strike price of the option to expand equals k_{ϕ_t} . The option to defer involves no further investment and its payoff equals zero in $t = 3$ in the current model setup. The value of the option to defer at $t = 3$ becomes positive in a later step, when I introduce the post-acquisition synergies that the CVC unit expects. For the sake of consistency, I nevertheless include the payoff of the option to defer in Equation (2.3). The last term represents the option to abandon the investment project, which constitutes a put option with a strike price equal to the liquidation value $LV_t = \delta \sum_{i=1}^{\phi_t} k_i$. Note that the simultaneous rights to either liquidate the start-up company or participate in its financial success resemble a convertible security with debt- and equity-like features that are often used in VC investments (Cornelli & Yosha, 2003; Cumming, 2005; Sahlman, 1990).

The value of the combined option in $t = 2$ is

$$O_2 = \max \left\{ \frac{k_{\phi_2}}{K} sM_2 + V_2(O_3) - k_{\phi_2}, V_2(O_3), \delta \sum_{i=1}^{\phi_2} k_i - \frac{\sum_{i=1}^{\phi_2} k_i}{K} sM_2 \right\}, \quad (2.4)$$

where $V_2(O_3)$ denotes the value of O_3 in $t = 2$.

I derive $V_2(O_3)$ by applying the risk-neutral valuation procedure using the risk-neutral probability approach (Cox et al., 1979). In $t = 3$, the option values in the possible up and down states are multiplied by the risk-neutral probabilities

$$p = \frac{(1+r)^\tau - d}{u-d} \text{ and } (1-p) = \frac{u - (1+r)^\tau}{u-d}. \quad (2.5)$$

Here, r is the annual risk-free rate of return. In order to derive the present value of the option in $t = 2$, the probability-weighted option value is then divided by $(1+r)^\tau$ (Cox et al., 1979). The options to expand and defer in $t = 2$ both represent compound options (e.g., Copeland & Antikarov, 2001), namely options on the option to expand, defer, or abandon in $t = 3$.

The value of the combined option in $t = 1$ is, accordingly,

$$O_1 = \max \left\{ \frac{k_{\phi_1}}{K} sM_1 + V_1(O_2) - k_{\phi_1}, V_1(O_2), \delta \sum_{i=1}^{\phi_1} k_i - \frac{\sum_{i=1}^{\phi_1} k_i}{K} sM_1 \right\}. \quad (2.6)$$

Hence, the value of the initial option to invest in $t = 0$ is

$$O_0 = \max \left\{ \frac{k_1}{K} sM_0 + V_0(O_1) - k_1, 0 \right\}. \quad (2.7)$$

The initial investment of k_1 is not only the price of the share s in the start-up company's initial market value, $\frac{k_1}{K} M_0$, but also the price of the multiple additional options the CVC unit has throughout the subsequent staged-financing process.

The decision framework thus far concentrates on the financial value of the investment opportunity and leaves out the various strategic motives of established corporations when investing in entrepreneurial firms (e.g., Chesbrough, 2002). In the sections that follow, I build upon prior work in the field of CVC and incorporate three important strategic considerations of corporate investors into the analysis, namely learning benefits (Schildt et al., 2005), business stealing effects (Hellmann, 2002), and expected post-acquisition synergies (Benson & Ziedonis, 2009, 2010).

Learning benefits

Established corporations often face make-or-buy decisions when considering whether to develop new technologies internally or acquire them externally (Bartel, Lach, & Sicherman, 2012). CVC investments, however, allow corporations to learn about new technologies and markets (Schildt et al., 2005) by simultaneously adopting a low level of commitment as compared to the setup of an internal development program or an outright acquisition (Folta, 1998; Wadhwa & Basu, 2013). In the following, the focal CVC unit values these learning benefits by taking the costs into account that would have been incurred if the knowledge about the start-up company's technology had been acquired otherwise, e.g., through expert interviews, internal trials, or external data acquisition.

In each of the four development stages, the established corporation realizes learning benefits with a value of l_1 in the start-up stage, l_2 in the early stage, l_3 in the expansion stage, and l_4 in the maturity stage. The parameters l_1 , l_2 , l_3 , and l_4 thereby depict the present value of the learning benefits at the beginning of the respective stage. The combination of l_1 , l_2 , l_3 , and l_4 can be interpreted as the sponsoring corporation's anticipated learning curve across the different development stages (Yang, Narayanan,

& Zahra, 2009). The learning benefits are based on management evaluations that are made in $t = 0$ and remain unchanged over time. Consequently, the learning benefits are deterministic in the sense that they are not connected to the development of the market value of the start-up company. The decoupling of the learning benefits from the development of the start-up company's market value is based on the rationale that established corporations may learn from thriving *and* failing start-up companies. In either case, they learn about general market conditions, customer preferences as well as the start-up company's technology, among many other aspects (Dushnitsky & Lenox, 2005b).

It is important to note that the learning benefits are tied to the achievement of the subsequent development stage. They only occur if the CVC unit opts for growing the start-up company's operations. If the deferral or the abandonment option is chosen, there are no learning benefits in the subsequent period. Since the parameters l_1 , l_2 , l_3 , and l_4 are assumed to be deterministic, they can be smoothly integrated into the ROA. Technically, the learning benefits affect the value the CVC unit assigns to the option to expand, as they reduce the perceived net costs of the investment. The value of the combined option in Equation (2.3) in $t = 3$ evolves to

$$O_3 = \max \left\{ \frac{k_{\phi_3}}{K} sM_3 + l_{\phi_3} - k_{\phi_3}, 0, \delta \sum_{i=1}^{\phi_3} k_i - \frac{\sum_{i=1}^{\phi_3} k_i}{K} sM_3 \right\}. \quad (2.8)$$

The values of the combined options in $t = 1, 2$ from Equations (2.4) and (2.6), respectively, become

$$O_t = \max \left\{ \frac{k_{\phi_t}}{K} sM_t + l_{\phi_t} + V_t(O_{t+1}) - k_{\phi_t}, \right. \\ \left. V_t(O_{t+1}), \delta \sum_{i=1}^{\phi_t} k_i - \frac{\sum_{i=1}^{\phi_t} k_i}{K} sM_t \right\}. \quad (2.9)$$

The option to initially invest in $t = 0$ presented in Equation (2.7) changes to

$$O_0 = \max \left\{ \frac{k_1}{K} sM_0 + l_1 + V_0(O_1) - k_1, 0 \right\}. \quad (2.10)$$

Business stealing

I now consider an overlap between the market of the CVC unit's parent corporation and the start-up company's target market. As described above, with each possible capital infusion k_{ϕ_t} the potential market value of the start-up company is further exploited by $\frac{k_{\phi_t}}{K} M_t$. However, the CVC unit's parent corporation may experience a business

stealing effect associated with an increasing market penetration of the start-up company (Hellmann, 2002). For example, this effect may be caused by a shift in demand in favor of the start-up company. The magnitude of this effect depends on the start-up company's market penetration and is captured by the cannibalization rate c . In particular, with each capital infusion k_{ϕ_t} , the CVC unit receives an additional fraction of $\frac{k_{\phi_t}}{K} s M_t$ of the start-up company's market value, but destroys a fraction of $\frac{k_{\phi_t}}{K} c M_t$ of its own market value. From the CVC unit's perspective, the net effect of an increase in the start-up company's market penetration is $\frac{k_{\phi_t}}{K} (s - c) M_t$. The value of the combined option in $t = 3$ changes to

$$O_3 = \max \left\{ \frac{k_{\phi_3}}{K} (s - c) M_3 + l_{\phi_3} - k_{\phi_3}, 0, \delta \sum_{i=1}^{\phi_3} k_i - \frac{\sum_{i=1}^{\phi_3} k_i}{K} s M_3 \right\}. \quad (2.11)$$

For $t = 1, 2$, the value of the option is

$$O_t = \max \left\{ \frac{k_{\phi_t}}{K} (s - c) M_t + l_{\phi_t} + V_t(O_{t+1}) - k_{\phi_t}, \right. \\ \left. V_t(O_{t+1}), \delta \sum_{i=1}^{\phi_t} k_i - \frac{\sum_{i=1}^{\phi_t} k_i}{K} s M_t \right\}. \quad (2.12)$$

In $t = 0$, I infer a value of

$$O_0 = \max \left\{ \frac{k_1}{K} (s - c) M_0 + l_1 + V_0(O_1) - k_1, 0 \right\}. \quad (2.13)$$

As the market entry is assumed to take place in the early stage, the initial business stealing effect in $t = 0$ depicts the value destruction of the established corporation that is triggered by a market reaction to the emergence of the start-up company's technology.

Post-acquisition synergies

I now turn to the preemptive right of the established corporation to acquire the remaining shares of the start-up company in $t = 4$. Because the established corporation expects that it has to pay the then-current market price of the remaining shares if it opts for acquisition, the opportunity to acquire does not fulfill the characteristics of a real option. Particularly, the opportunity to acquire does not involve a predetermined equity price, a necessary condition for the applicability of ROA (e.g., Copeland & Antikarov, 2001). However, I apply ROA to value the post-acquisition synergies that the CVC unit expects if it opts for acquisition.

The CVC unit anticipates that the overall value of the start-up company amounts to $(1 + \lambda) \frac{\sum_{i=1}^{\phi_4} k_i}{K} M_4$ in $t = 4$ if it is acquired by the CVC unit's parent corporation. The parameter λ thereby determines the level of the expected post-acquisition synergies. Moreover, these synergies are proportional to the market value the start-up company has reached by $t = 4$, i.e., to $\frac{\sum_{i=1}^{\phi_4} k_i}{K} M_4$. This implies that the greater the market penetration of the start-up company is until $t = 4$, the greater are the revenue synergies its acquirer expects. Hence, these post-acquisition synergies can be readily integrated into the analysis, because they depend on the development of M_t . The corporate investor expects that these synergies can be achieved without incurring further costs. The expected payoff S_4 of the opportunity to acquire the start-up company is

$$S_4 = \lambda \frac{\sum_{i=1}^{\phi_4} k_i}{K} M_4. \quad (2.14)$$

As a consequence, the CVC unit always opts for acquisition in $t = 4$ if the value of the post-acquisition synergies is positive, i.e., if $S_4 > 0$.

As the value of the expected post-acquisition synergies is related the market value of the start-up company, it can easily be integrated into the ROA. Technically, the expected post-acquisition synergies increase the value of the expansion option and the deferral option by $S_3 = \lambda \frac{\sum_{i=0}^{\phi_3} k_i}{K} M_3$ in $t = 3$. Hence, the payoff function of the combined option in $t = 3$ depicted in Equation (2.11) can be transformed into

$$O_3 = \max \left\{ \left(\frac{k_{\phi_3}}{K} (s - c) + \lambda \frac{\sum_{i=1}^{\phi_3} k_i}{K} \right) M_3 + l_{\phi_3} - k_{\phi_3}, \right. \\ \left. \lambda \frac{\sum_{i=1}^{\phi_3} k_i}{K} M_3, \delta \sum_{i=1}^{\phi_3} k_i - \frac{\sum_{i=1}^{\phi_3} k_i}{K} s M_3 \right\}. \quad (2.15)$$

By applying the backward induction method, the expected post-acquisition synergies are included in the valuation of the investment opportunity in $t = 0$.

2.3.3 Technological risk

Investments in start-up companies not only entail risk concerning the market value of the start-up company's technology or business model (Trigeorgis, 1993), but also private risk. Private risk comprises all kinds of risks that cannot be hedged by traded securities (Smith & Nau, 1995). Examples of private risk applicable to start-up companies include technological risk, lawsuits, or the rejection of a patent application (Alvarez-Garrido & Dushnitsky, 2016; Shi & Manning, 2009). In this essay, I focus on technological risk as the only source of private risk. However, the analysis can be applied to other or multiple

sources of private risk. Note that the following description refers to the technological risk as perceived by the CVC unit.

The CVC unit assumes that the investment project encounters technological risk during the start-up stage. In this stage, the development of the start-up company's technology and the application for a patent can either succeed with probability χ or fail with probability $(1-\chi)$ (Friedl, 2003; MacMillan et al., 2008). In $t = 0$, the initial investment can either yield the value of the option to invest depicted in Equation (2.13), or, otherwise, yield the net present value (NPV) of the initial learning benefits l_1 and the liquidation value if the start-up company fails. Table 2.1 illustrates the expected payoffs of the strategy to invest and not to invest in $t = 0$. Note that the CVC unit only opts for investing if the value of the option to invest derived from ROA, which is depicted in the left column of Table 2.1, is greater than zero.

First, I consider a situation in which the probability of technological success converges to zero. Even in this extreme case, the CVC unit may be willing to invest as long as the learning benefits in the start-up stage l_1 compensate the financial loss from the investment, i.e., if

$$l_1 > k_1 - \delta \frac{k_1}{1+r}. \quad (2.16)$$

This complies with the argument of Dushnitsky and Lenox (2006) that “even the outright failure of the venture may not be a bad outcome if the strategic benefits outweighed the initial investment” (p. 758). Here, the risk-free discount rate r applies, because the CVC unit assumes the technological risk to be diversifiable (Copeland & Antikarov, 2001). Note that this simplifying assumption does not affect the implications of the proposed model framework and can easily be adjusted to situations in which the CVC unit demands a risk premium for technological risk.

Table 2.1: Payoff profile in $t = 0$ in consideration of technological risk.

Strategy	ROA (Success)	NPV (Failure)
Investment	$\chi \left\{ \frac{k_1}{K}(s-c)M_0 + l_1 + V_0(O_1) - k_1 \right\}$	$(1-\chi) \left\{ -k_1 + l_1 + \delta \frac{k_1}{1+r} \right\}$
No investment	0	0

In a situation where the probability of technological success converges to one, the initial investment decision depends solely on the option value depicted in Equation (2.13). In summary, the CVC unit opts for investing in $t = 0$, if $O_0 \geq 0$ and if the probability-weighted average of the payoffs depicted in Table 2.1 is positive (Hespos & Strassmann,

1965; Magee, 1964).

2.3.4 Corporate vs. independent venture capital

In Section 2.4, the investment decisions made by the CVC unit are compared to those made by a hypothetical IVC investor. In the numerical analysis, the model parameters are the same for the CVC unit and the IVC investor, except for the parameters describing learning benefits, business stealing effects, and post-acquisition synergies. Since the IVC investor only cares about the financial return (Chemmanur et al., 2014; Dushnitsky & Shapira, 2010; Park & Steensma, 2012), these strategic parameters are taken into account solely by the CVC unit. The technological risk introduced in Section 2.3.3 is perceived identically by the IVC investor, if not stated differently in the numerical analysis.

2.4 Numerical analysis

2.4.1 General parameter assumptions

In this section, I conduct multiple numerical analyses, a common way of demonstrating implications of ROA-based frameworks (e.g., Brandão & Dyer, 2005; Brandão et al., 2005). Throughout the numerical analysis, I integrate findings of former studies on CVC, staged financing, and ROA. The general parameter assumptions made in the next paragraph are not supposed to perfectly fit a certain start-up company or sector. The emphasis is on basic relationships and comparative statics rather than on precise predictions for specific investment scenarios.

I assume that the total implementation costs amount to $K = 100.0$. Every number in the numerical analysis can hence be easily converted into a percentage value of K . The total implementation costs are split into four contingent capital infusions with $k_1 = 10.0$, $k_2 = 20.0$, $k_3 = 30.0$, and $k_4 = 40.0$ if not stated otherwise. Because CVC investments are commonly minority investments (Gompers & Lerner, 2000), I assume that the CVC unit gains a share of $s = 0.2$ in the start-up company if it opts to invest in $t = 0$. The liquidation parameter is $\delta = 0.3$, i.e., each capital infusion k_{ϕ_t} increases the liquidation value of the start-up company by 30.0% of the newly-invested capital. This value determines the asset specificity (Gompers, 1995) or, similarly, the irreversibility of the investment (Tong & Li, 2011).

The potential market value of the start-up company amounts to $M_0 = 300.0$ in $t = 0$. The market volatility of the start-up company's industry is $\sigma = 0.8$ and the time

increment between two periods is one year. This implies $u = 2.23$ and $d = 0.45$. By applying an annual risk-free rate of return of $r = 0.03$, the risk-neutral probabilities are $p = 0.33$ and $(1 - p) = 0.67$, respectively. Note that I apply the annual risk-free rate of return to discount the option values as described in the preceding section. The real-world probabilities of the upwards and downwards movements, which will be required for the computation of probability density functions in a later analysis, are $q = 0.50$ and $(1 - q) = 0.50$, respectively. The learning curve of the CVC unit's parent corporation is assumed to be flat over all stages; that is, in each stage the parent corporation realizes constant learning benefits amounting to $\overline{l_{\phi_t}} = 5.0$. The parameters describing the business stealing effects and expected post-acquisition synergies, c and λ , are zero and the probability of technological success χ equals one if not stated differently.

2.4.2 Overall value of the option to invest

In their empirical work on the implications of CVC financing for entrepreneurial firms, Gompers and Lerner (2000) found that CVC units invest at a premium compared to IVC investors. The authors stated two potential reasons for this phenomenon. First, the premium paid by CVC units may arise from the relative inexperience of corporate investment managers and the resulting tendency to overpay for equity shares. Second, the premium may stem from indirect, strategic benefits for the parent corporation that induce them to pay higher prices for equity shares in entrepreneurial firms. In this essay, the strategic benefits expected by the CVC unit's parent corporation are represented by learning benefits and expected post-acquisition synergies. In the following numerical analysis, I examine the conditions under which the valuations of CVC units and IVC investors diverge from each other and thereby deliver additional explanations for the findings of Gompers and Lerner (2000) and related studies (e.g., Ivanov & Xie, 2010).

To begin with, Figure 2.2 shows how the market volatility σ and the liquidation parameter δ affect the value of the option to invest in $t = 0$. Next to the IVC investor described in Section 2.3.4, two different types of CVC units are considered. The type 1 CVC unit represents a corporate investor with the general parameter assumptions made in the previous section. The same assumptions apply for the type 2 CVC unit, except for the post-acquisition synergies, which this investor type expects to be positive with $\lambda = 0.05$. In accordance with the general implications of the real options theory, the value of the option to invest in $t = 0$ increases with increasing market volatility, which is depicted in the left-hand diagram in Figure 2.2 (Dixit & Pindyck, 1994; Trigeorgis, 1996).

This result supports the observation of Tong and Li (2011). Based on theoretical pre-

dictions drawn from the real options theory, the authors found empirical evidence for their hypothesis that corporations choose flexible investment modes, such as CVC, over acquisitions in environments involving high uncertainty. Given the parameter assumptions above, the IVC investor assigns a lower valuation to the option to invest in $t = 0$ than the CVC units. The difference between the valuations of the type 1 CVC unit and the type 2 CVC unit demonstrates the substantial impact of the expected post-acquisition synergies on the overall valuation of the option to invest in $t = 0$. Moreover, the results of this analysis suggest that corporate investors expecting strategic benefits may also invest in start-up companies with a relatively small upside potential, that is, with a low market volatility, which IVC investors would not finance.

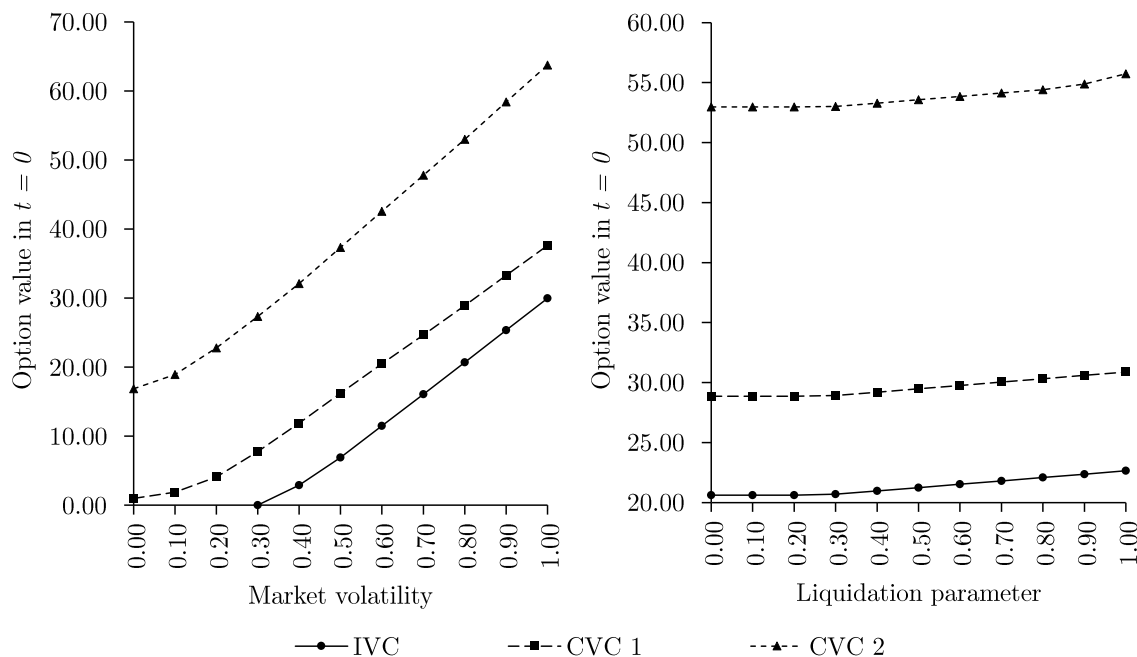


Figure 2.2: Market volatility and downside protection.

The right-hand diagram in Figure 2.2 shows that the impact of the liquidation parameter and the associated downside protection on the value of the option to invest in $t = 0$ is less pronounced than the impact of the market volatility under the current parameter assumptions. Even if $\delta = 1.0$, which implies that the invested capital can be fully recovered if the start-up company is liquidated, the overall value of the option to invest in $t = 0$ is only slightly higher as compared to the base case with $\delta = 0.3$. This result holds true for all considered investor types. Note that the effect of the liquidation parameter increases when the model parameters s or M_0 decrease, i.e., when it becomes more likely that the value of the investors' holdings will fall below their liquidation value. Furthermore, the parameter assumptions can be changed in order to identify situations in which the corporate investors under consideration finance the

focal start-up company, but the IVC investor refrains from investing due to a lack of downside protection. This suggests that CVC units are more likely to invest in start-up companies, whose assets show a low liquidation value, than IVC investors (Tong & Li, 2011).

Figure 2.3 demonstrates how learning benefits and expected post-acquisition synergies influence the value of the option to invest in $t = 0$. Three kinds of investors are considered: the IVC investor, the type 1 CVC unit for whom the general parameter assumptions from Section 2.4.1 apply, and the type 2 CVC unit whose parent corporation experiences a business stealing effect with a cannibalization rate of $c = 0.05$. The left-hand diagram in Figure 2.3 shows the effect of increasing learning benefits. Note that the learning curve is still assumed to be flat across all stages. For example, a value of 1.00 on the abscissa implies a flat learning curve of $\bar{l}_{\phi_t} = 1.0$ for all stages reached. The fact that an increasing level of the learning benefits leads to an increasing value of the option to invest in $t = 0$ meets the general expectation that CVC units are willing to pay a higher equity price when the learning benefits are greater. In this vein, Gompers and Lerner (2000) conjecture that the premium paid by CVC units decreases when the “understanding of the market” (p. 42) improves, which is the case when the learning benefits decrease in the present model framework.

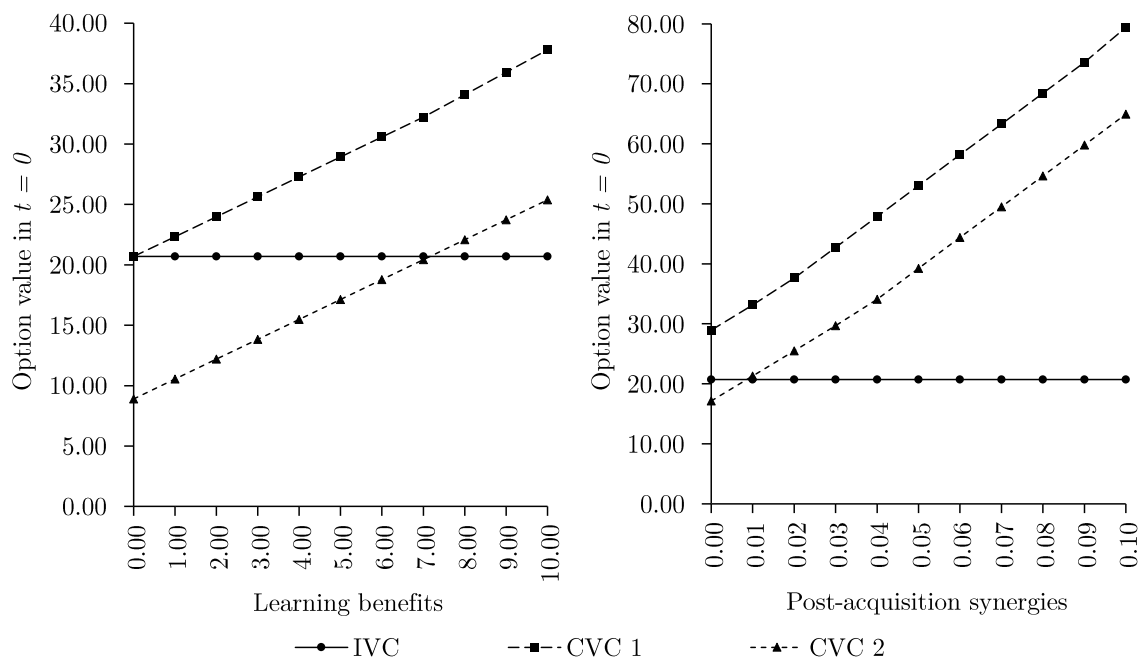


Figure 2.3: Learning benefits and post-acquisition synergies.

The left-hand diagram also reveals that the valuation of the option to invest in $t = 0$ strongly depends on the cannibalization rate c . Intuitively, corporate investors assign a lower value to start-up companies that destroy a fraction of their own value. For

low learning benefits, the valuation of the type 2 CVC unit is even lower than that of the IVC investor. The right-hand diagram in Figure 2.3 shows the effect of expected post-acquisition synergies, which is more pronounced than the effect of learning benefits. Under the given parameter assumptions, a relatively low level of expected post-acquisition synergies of approximately $\lambda = 0.01$ suffices to compensate the business stealing effect and to lift the valuation of the type 2 CVC unit up to the level of the IVC investor.

The next numerical analysis addresses the empirical finding of Gompers and Lerner (2000) that the premium paid by CVC units remains roughly constant when there is a stronger strategic fit between the parent corporation and the start-up company. This is a surprising finding since a higher strategic fit is intuitively associated with a larger premium paid by CVC units. Gompers and Lerner (2000) reasoned that with an increasing strategic fit the corporation may enjoy higher strategic benefits, but the willingness to pay a premium is lower due to better knowledge of the market. The proposed model framework allows another interpretation of this finding. A higher strategic fit may also be associated with a greater overlap between the markets of the CVC unit's parent corporation and the start-up company. This may result in an increased business stealing effect. Here, the CVC unit must anticipate higher strategic benefits if the business stealing effect increases, in order to keep the value of the option to invest in $t = 0$ constant.

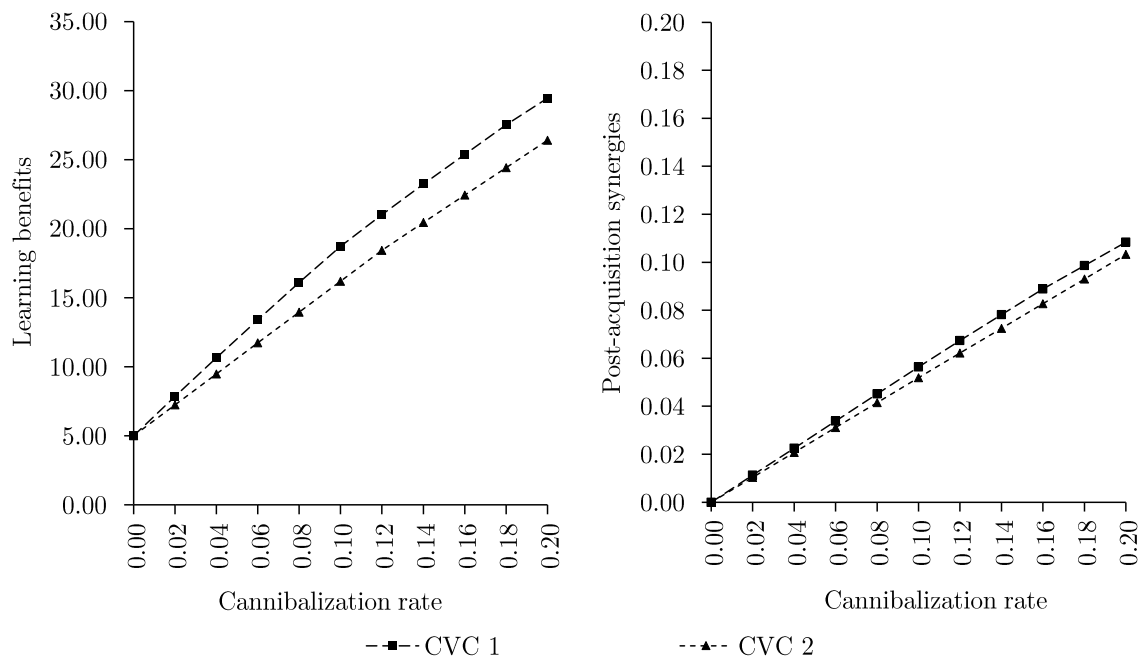


Figure 2.4: Parameter combinations that yield the same option value in $t = 0$.

The parameter combinations that yield the same option values in $t = 0$ are sketched

in the diagrams in Figure 2.4. Because the business stealing effect only applies for corporate investors, I omit the hypothetical IVC investor in this analysis. For the type 1 CVC unit, the general parameter assumptions apply. The type 2 CVC unit expects post-acquisition synergies with $\lambda = 0.05$ in the left-hand diagram and high learning benefits amounting to $\overline{l_{\phi_t}} = 20.0$ in the right-hand diagram. Figure 2.4 shows that a higher cannibalization rate is associated with a significant increase in the learning benefits and expected post-acquisition synergies, in order to keep the value of the option to invest in $t = 0$ constant. Under the given parameter constellation, the high level of learning benefits assigned to the type 2 CVC unit in the right-hand diagram only slightly reduces the level of post-acquisition synergies required to keep the option value constant.

The model framework yields multiple further insights into the value that corporate investors assign to new investment opportunities that I do not show here for reasons of space. Some of these implications are particularly noteworthy. As compared to an IVC investor, a CVC unit that expects strategic benefits in the form of learning benefits and post-acquisition synergies may be ‘satisfied’ with a lower equity share s in the start-up company. A CVC unit that anticipates strategic benefits may also be willing to sponsor a start-up company that incurs higher implementation costs K . Note that if the opposite holds true and the CVC unit expects strategic disadvantages from an investment, e.g., through a considerable business stealing effect, it demands a higher equity share s in the start-up company and lower implementation costs K than the IVC investor.

Another result that can be easily derived from the model framework is that differences in the value that CVC units and IVC investors assign to new investment opportunities may stem from deviations in the expected implementation costs K . In the preceding analyses, CVC units and IVC investors bear the same implementation costs. However, CVC units may leverage complementary resources of their parent corporations, such as technical facilities as well as existing marketing and distribution channels (e.g., Ivanov & Xie, 2010) and, thus, be able to reduce the costs that the start-up company incurs over the different development stages. This increases the value of the investment opportunity for corporate investors in $t = 0$ and may explain why CVC units finance certain start-up companies that IVC investors would not be willing to finance (e.g., Gompers & Lerner, 2000).

2.4.3 Technological risk as a barrier to invest

The next numerical analysis comprises an examination of how the technological risk introduced in Section 2.3.3 affects the decisions of the different investor types. In the following analysis, I consider a CVC unit and an IVC investor for whom the general parameter assumptions, as outlined in Section 2.4.1, apply. The left-hand diagram in Figure 2.5 shows the expected value of the strategy to invest in $t = 0$ by taking into account the technological risk, which is sketched on the abscissa. Under the decision rule described in Section 2.3.3, the CVC unit opts to invest at a much lower probability of technological success than the IVC investor, namely at approximately $\chi = 6.7\%$. From the perspective of the IVC investor, the value of the investment opportunity in $t = 0$ becomes only positive at approximately $\chi = 25.5\%$. The model framework thus suggests that start-up companies that face higher technological risk may be dependent on CVC financing, because IVC investors may tend to avoid financing them.

In this regard, Chemmanur et al. (2014) provided empirical evidence that CVC-backed start-up companies are riskier by comparing industry betas of CVC- and IVC-backed start-up companies. The current model framework demonstrates that CVC units may also invest in start-up companies that bear higher technological risk than those financed by IVC investors. Next, Chemmanur et al. (2014) found that CVC-backed start-up companies are younger at the time they receive VC funding than IVC-backed start-up companies. An explanation derived from the model framework is that CVC units may invest earlier due to strategic benefits that balance the disadvantages that arise from technological risk. IVC investors may prefer to wait for the technological risk to dissolve, which is the case at $t = 1$ in the present model framework, and thus invest later than CVC units.

Furthermore, Chemmanur et al. (2014) found that CVC-backed start-up companies are more innovative as compared to IVC-backed start-up companies, measured in terms of patenting rates and patent citations. A possible explanation for this might be that the more innovative start-up companies carry a higher probability of technological failure (Green, Gavin, & Aiman-Smith, 1995). Despite the increased level of technological risk, corporate investors may be willing to support these highly innovative start-up companies due to strategic benefits, whereas IVC investors do not support these firms. However, this result should be interpreted with caution, because it is based on the premise that start-up companies whose technology is particularly innovative face higher technological risk.

The right-hand diagram in Figure 2.5 depicts combinations of the probability of technological success and the market volatility that yield an expected payoff of zero in $t = 0$.

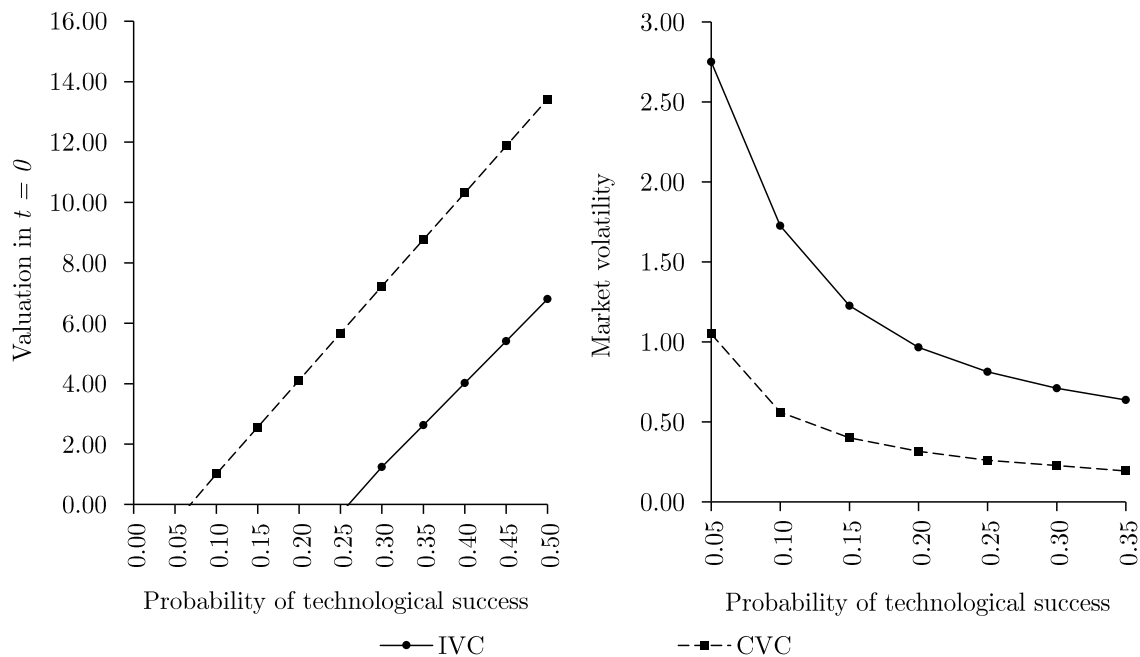


Figure 2.5: The effects arising from technological risk.

Considering that CVC units invest in start-up companies that carry a higher risk of technological failure, the model framework also suggests that they demand a higher market volatility, i.e., a higher upside potential that increases the expected value of the investment opportunity in $t = 0$. For example, the CVC unit is willing to invest in a start-up company with a probability of technological success of only $\chi = 5.0\%$ as long as the market volatility is higher than $\sigma = 1.05$. The IVC investor may be focusing on start-up companies with a higher probability of technological success of, for example, $\chi = 30.0\%$, and, thereby, be satisfied with a lower market volatility of $\sigma = 0.71$. The model framework thus unveils that an increasing market volatility, which implies an increasing upside potential, may balance an increasing technological risk.

2.4.4 Achieved development stage

I now turn to a finding of Gompers and Lerner (2000), which is that CVC-backed start-up companies are more likely to go public and less likely to be liquidated than IVC-backed start-up companies. The authors found this effect to be especially pronounced when there is a strong strategic fit between the CVC unit's parent corporation and the start-up company. The proposed model framework incorporates the different development stages that a start-up company may undergo and leaves the decision to the investor to either grow the start-up company, defer its development, or liquidate its business at an intermediary point in time. Note that an IPO is only possible if the

start-up company reaches the maturity stage, as described in Section 2.3.1.

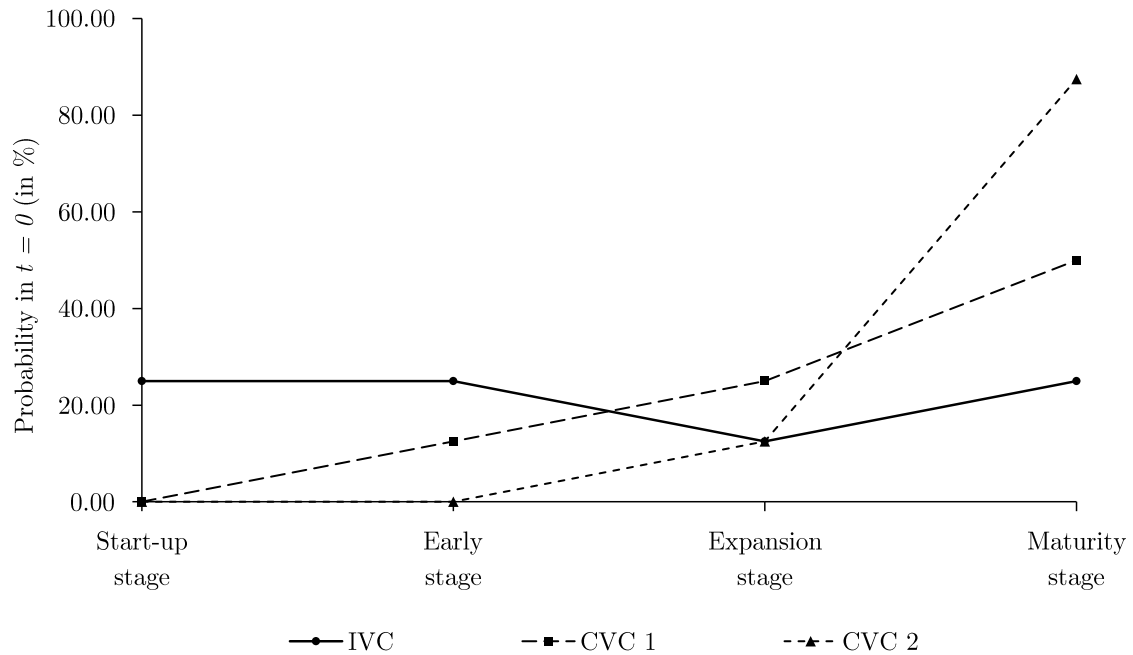


Figure 2.6: Probabilities of the development stage reached at $t = 4$ from the viewpoint in $t = 0$ (type 2 CVC unit considers post-acquisition synergies).

Figures 2.6 and 2.7 show the expected probabilities of the achieved development stage at $t = 4$ from the viewpoint in $t = 0$. The probabilities of the respective stages being reached are derived from the real-world probabilities of the upward and the downward movements at the points in time, as well as the ROA-based decision-making outcomes outlined in Section 2.3. In Figure 2.6, the type 1 CVC unit realizes learning benefits with a constant value of $\overline{l_{\phi_t}} = 20.0$ per development stage achieved. For the type 2 CVC unit, the same learning benefits apply. However, this investor type additionally expects post-acquisition synergies with $\lambda = 0.2$. Here, comparably high parameter values of learning benefits and post-acquisition synergies are chosen in order to highlight the different decision-making outcomes of the considered investor types.

The IVC-backed start-up company has the lowest probability (25.0%) of reaching the maturity stage and going public, given these parameter assumptions. The start-up company backed by the type 2 CVC unit has the highest probability (87.5%) of reaching the maturity stage. This start-up company will be acquired by the CVC unit's parent corporation according to the decision rule outlined in Section 2.3.2. The highest probability (50.0%) of reaching the maturity stage *and* going public is the start-up company sponsored by the type 1 CVC unit, who enjoys learning benefits but does not expect any post-acquisition synergies. Note that for the start-up companies backed by the IVC and the type 1 CVC unit, the sketched probabilities do not total up to

100.0%, because these firms are liquidated with a probability of 12.5% during the considered time span. The probability of being liquidated is nil for the start-up company financed by the type 2 CVC unit. This result shows that strategic considerations, such as expected post-acquisition synergies, may substantially affect the probability of the start-up company's survival.

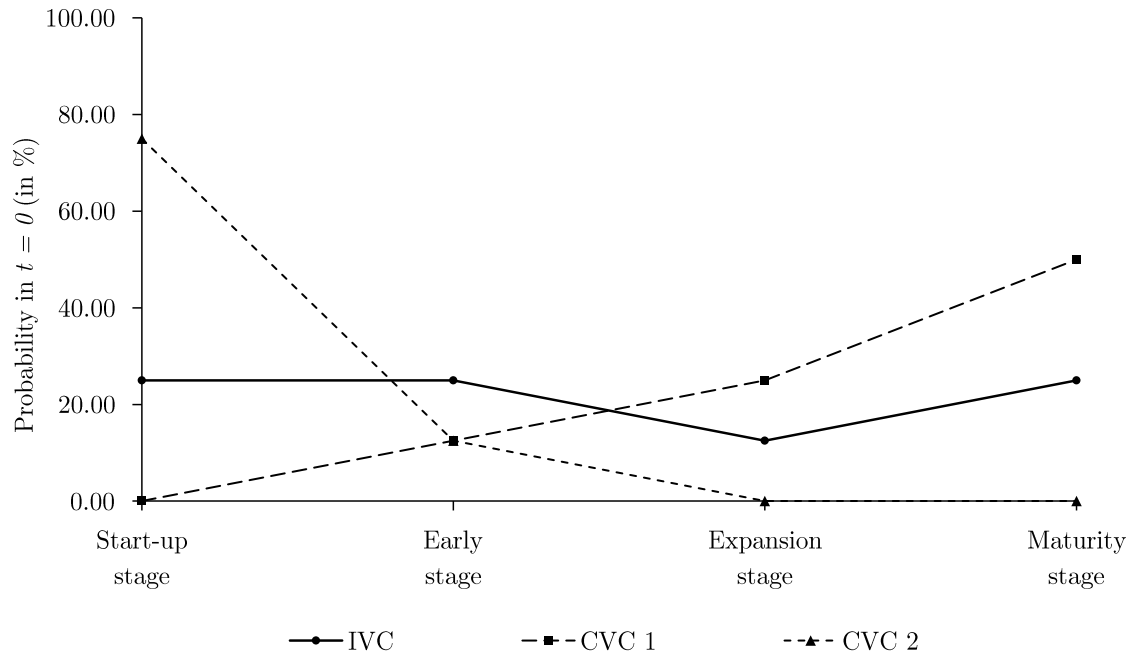


Figure 2.7: Probabilities of the development stage reached at $t = 4$ from the viewpoint in $t = 0$ (type 2 CVC unit considers business stealing).

Figure 2.7 shows that CVC financing may also be detrimental for the development of the start-up company. In this analysis, the parameter assumptions for the type 2 CVC unit are different. This investor type does not expect any post-acquisition synergies, but anticipates a business stealing effect with $c = 0.2$ instead. Figure 2.7 demonstrates that the type 2 CVC unit initially invests, but makes either no additional investment with a probability of 75.0% or one additional investment with a probability of 12.5% until $t = 3$. These results demonstrate that strategic considerations may induce corporate investors to hinder start-up companies from realizing their full market value (Hellmann, 2002). More generally, this result suggests that the development of start-up companies that receive CVC financing depends on how their business interacts with existing operations of corporate investors.

2.5 Discussion

2.5.1 Discussion of results

The main goal of this essay was to determine what inferences can be drawn from a real options-based model framework about the decision-making behavior of CVC units when they conduct staged investments in entrepreneurial firms. The research linking CVC investments to the real options theory is predominantly empirical (e.g., Basu et al., 2011; Ceccagnoli et al., 2018; Tong & Li, 2011), and lacks a model-based approach that furthers our theoretical understanding of the interconnection between these fields of study. In this essay, I set out to close this research gap and developed a formal decision framework, in which a CVC unit makes sequential investments in a start-up company. The CVC unit takes three strategic considerations into account that I derived from the literature: learning benefits (Schildt et al., 2005), business stealing effects (Hellmann, 2002), and expected post-acquisition synergies (Benson & Ziedonis, 2009, 2010).

The numerical analysis presented in the preceding section sheds new light on former empirical findings in the field of CVC research. I demonstrated that expected strategic benefits considerably increase the value that CVC units assign to new investment opportunities. In particular, I determined the conditions under which the valuation of CVC units exceeds the valuation of IVC investors and gave a possible explanation of the finding of Gompers and Lerner (2000) that CVC units invest at a premium. In the proposed model framework, learning benefits and expected post-acquisition synergies generally increase the value of investment opportunities from the CVC units' point of view, whereas business stealing effects decrease their value. I also elucidated the conditions under which the value assigned by CVC units falls below the valuation of IVC investors, namely when strategic disadvantages from investments outweigh the strategic benefits.

The model framework yields several additional insights into the interaction of central model parameters that merit further consideration. The results of the numerical analysis suggest that CVC units accept smaller equity stakes and are willing to bear higher implementation costs than IVC investors, as long as the strategic benefits from the investment are large enough. Also, they are willing to invest with a lower downside protection, i.e., in start-up companies with a lower liquidation value, than IVC investors if they generate sufficiently-large learning benefits and expected post-acquisition synergies. However, if the strategic disadvantages outweigh the advantages, e.g., due to an extensive business stealing effect, the opposite holds true and corporate investors may demand larger equity stakes than IVC investors, as well as invest only in start-up com-

panies with lower implementation costs and a higher liquidation value. Taken together, the model framework adds to the literature on the investment behavior of CVC units (e.g., Basu, Wadhwa, & Kotha, 2016; Chemmanur et al., 2014; Drover et al., 2017; Dushnitsky, 2012; Gompers & Lerner, 2000) by showing that strategic considerations of CVC units may affect both contractual terms, such as the equity stakes demanded, as well as the characteristics of the start-up companies in which they invest, e.g., in terms of implementation costs and liquidation value.

It has been widely recognized in the literature that start-up companies may benefit from receiving CVC financing, because this investor group could leverage the existing resources of their parent corporations (Drover et al., 2017; Dushnitsky, 2012). As opposed to previous studies, which focus on the benefits of these complementary resources for start-up companies (e.g., Ivanov & Xie, 2010), the proposed model framework suggests that they may also affect the initial valuation and subsequent decision-making behavior of CVC units. In particular, CVC units that are able to draw from their parent corporations' existing resources, such as laboratories and large-scale distribution channels, may expect lower implementation costs than IVC investors. It can be inferred from the model framework that this not only results in a higher initial valuation, but also in an increased likelihood of additional investments of CVC units that IVC investors would possibly not be willing to make.

The numerical analysis further demonstrates that strategic benefits may induce CVC units to make investments in start-up companies that bear higher technological risk, which IVC investors would not be willing to finance. An insight gained from this result is that IVC investors may wait for the technological risk to dissolve and thus defer the initial investment to a later point in time. This corresponds to the finding of Chemmanur et al. (2014) that CVC units invest earlier than IVC investors. A related consideration concerning technological risk is that CVC units may expect this kind of risk to be lower than IVC investors do. Specifically, CVC units may receive support from in-house engineers and have access to a unique testing infrastructure, which potentially decreases the perceived technological risk and increases the valuation of the investment opportunity. The same holds true for other private risks. For example, CVC units may get help from their parent corporations' legal departments in the event of lawsuits or leverage their parent corporations' political influence to prevent or spur regulatory change. Differences in the perception of such private risks may cause further deviation between the valuations made by CVC units and IVC investors.

It is crucial to understand that the decision rule regarding the technological risk introduced in Section 2.3.3 is based on the assumption that the CVC unit takes only the expected value of the investment into account, thus implying risk neutrality (Smith &

Nau, 1995). However, established corporations are often characterized by excessive risk aversion (Benner & Tushman, 2002), and their CVC units may also take the variance of the potential outcomes into account. When CVC units are more risk averse than IVC investors, the argument in the preceding paragraph reverses. In particular, there may be paradoxical situations in which IVC investors would be willing to invest in a focal start-up company, while CVC units refrain from investing, even if they expect a lower probability of technological failure and strategic advantages from the investment.

The results suggest that strategic considerations of established corporations and their CVC units also influence their investees' development progress and the likelihood of their potential liquidation across the considered periods. In particular, the strategic benefits expected from their investments may induce CVC units to propel their portfolio firms further towards the maturity stage. In the model framework, the CVC unit under consideration could profit from the further development of the start-up company, especially through additional learning benefits and higher levels of expected post-acquisition synergies. The opposite holds true when strategic disadvantages dominate and corporate investors refrain from further investments. My analysis indicates that CVC-backed start-up companies are most likely to go public when corporate investors expect high learning benefits and a low business stealing effect, as well as no post-acquisition synergies.

2.5.2 Theoretical implications

This essay makes several important theoretical contributions to the field of CVC research. My work complements the existing literature by developing a formal, real options-based model framework in order to investigate the decision-making behavior of CVC units in a staged-financing scenario. The proposed model framework and the subsequent numerical analysis deliver additional or alternative explanations for various former empirical findings. In particular, my analysis demonstrates when and why corporate investors (1) acquire equity shares in start-up companies at a premium (Gompers & Lerner, 2000) and (2) invest in start-up companies that bear higher risk (Chemmanur et al., 2014). Moreover, my work shows the conditions under which (3) CVC-backed start-up companies are more likely to go public and less likely to be liquidated as compared to IVC-backed start-up companies (Gompers & Lerner, 2000; Ivanov & Xie, 2010).

This essay extends our understanding of how central financial and strategic parameters of CVC investments interact and may provide a theoretical basis for future empirical studies. For example, it can be inferred from the analysis that the strategic bene-

fits derived from such investments may lead CVC units to accept lower equity stakes in start-up companies than IVC investors. They may also be willing to invest in entrepreneurial firms that face higher implementation costs or have a lower liquidation value. The model framework suggests that start-up companies profit from receiving CVC funding, as long as learning benefits and post-acquisition synergies incentivize corporate investors to provide additional capital and, thus, grow their portfolio firms' operations. Hence, my analysis contributes to the ongoing scholarly debate on how strategic objectives affect corporate investors' decision-making (e.g., Basu, Wadhwa, & Kotha, 2016; Chemmanur et al., 2014; Drover et al., 2017; Dushnitsky, 2012; Gompers & Lerner, 2000).

The model framework contains several theoretical implications for the interconnection of CVC units and IVC investors. Institutional VC investors often engage in syndicated investments, where several investors simultaneously invest smaller amounts in order to reduce the risk exposure (Gompers & Lerner, 2000; Sahlman, 1990). The involvement of CVC units in investment syndicates may increase the value of an investment opportunity from the perspective of IVC investors, especially when CVC units are able to reduce the implementation costs of their portfolio firms due to their access to the complementary resources of their parent corporations. It can also be inferred that the value of a joint investment opportunity may increase from the viewpoint of IVC investors, when corporate investors are able to reduce the technological risk.

This essay yields theoretical insights for related, non-equity-based forms of collaboration between established corporations and start-up companies, such as corporate accelerator programs (Weiblen & Chesbrough, 2015). In the proposed model framework, this is the case when the equity stake in the start-up company, captured by the parameter s , equals zero. The analysis suggests that established corporations may still be willing to bear the start-up company's implementation costs and accelerate its business if the learning benefits as well as the expected synergies derived from a later acquisition are high enough to compensate these costs. Next, the model framework can also be applied to internal corporate venturing activities where s equals one, i.e., when the innovative technology is fully-owned by the established corporation. Even in this scenario, the established corporation may not be able to realize the full market potential of the technology due to the cannibalization of existing operations, captured by the model parameter c , and the internal conflicts that may result.

2.5.3 Managerial implications

The research presented in this essay offers several practical implications that may guide the decision-making of corporate executives concerning CVC investments. Such investment activities are often seen skeptically by corporate decision makers. In this regard, a managing director of an innovative business unit of a large corporation listed in the German share index (DAX 30) made the following statement in an interview that I conducted during the elaboration of this research project:

“It does not make sense to invest in an external start-up company in which we only hold 10.0% of the equity and profits.”

My analysis demonstrates that this view is too simplistic and even inappropriate in many investment scenarios. Even if a start-up company destroys a fraction of the investing firm’s value, these losses may be offset by strategic benefits derived from these investments, such as the learning benefits and expected post-acquisition synergies treated in this essay. Corporate executives have to carefully weigh the benefits against the costs of CVC investments in order to approximate the value of new investment opportunities in a holistic manner. This essay demonstrates that strategic considerations may turn unattractive investment opportunities into attractive ones if corporate executives incorporate these additional gains in their decision-making. The decision framework may assist corporate executives in not only disentangling the various strategic consequences of their investments, but also the different kinds of risk involved in financing entrepreneurial firms, such as market risk and technological risk.

The analysis also yields important insights for entrepreneurs who consider receiving CVC or IVC financing. It demonstrates that even if the CVC unit’s parent corporation is a competitor, i.e., when there is a business stealing effect, the respective start-up company may nevertheless be better off receiving CVC financing. For example, when entrepreneurs expect corporate investors to have substantial learning benefits and, at the same time, to incur only moderate business stealing, CVC units may propel start-up companies further towards the maturity stage than IVC investors. Furthermore, my analysis delivers important insights for other investor groups, such as IVC investors or business angels. It explains why CVC units invest in certain entrepreneurial firms that other investor groups would not be willing to finance. The essay not only sheds light on situations in which co-investing with CVC units is favorable (e.g., due to reduced implementation costs), but also demonstrates when partnering with CVC units may turn out unfavorable (e.g., when CVC units expect a business stealing effect).

2.5.4 Limitations, future research, and conclusion

The proposed model framework is subject to some limitations that need to be discussed. Institutional VC investors conduct complex investment decisions under consideration of additional factors that the proposed model framework does not capture explicitly. For example, prior research has found that the characteristics of entrepreneurial teams, such as their experience in a relevant industry, play a crucial role in the investment decisions of VC investors (Franke, Gruber, Harhoff, & Henkel, 2008). Next, I only examined situations where one investor has the opportunity to invest in the start-up company, which allowed me to concentrate on main differences between CVC units and IVC investors. However, VC investments are often syndicated as discussed earlier. A natural progression of the model framework is to consider joint investments of CVC units with IVC investors, or even with other CVC units. Another extension of the model is to consider situations in which CVC units and IVC investors compete for investment opportunities. One potential consequence of competitive VC environments is that business stealing effects are no longer relevant to CVC units, because the entrepreneurial firm will receive financing from IVC investors and, thus, disrupt the industry anyway. Another progression of this work is to consider portfolio effects (e.g., Lin & Lee, 2011; Yang et al., 2014), i.e., to look at multiple new or existing investments and observe the decision outcomes of CVC units and IVC investors. Moreover, I concentrated on CVC investments and later acquisitions as the only two forms of firm activities (Dushnitsky, 2012). Future formal work drawing from the real options theory could analytically investigate the link between CVC and strategic alliances (e.g., Van de Vrande & Vanhaverbeke, 2013).

I took the number as well as the level of the four possible capital infusions as given, applying a cost-based approach to these investments (e.g., Bergemann et al., 2011). Future formal work could model the level of the single investments as the result of ongoing renegotiations between CVC units and entrepreneurs (e.g., Guo et al., 2015). Furthermore, my analysis is based on the assumption that there is an existing market in which the start-up company operates. However, start-up companies often tap into new markets of unknown size and with unknown risk, which may render the respective model parameters immeasurable in practice (Brandão & Dyer, 2005). The same applies to the model parameters that capture the strategic considerations of CVC units, namely learning benefits, business stealing effects, and post-acquisition synergies (Asel et al., 2015). Although the literature does contain some attempts to approximate the strategic value of CVC investments (e.g., Bassen, Blasel, Faisst, & Hagenmüller, 2006), existing approaches are rather vague and fail to deliver metrics that enable corporate executives to assign a financial value to these indirect, strategic benefits. Lastly, I only

qualitatively discussed possible implications of the risk aversion of CVC units in order to keep the complexity of the model framework manageable. Future research may further investigate the implications of risk aversion in similar model setups. The numerical analysis yields testable predictions that may serve as a foundation for future research in this field, for example, that CVC units accept smaller equity stakes and increasing implementation costs if the strategic benefits derived from their investments increase.

This work complements the existing literature by looking at CVC through the lens of the real options theory. Previous research into CVC has recognized the real options character of CVC investments. However, the literature connecting CVC and the real options theory is predominantly empirical and lacks a formal, model-based approach. I developed a model framework that combines ROA with features derived from decision tree analysis. The model framework incorporates three strategic considerations of corporate investors derived from the literature: learning benefits, business stealing effects, and expected post-acquisition synergies. Taking into account the strategic objectives of CVC units, I examined their decision-making in a staged-financing setting. My analysis not only delivers explanations for former empirical findings in the context of CVC, but also offers multiple testable predictions that may inform future empirical research.

Chapter 3

What Drives Entrepreneurs' Willingness to Partner With Corporate Venture Capital Units? The Scope of Managerial Action

Abstract

Scholars mostly focus on industry- and firm-level parameters when examining start-up companies that opt for corporate venture capital (CVC) financing. In doing so, they omit the individuals who actually make the financing decisions, namely entrepreneurs with diverse backgrounds and distinct personalities. This essay sheds light on the subtle dynamics in individual entrepreneurs' decision behavior when considering taking financing from corporate investors. Based on a comprehensive review of the literature, I put forward six central attributes of CVC units and test their effect on entrepreneurs' willingness to partner with this investor type. Using data on $N = 992$ assessments made by $N = 62$ entrepreneurs collected in a metric conjoint experiment and applying hierarchical linear modeling (HLM), I demonstrate that the proposed attributes strongly affect the decision-making of entrepreneurs. Entrepreneurs are considerably more willing to partner with CVC units that provide them with complementary market- and R&D-related resources. Whether CVC units employ experienced investment managers or not has a significantly lower impact on their willingness to partner. Using the psychological constructs of entrepreneurial self-efficacy and risk propensity, I also found direct and moderating effects of entrepreneurs' personal characteristics on their willingness to partner. This essay contributes to the literature by extending our knowledge on how the specific attributes of CVC units influence the decisions of entrepreneurs when dealing with this investor group. It also informs managerial practice by providing corporate executives with guidance on how to configure viable CVC units, a key issue faced by established corporations today.

Keywords: Corporate venture capital, dynamic capabilities, personal characteristics

JEL: G24, G41, L22, L26, M13, O32

Author: Julian Ludat

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3.1 Introduction

As a crucial component of their innovation strategies, established corporations around the globe closely monitor the activities of young, innovative start-up companies and frequently engage in different forms of collaboration with them (Weiblen & Chesbrough, 2015). Today, corporate venture capital (CVC) represents an increasingly used instrument of incumbent firms to partner with entrepreneurial companies and obtain insights into their innovative technologies and business models (Alvarez-Garrido & Dushnitsky, 2016). CVC refers to minority equity investments of established corporations in independent, external start-up companies that are usually conducted by dedicated departments or fully-owned subsidiaries (Dushnitsky & Lenox, 2005a; Gompers & Lerner, 2000).

Accounting for more than 20.0% of the global venture capital (VC) investment volume today (BCG, 2018; CB Insights, 2017), CVC has become a multi-billion dollar investment business with many prominent players involved, including Google, Intel, and General Electric being among the most active investors in recent years (CB Insights, 2017). Alongside the steep rise in yearly CVC investment volumes, a considerable amount of academic research has been published on this subject (Drover et al., 2017; Dushnitsky, 2012; Narayanan, Yang, & Zahra, 2009). The research to date has focused on industry- and firm-level effects in the context of CVC. For example, previous studies have demonstrated positive effects of such equity-based collaborations on the innovation outputs (Chemmanur et al., 2014; Dushnitsky & Lenox, 2005a) and firm values (Dushnitsky & Lenox, 2006; Ivanov & Xie, 2010; Park & Steensma, 2012) of the involved established corporations and start-up companies.

Surprisingly little attention has been paid to the entrepreneurs operating the entrepreneurial ventures with whom established corporations seek to collaborate. The pivotal role of entrepreneurs in shaping their young, growing organizations (Arthurs & Busenitz, 2006) and, specifically, in selecting outside investors (e.g., Drover, Wood, & Fassin, 2014), makes them a crucial object of study. Prior research has not explicitly treated how entrepreneurs decide whether or not to partner with CVC units in concrete financing scenarios (Basu, Wadhwa, & Kotha, 2016). The purpose of this research is to advance the understanding of the subtle dynamics in individual entrepreneurs' decision-making when considering to receive financing from corporate investors. CVC units stand out in the VC market due to their unique characteristics that arise from their affiliation with an established corporation (e.g., Gompers & Lerner, 2000; Ivanov & Xie, 2010). Currently, it is only poorly understood how these unique characteristics affect entrepreneurs in their decision-making (Basu, Wadhwa, & Kotha, 2016).

On the one hand, CVC units are often embedded in their parent organizations (Weiblen & Chesbrough, 2015), which may, among other issues, result in a lack of flexibility and unclear resource commitment (Chemmanur et al., 2014), a bias towards the strategic interests of their parent corporations (Ivanov & Xie, 2010), as well as the inability to attract experienced investment managers due to missing high-powered compensation schemes (Gompers & Lerner, 2000). On the other hand, this investor group may also provide start-up companies with unique opportunities by giving them access to vital resources of their parent corporations, such as large-scale marketing and distribution channels as well as technical know-how (Chemmanur et al., 2014), which may enhance entrepreneurs' propensity to accept a financing offer from them. Moreover, entrepreneurs may perceive CVC financing as an exit opportunity, as established corporations frequently acquire former portfolio companies (Benson & Ziedonis, 2009, 2010); an opportunity that other investors, such as independent venture capital (IVC) investors or angel investors, do not offer. In summary, partnering with established corporations via CVC yields certain risks and opportunities for entrepreneurs (e.g., Ivanov & Xie, 2010), rendering the exact configuration of CVC units a potentially crucial factor for entrepreneurs' decision-making. Therefore, the research question is the following: Which factors drive entrepreneurs' willingness to partner with CVC units?

To address this research question, I distinguish between factors on the supply side and factors on the demand side of CVC. With regard to the supply-side factors, I argue that the ability of established corporations to set up viable CVC units that meet the specific demands of the entrepreneurial ecosystem, and to exploit their resource- and capability-based advantages in the start-up financing context, is rooted in their dynamic capabilities (Teece et al., 1997). The dynamic capabilities view of the firm evolves from the resource-based view (RBV) (Wernerfelt, 1984) and discusses how firms sustain competitive advantages in dynamic markets (Eisenhardt & Martin, 2000). Following the initial definition of Teece et al. (1997), dynamic capabilities refer to a "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (p. 260). Scholars view dynamic capabilities as 'higher-order' capabilities (Teece, 2012; Winter, 2003) that allow firms to alter their operating routines and resource configuration (Zahra, Sapienza, & Davidsson, 2006) in order to cope with external change. In the context of CVC, I suggest that established corporations must deploy their dynamic capabilities to optimally configure their CVC units, i.e., to effectively increase entrepreneurs' willingness to partner with them.

Based on a review of the CVC literature and a preliminary survey that I conducted as part of this essay, I argue that an optimal configuration manifests in CVC units' (1) independence from their parent corporations' structures and operational procedures,

(2) ability to consistently act in the best interest of their investees, and (3) adequate incentive schemes that allow them to attract experienced investment managers. CVC units also need to be able to offer start-up companies access to (4) market-related resources, such as marketing and distribution channels, and (5) R&D-related resources, such as technical know-how. Moreover, entrepreneurs most likely prefer CVC units that are integrated in their parent corporations' mergers and acquisitions (M&A) activities, i.e., by supplying other corporate units with potential acquisition targets, thus (6) providing entrepreneurs with an exit opportunity in the form of a later acquisition by their respective parent corporation. I hypothesize that all of these attributes of CVC units (1-6) positively affect entrepreneurs' willingness to partner with them.

Although the exact configuration of CVC units is expected to significantly alter entrepreneurs' willingness to partner, it does not account for intrinsic factors that affect the preferences of entrepreneurs, i.e., for demand-side factors. In particular, little is known to date about how entrepreneurs' personal characteristics influence their propensity to opt for CVC financing, even though previous studies have demonstrated that personal characteristics play a vital role in entrepreneurial decision-making (e.g., Domurath & Patzelt, 2016; Holland & Shepherd, 2013) or more generally, in entrepreneurial achievements (e.g., Ciavarella, Buchholtz, Riordan, Gatewood, & Stokes, 2004). This study sets out to fill this research gap and investigates to what extent entrepreneurs' personal characteristics affect their willingness to partner with CVC units. In particular, I test for the direct and moderating effects of two psychological constructs deemed relevant in the context of CVC, namely entrepreneurial self-efficacy (ESE) (McGee et al., 2009; Schmutzler, Andonova, & Diaz-Serrano, 2018) and risk propensity (Palich & Bagby, 1995; Stewart & Roth, 2001).

ESE refers to individuals' confidence in their capacity to accomplish entrepreneurial tasks (McGee et al., 2009) and represents one of the key constructs used to explain the antecedents and outcomes of entrepreneurial behavior (Newman, Obschonka, Schwarz, Cohen, & Nielsen, 2019). Entrepreneurs showing a high level of ESE are highly confident about their ability to successfully launch their entrepreneurial ventures on their own (McGee et al., 2009). This may systematically affect their willingness to accept outside help in the form of CVC financing. The construct of risk propensity is employed in this context to investigate whether risk-averse entrepreneurs are more willing to partner with CVC units than entrepreneurs with a high risk propensity. Established corporations are associated with high levels of predictability and accountability (Hannan & Freeman, 1984), or as Benner and Tushman (2002) put it, with a "bias towards certainty and predictable results" (p. 239). These are features that may especially appeal to more risk-averse entrepreneurs when considering to partner with corporate

investment arms.

I conducted a metric conjoint experiment to test the hypotheses. Conjoint experiments represent an increasingly used instrument in entrepreneurship research and have been applied in a wide range of research settings (Lohrke et al., 2010), including research on how entrepreneurs select investors (e.g., Drover et al., 2014). Like other experimental designs, conjoint experiments allow researchers to gather data on individuals' decision-making *at the very moment* the decisions are made, thus avoiding post hoc rationalization and other issues often encountered with post hoc methods, like conventional surveys (Behrens & Patzelt, 2016; Dawson, 2011). Using data on $N = 992$ investor assessments made by $N = 62$ entrepreneurs and hierarchical linear modeling (HLM) analysis, I found support for my hypotheses.

First, the results show that the configuration of CVC units significantly influences entrepreneurs' willingness to partner with them. The ability of CVC units to provide start-up companies access to market-related resources of their parent corporations has the strongest effect on entrepreneurs' willingness to partner with them, followed by their ability to provide R&D-related resources. Surprisingly, whether CVC units employ experienced investment managers or not is of significantly lower importance for entrepreneurs. Second, my results reveal that the proposed personal characteristics of entrepreneurs affect their propensity to partner with CVC units; that is, entrepreneurs showing higher levels of ESE or a higher risk propensity are, as hypothesized, significantly less willing to partner with CVC units. Moreover, I found that entrepreneurs with a high degree of ESE place distinctly more emphasis on the independence of CVC units from their parent corporations' operational procedures and strategic interests, thus demonstrating moderating effects of ESE.

This study makes several noteworthy contributions to the literature. It extends the knowledge of how the unique attributes of CVC units affect entrepreneurs' decision-making in concrete financing scenarios (Basu, Wadhwa, & Kotha, 2016). It also sheds light on the role of personal characteristics in entrepreneurial decisions regarding this investor group, and contributes to the growing body of literature on the role of ESE in entrepreneurial behavior (e.g., Newman et al., 2019; Schmutzler et al., 2018). In addition, my research informs managerial practice by providing corporate executives with guidance for optimizing the supply side of CVC (i.e., the configuration of CVC units), and by highlighting subtle factors on the demand side that are beyond the scope of managerial action (i.e., personal characteristics of entrepreneurs).

The remainder of this paper is structured as follows. Section 3.2 introduces the dynamic capabilities view as the conceptual framework of this study, which is the basis for the hypotheses development in Section 3.3. Section 3.4 explains the research method that

was chosen to test the hypotheses. Section 3.5 presents the results, which are then discussed in Section 3.6.

3.2 Conceptual framework

Established corporations aim to operate their start-up financing activities similarly to the model of IVC investors, i.e., traditional, profit-maximizing venture capital (VC) firms (Chesbrough, 2000; Weiblen & Chesbrough, 2015). In particular, they intend to equip their CVC units with appropriate organizational conditions and resources in order to meet the requirements of the dynamic VC market (Weiblen & Chesbrough, 2015). Their ability to adapt to this external environment (Teece, 2007), and to configure competitive CVC units with whom entrepreneurs are willing to partner, is thereby anchored in their dynamic capabilities (Teece et al., 1997). Originally, the concept of dynamic capabilities emerged from the resource-based view (RBV) of the firm (Penrose, 1959; Wernerfelt, 1984), which regards firms as bundles of resources, i.e., accumulations of tangible and intangible assets (Wernerfelt, 1984).

The RBV suggests that competitive advantages arise when firms possess resources that are immobile and unevenly distributed across competing firms (Barney, 1991; Mahoney & Pandian, 1992; Wernerfelt, 1984). According to Barney (1991), these resources must be valuable, rare, inimitable, and non-substitutable (so-called ‘VRIN’ properties) to enable sustained competitive advantage. While the RBV had a great impact on strategic management and related research areas in the 1990s (Wernerfelt, 1995), it has also been subject of much controversy (Kraaijenbrink, Spender, & Groen, 2010). The RBV has been criticized for representing a static view of the firm that fails to take account of the continually changing external environment (Eisenhardt & Martin, 2000). Scholars questioned if sustained competitive advantage can really exist (Kraaijenbrink et al., 2010), especially in “situations of rapid and unpredictable change” (Eisenhardt & Martin, 2000, p. 1106).

Based on these and related concerns, scholars set out to advance the RBV towards a more holistic view of the firm, resulting in the emergence of the dynamic capabilities view (Eisenhardt & Martin, 2000; Teece et al., 1997). Teece et al. (1997) initially described dynamic capabilities as a “firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (p. 260). Over the past decades, the dynamic capabilities view has informed numerous studies in all major disciplines of business research (Barreto, 2010), including the field of entrepreneurship research (Arthurs & Busenitz, 2006; Zahra et al., 2006). While the RBV emphasizes the *possession* of VRIN resources as outlined above, the dynamic

capabilities view deems the right *employment* of resources, i.e., the “capacity of an organization to purposefully create, extend, or modify its resource base” (Helfat et al., 2007, p.260), at the core of any competitive advantage. A substantial debate exists on the exact nature of dynamic capabilities (Barreto, 2010; Wang & Ahmed, 2007). Some scholars view them as abilities (e.g., Helfat et al., 2007; Teece et al., 1997; Zahra et al., 2006), highlighting the pivotal role of firms’ managers (Teece, 2012), whereas others see them as processes or routines (e.g., Eisenhardt & Martin, 2000). Despite the discrepancies about their exact nature, scholars widely agree that dynamic capabilities are ‘higher-order’ capabilities (Winter, 2003), i.e., those capabilities that allow firms to change their ‘ordinary’ operating routines and resources (e.g., Zahra et al., 2006). Hence, dynamic capabilities are especially relevant when firms undergo change and adjust their organizations due to external pressures (e.g., Teece, 2012; Teece et al., 1997).

Surprisingly few studies explicitly connect the dynamic capabilities view with the topic of CVC (e.g., Dushnitsky & Lenox, 2005b; Lee & Kang, 2015), although these topics are inextricably linked to each other. In innovation- and knowledge-driven markets (Volberda, Foss, & Lyles, 2010), incumbent firms conduct CVC investments in order to learn about emerging technologies and business models (Dushnitsky & Lenox, 2005a). For example, MacMillan et al. (2008) found that established corporations run start-up financing programs mainly to obtain a ‘window’ on new technologies and markets as well as to develop new products, among other strategic objectives. Established corporations use CVC investments, and the resulting ties with entrepreneurial firms, to adjust their organizations to the fast-paced external innovation environment (Lee & Kang, 2015; Weiblen & Chesbrough, 2015), which corresponds to the basic premise of the dynamic capabilities view, namely that firms must take actions that “address, and possibly shape, rapidly changing business environments” (Teece, 2012, p. 1395) in order to remain competitive over time.

CVC units may have certain deficiencies, which render them unattractive to entrepreneurs. These deficiencies relate to the corporate procedures in which CVC units may be involved (Chemmanur et al., 2014), the uncertainty about the exact nature of their objectives (Ivanov & Xie, 2010), and the potential lack of VC-related competence (Gompers & Lerner, 2000). However, they may also offer unique opportunities to entrepreneurs, such as access to complementary resources (Chemmanur et al., 2014) as well as an exit opportunity (Benson & Ziedonis, 2009, 2010). In order to reduce or eliminate their organizational shortcomings and exploit their resource- and capability-based advantages, established corporations need to employ their dynamic capabilities; that is, they need to adjust their organizations, including their operating routines and

resource configuration (Zahra et al., 2006), to the specific requirements of the entrepreneurial ecosystem. Using the notion of Teece (2007), this enables them “to seize the opportunity” (p. 1319) to benefit from the external innovation environment.

Thus far, this section focuses on the dynamic capabilities that corporations require to optimize the supply side of their CVC programs and potentially increase entrepreneurs’ willingness to partner with them. These factors are all within the scope of managerial action, because they can be altered given that established corporations possess and adequately employ dynamic capabilities. The purpose of this essay is to highlight additional factors on the demand side that established corporations cannot influence. Thus, this essay does not one-sidedly examine established corporations’ opportunities to attract entrepreneurs, but also seeks to identify boundaries of the scope of managerial action. One of the subtle factors that is not controllable by corporations and their CVC units are the personal characteristics of the entrepreneurs with whom they seek to collaborate. Prior studies have demonstrated that entrepreneurs’ personal characteristics influence their decisions (e.g., Domurath & Patzelt, 2016; Holland & Shepherd, 2013), making them a crucial factor to investigate in the context of CVC. In this essay, I use the constructs of entrepreneurial self-efficacy (ESE) (McGee et al., 2009; Schmutzler et al., 2018) and risk propensity (Palich & Bagby, 1995; Stewart & Roth, 2001) to examine whether entrepreneurs’ personal characteristics systematically influence their willingness to partner with CVC units.

The next section discusses in detail how established corporations’ dynamic capabilities affect their ability to build appropriate organizational conditions for CVC units and to leverage their resource- and capability-based advantages in the context of start-up financing (Keil, 2004). Furthermore, it describes why the exact configuration of CVC units matters for entrepreneurs as well as motivates the main hypotheses of this essay.

3.3 Hypotheses

3.3.1 Building appropriate organizational conditions for CVC units

Creating the organizational conditions for a dedicated CVC unit is a potentially challenging task for established corporations (e.g., Asel et al., 2015; Winters & Murfin, 1988). The first organizational issue they have to cope with relates to their inherent rigidities (Arthurs & Busenitz, 2006). To start with, social ecology scholars have argued that established corporations are esteemed by their stakeholders for their accountability and reliability and, therefore, develop organizational structures that promote these characteristics (Hannan & Freeman, 1984). However, these organizational structures

are often characterized by extensive formalization and bureaucracy (Hill & Rothaermel, 2003), resulting in lengthy processes and routines (Hannan & Freeman, 1984). This may in an extreme case, lead to ‘structural inertia’, a state in which established corporations are too inflexible to adapt to changes in their environments and pursue new opportunities (Arthurs & Busenitz, 2006; Hannan & Freeman, 1984).

In a similar vein, strategic management scholars have reasoned that established corporations commonly devote great attention to sustaining their core capabilities, i.e., those capabilities that “differentiate a company strategically” (Leonard-Barton, 1992, p. 111) and bring success at a given point in time. As a result, core capabilities become an inherent part of their organizations that are anchored in their central constituents, such as their values and skills (Leonard-Barton, 1992). However, these core capabilities may turn into ‘core rigidities’ in situations of radical change, i.e., when core capabilities become obsolete and organizations need to transform due to external pressures (Leonard-Barton, 1992).

As opposed to established corporations, start-up companies are unlikely to show such inertial forces and rigidities; they are only at the start of building their resources and capabilities in the pursuit of an entrepreneurial opportunity and enjoy greater flexibility in shaping their nascent organizations (Arthurs & Busenitz, 2006). Entrepreneurs and their start-up companies may come into contact with the rigid organizational structures and processes of incumbent firms when partnering with their CVC investment arms (Thornhill & Amit, 2000). In the early days of CVC research, Siegel et al. (1988) warned that established corporations are “nonentrepreneurial relative to the way they make decisions and operate” (p. 234). Hence, start-up companies may encounter time-consuming operational procedures, such as lengthy approval processes, information requirements, and documentation obligations (e.g., Bleicher & Paul, 1987; Chesbrough, 2000; Siegel et al., 1988). This may adversely affect their core strength, the ability to quickly react to changing consumer needs and to swiftly adjust their business models to new market demands (Rode & Vallaster, 2005). In this regard, an entrepreneur made the following statement in the preliminary survey that I conducted as part of this essay:

“The corporate structure of the CVC unit may impede the start-up company’s agility, which may—more or less—lead to its failure.”

This discrepancy in the flexibility, or agility, of established corporations and start-up companies may reduce entrepreneurs’ willingness to partner with CVC units and make their organizational configuration a crucial aspect. In a recent article on the interconnection of dynamic capabilities and organizational agility, Teece, Peteraf, and Leih (2016) proposed “reengineering rule-bound hierarchies” (p. 22) as one way for estab-

lished corporations to create or preserve agility within their organizations. In particular, the authors suggested self-organizing entities and decentralized decision-making as effective means of creating agile corporate units. As part of their dynamic capabilities, established corporations must therefore “seize the opportunity” (Teece, 2007, p. 1319) and provide their CVC units with the necessary independence from corporate structures and routines, thereby reducing the level of hierarchy and bureaucracy inhering these units (Teece et al., 2016).

Furthermore, self-organization reduces CVC units’ dependence on the resource allocation mechanisms of their parent corporations (Chemmanur et al., 2014; Siegel et al., 1988) and, thus, lowers the probability of ad-hoc reallocations of resources (Asel et al., 2015; Benson & Ziedonis, 2009; Ernst, Witt, & Brachtendorf, 2005). As a result, entrepreneurs may face less uncertainty that crucial resources, such as the investment managers who support their start-up companies, may be withdrawn from CVC units at some point in time during the investment period (Benson & Ziedonis, 2009). Based on these considerations, I argue that entrepreneurs prefer CVC units that are operationally independent from their parent corporations (henceforth also referred to as ‘operational autonomy’) and put forward the following hypothesis:

H1a: The more established corporations provide their CVC units with operational autonomy, the more entrepreneurs are willing to partner with CVC units.

The second organizational issue that established corporations face when building appropriate organizational conditions for CVC units is how to deal with conflicting strategic interests. CVC units may find themselves in unfavorable situations, in which the interests of portfolio companies do not comply with those of their parent corporations (Hardymon et al., 1983; Hellmann, 2002; Ivanov & Xie, 2010). In these situations, corporate managers may interfere in the operations of CVC units, aiming to realign the strategic decisions of portfolio companies with corporate interests (Benson & Ziedonis, 2009; Chesbrough, 2000; Souitaris & Zerbinati, 2014).

Such strategic conflicts may arise when portfolio companies decide to enter the parent corporations’ markets with a substitute product (Hellmann, 2002), or when the start-up company plans to also collaborate with competitors of the parent corporations (Ivanov & Xie, 2010; Park & Steensma, 2012). Conflicts of interest are also likely to arise when start-up companies refuse to disclose critical knowledge about their inventions, which corporate units seek to access through the investment relationship (Dushnitsky & Lenox, 2006; Dushnitsky & Shaver, 2009; Ivanov & Xie, 2010; Katila et al., 2008). When asked for major drawbacks of collaborating with CVC units, an entrepreneur stated in the preliminary survey:

“As strategic investors, they exert influence on the [start-up company’s] decision-making, dependent on the strategic interests of their parent corporations.”

In order to increase entrepreneurs’ willingness to partner, and attract prospective investment opportunities, CVC units need to consistently act in the interests of their investees and must, hence, be protected against strategic interventions from corporate executives with divergent interests (Basu, Phelps, & Kotha, 2016; Ernst et al., 2005; Hardyman et al., 1983). In this context, Hardyman et al. (1983) postulated that “well-run CVC units function autonomously, as if they were independent operations” (p. 118), thus helping CVC units to reduce entrepreneurs’ concerns about a potential bias towards the strategic interests of their parent corporations. Same as for achieving agility as described before (H1a), established corporations need to employ their dynamic capabilities, leading to the “reengineering [of] rule-bound hierarchies” (Teece et al., 2016, p. 22) and the creation of self-organizing entities, which carry out their decisions independently, thus allowing them to build credibility.

It is crucial to note that the self-organization of CVC units, and the associated higher degree of agility, do not automatically imply the absence of a bias towards the interests of their parent corporations. For example, when a corporate executive is managing both a CVC unit and an internal R&D project, problems arising from divergent interests cannot be completely ruled out (Dushnitsky & Shaver, 2009), independently of the level of agility of the respective CVC unit. In other words, self-organization is a necessary, though not sufficient step in configuring viable start-up financing programs; established corporations also need to assess, on a case-by-case basis, *who* gets involved in their CVC units, thus reducing the risk of spill-over effects from core business operations. This can be seen as a recourse configuration at the micro level (e.g., Teece, 2007), as it implies the ‘handpicked’ selection of individuals that get involved in the respective CVC unit. Based on the considerations above, I argue that entrepreneurs are more willing to partner with CVC units that are not biased towards the strategic interests of their parent corporations (henceforth also referred to as ‘strategic autonomy’). This leads to the following hypothesis:

H1b: The more established corporations provide their CVC units with strategic autonomy, the more entrepreneurs are willing to partner with CVC units.

The third organizational issue that established corporations encounter when configuring CVC units is how to attract and retain experienced investment managers that are trained in supporting entrepreneurial firms and acquainted with the peculiarities of the VC business (Block & Ornati, 1987; Gompers & Lerner, 2000). Established corporations

usually aim at maintaining pay equality when setting up CVC units (Block & Ornati, 1987) to avoid resentment within their organizations (Dushnitsky & Shaver, 2009; Sykes, 1992). For example, employees in internal R&D units may be displeased by higher compensations in CVC units. As a result, many CVC units are often not able to offer their investment managers the high-powered incentive schemes that prevail in the VC market (Gompers & Lerner, 2000; Ivanov & Xie, 2010), which may result in an adverse selection situation, where CVC units are only able to attract and retain the less experienced and talented investment managers (Gompers & Lerner, 2000).

This potentially has a detrimental effect on entrepreneurs' willingness to partner with CVC units, as more experienced investment managers are usually associated with higher skills (e.g., Barry, Muscarella, Peavy, & Vetsuypens, 1990) as well as large social networks (Alexy, Block, Sandner, & Ter Wal, 2012). The potentially large social networks of experienced investment managers especially enable them to provide entrepreneurs with strategically relevant market information and connect them with other investors and resources in the entrepreneurial ecosystem (e.g., Alexy et al., 2012; Hsu, 2006; Rind, 1981; Winters & Murfin, 1988). Supporting the relevance of this issue, an entrepreneur expressed the following concern regarding a potential collaboration with a CVC unit in the preliminary survey:

“The investment managers should have been employed at IVC funds before, at least the one who supervises my company.”

The recruitment of skilled personnel from the VC market requires an adaptive firm behavior, namely the adjustment of compensation schemes to the standards of the VC market (Hardymon et al., 1983) and consequently, necessitates established corporations to employ their dynamic capabilities (Wang & Ahmed, 2007). Self-organization and the resulting organizational independence (Teece et al., 2016), may facilitate the installment of appropriate compensation schemes in CVC units (Dushnitsky, 2012; Hardymon et al., 1983). However, established corporations may still incur resentment in other corporate units that are closely connected with CVC units, such as internal R&D units.

A possible approach to deal with this, is the alignment of incentives within these ‘nearby units’ with those of CVC units (zu Knyphausen-Aufseß, 2005). Supporting this argument, Teece (2007) sees proper incentive structures as an important precondition to seize opportunities *inside* firms, and proposes the “reward[ing] of creative action” (p. 1333) as an effective means to foster internal innovation. Hence, the question whether CVC units should have reward-based compensation schemes should be reversed to why ‘nearby units’ do not employ these schemes. Overall, I argue that the recruitment

of experienced investment managers (henceforth also referred to as ‘VC experience’) through redesigned compensation schemes pays off in the form of a greater willingness among entrepreneurs to partner with CVC units. The resulting hypothesis is:

H1c: The more VC-related experience CVC units’ investment managers have, the more entrepreneurs are willing to partner with them.

3.3.2 Leveraging complementary resources and organizational capabilities

Established corporations have built and acquired vast amounts of tangible and intangible resources over time, yet often lack new ideas and inventions to fully exploit their resource advantage (Arthurs & Busenitz, 2006). Entrepreneurs and their start-up companies face the opposite problem: They have identified a promising entrepreneurial opportunity, but lack the tangible and intangible resources to implement them (Arthurs & Busenitz, 2006). Next to other external corporate venturing modes, such as corporate accelerators (e.g., Weiblen & Chesbrough, 2015), CVC investments can be seen as a way of bringing together these two complementary needs. In an ideal configuration, CVC units act as ‘resource brokers’: Being part of the intra-firm networks of their parent corporations (Simsek, Lubatkin, & Floyd, 2003), they channel start-up companies to the right units within their parent organizations, thereby providing these units with insights into the innovative technologies and business models of these start-up companies (Basu, Phelps, & Kotha, 2016; Keil, Autio, & George, 2008). In this essay, I differentiate between two kinds of resources that start-up companies may access by collaborating with CVC units, namely market-related and R&D-related resources (e.g., Chemmanur et al., 2014).

To begin with, market-related resources comprise those resources that help start-up companies to commercialize their innovative technologies and business models and to scale up their operations, ranging from access to pilot customers at an early stage to the co-utilization of large-scale marketing and distribution channels at later stages (Ivanov & Xie, 2010). The integration of start-up companies in the marketing and sales activities of established corporations may also serve as a quality signal and enhance their credibility (Wang & Wan, 2013), because they become associated with the brand name of the respective incumbent firm (Chemmanur et al., 2014), which in turn can potentially trigger an ‘endorsement’ effect (Stuart, Hoang, & Hybels, 1999). The following statement of an entrepreneur made in the preliminary survey supports this view:

“Collaborating with a CVC unit may give us access to strategically relevant sales markets. Especially, in the business-to-business market, the good reputation of a strategic CVC unit may help us to significantly shorten the

sales cycle.”

The second kind of resources relates to the R&D-related resources of established corporations from which start-up companies may benefit when collaborating with CVC units. These resources allow start-up companies to further develop, or optimize, their innovative technologies and business models. These resources include access to technical expertise and scientific support (MacMillan et al., 2008), product development assistance and testing infrastructure (Park & Steensma, 2012), as well as data and information (Ivanov & Xie, 2010). In light of this, an entrepreneur posed the following question in the preliminary survey when asked for the most important aspects of CVC financing:

“Does the start-up company have access to the technical know-how of the parent corporation?”

The capacity of established corporations to provide start-up companies with market-related and R&D-related resources builds on their ability to recombine internal with external resources (or competences), a crucial element of the dynamic capabilities view (Teece et al., 1997). At an abstract, strategic level, this requires established corporations to use their adaptive capability (Chakravarthy, 1982), namely their strategic flexibility in applying their resources (Sanchez, 1995). The inherent flexibility of their resources allows firms to align them to new market demands (Wang & Ahmed, 2007), and to recombine them with external resources. At a less abstract, operational level, the recombination of external resources (e.g., new technologies developed by entrepreneurial firms) with internal resources (e.g., knowledge of internal engineers) may, however, be difficult to implement. Corporate units are usually inclined to narrowly focus on their core business operations and assets due to a lack of incentive to do otherwise (Teece, 2007). According to Teece (2007), this may lead to situations in which “managers may not successfully address opportunities or potential innovations even when they do recognize them” (p. 1335). Corporate personnel may neither have the incentives nor the time to lend support to *external* entrepreneurial firms.

This requires corporate executives to redesign deeply rooted decision-making routines based on appropriate incentives (Teece, 2007), which reward collaborations with portfolio companies of their parent corporations (Ernst et al., 2005). Such redesigned incentive schemes could, for example, entail the rewarding of corporate units based on the number of portfolio companies they supported in a specific period (e.g., Bassen et al., 2006; Battistini et al., 2013). In an ideal setting, this enables CVC units to act as effective ‘resource brokers’ between corporate units and start-up companies, which I assume to substantially increase entrepreneurs’ willingness to partner with them. The

related hypotheses are:

H2a: When CVC units are able to give start-up companies access to market-related resources, entrepreneurs are more willing to partner with them.

H2b: When CVC units are able to give start-up companies access to R&D-related resources, entrepreneurs are more willing to partner with them.

Established corporations frequently use CVC investments as an instrument to spot and observe start-up companies that are suitable candidates for a later acquisition (Benson & Ziedonis, 2009, 2010). Acquisitions give entrepreneurs an opportunity to exit their entrepreneurial firms, whereby an entrepreneurial exit is defined as “the process by which the founders of privately held firms leave the firm they helped to create; thereby removing themselves, in varying degree, from the primary ownership and decision-making structure of the firm” (DeTienne, 2010, p. 203). Prior research has emphasized that exit intentions guide entrepreneurial actions, most likely at early stages of their ventures, because the intended exit path has implications for strategic decisions throughout their firms’ life cycle (Wennberg & DeTienne, 2014).

In a relatively recent survey, DeTienne and Cardon (2012) have demonstrated that in 70.0% of the examined cases, entrepreneurs indeed exited their start-up companies in the intended way. When dealing with CVC units, entrepreneurs most likely consider the exit opportunity through a later acquisition as a strategic option for their exit intentions. Supporting this argument, an entrepreneur made the following statement in the preliminary survey when asked for the most important criteria when assessing financing offers from CVC units:

“The CVC unit’s parent corporation should be a realistic candidate for an exit.”

There is a substantial heterogeneity among established corporations in how frequently they acquire start-up companies, ranging from highly active start-up acquirers, such as Cisco, to only moderately active start-up acquirers, such as Texas Instruments (e.g., Benson & Ziedonis, 2009). How frequently established corporations acquire start-up companies and, in particular, how often they acquire former portfolio companies of their CVC units, potentially affects entrepreneurs’ willingness to partner due to their desire to exit their ventures at a future point in time (Wennberg & DeTienne, 2014).

The link between established corporations’ CVC and M&A activities is, among other factors, determined by their dynamic capabilities, namely by their ability to ‘sense’ and ‘seize’ opportunities (Teece, 2007, 2012; Teece et al., 2016). In particular, I argue that established corporations, which use their CVC investments to spot and observe (i.e., to

‘sense’) potential acquisition targets and which frequently ‘seize’ these opportunities by acquiring former portfolio companies, may be better able to attract entrepreneurs due to the fact that entrepreneurs value this prospect of an exit opportunity. Hence, I bring forward the following hypothesis:

H2c: When there is an anticipated exit opportunity in form of an acquisition by CVC units’ parent corporations at a later point in time, entrepreneurs are more willing to partner with CVC units.

3.3.3 The role of personal characteristics

I now turn to the two demand-side factors that I investigate in this essay, namely entrepreneurs’ level of ESE and their risk propensity. ESE refers to individuals’ confidence in their ability to cope with certain entrepreneurial tasks and challenges, such as the identification of needs for new products or services (McGee et al., 2009). ESE is considered a key psychological construct in entrepreneurship research (Miao, Qian, & Ma, 2017) and has been found to be an important factor for the antecedents and outcomes of entrepreneurial behavior (e.g., Newman et al., 2019). The question raised in this essay is how entrepreneurs’ level of ESE affects their decision-making when considering to receive CVC financing. The first effect to consider is the direct effect of ESE on the willingness to partner with CVC units. Entrepreneurs with a high level of ESE are highly confident about their ability to successfully accomplish entrepreneurial tasks and challenges on their own (McGee et al., 2009). This may reduce the perceived need of collaborating with external parties and result in a generally lower willingness to accept outside help from CVC units.

The second effect to consider is the moderating effect of ESE on the willingness to partner with CVC units (e.g., Ahlin, Drnovšek, & Hisrich, 2014). Entrepreneurs showing a high level of ESE may be especially sensitive to the independence of CVC units from their parent corporations, due to their strong belief in their ability to operate their ventures autonomously. This suggests a moderating effect of ESE on the effect of operational (H1a) and strategic (H1b) autonomy of CVC units on entrepreneurs’ willingness to partner with them. Moreover, these individuals may be less attracted by the support and opportunities that corporate investors may bring (H1c and H2a-H2c), because of the high level of confidence in their own abilities. Hence, I propose the following hypotheses regarding the main effect as well as the moderating effects of ESE on the willingness to partner with CVC units:

H3a: Entrepreneurs showing a higher level of ESE are generally less willing to partner with CVC units.

H3b: The positive effects of operational autonomy (H1a) and strategic autonomy (H1b) on entrepreneurs' willingness to partner with CVC units increase with their ESE.

H3c: The positive effects of VC experience (H1c), market-related support (H2a), R&D-related support (H2b), and exit opportunity (H2c) on entrepreneurs' willingness to partner with CVC units decrease with their ESE.

The second personal characteristic that I examine in this essay is the risk propensity of individual entrepreneurs. While some research has been carried out on entrepreneurs' risk propensity in general (e.g., Palich & Bagby, 1995; Stewart & Roth, 2001), far too little attention has been paid to the role of risk propensity in entrepreneurs' investor choices. Although entrepreneurship is generally associated with risk taking, i.e., with uncertain rewards (Cramer, Hartog, Jonker, & Van Praag, 2002), prior research has demonstrated that some entrepreneurs are less willing to take risks than others (Stewart & Roth, 2001).

Therefore, it may be the case that this variation in entrepreneurs' risk propensity affects their willingness to partner with CVC units. As described in Section 3.3.1, established corporations usually aim to fulfill their stakeholders' desire for accountability and predictability (Hannan & Freeman, 1984) and often build organizational structures and operational routines that promote risk aversion (e.g., Teece, 2007). I suggest that entrepreneurs are more attracted by the inherent risk aversion of established corporations when they are themselves more risk-averse and vice versa. I propose the following hypothesis regarding the effect of entrepreneurs' risk propensity on the willingness to partner with CVC units:

H3d: Entrepreneurs showing a higher risk propensity are generally less willing to partner with CVC units.

3.4 Research method

3.4.1 Conjoint experiment

I conducted a metric conjoint experiment to gather data on entrepreneurs' decision-making behavior when they receive financing offers from CVC units. In a conjoint experiment, participants make evaluations on a sequence of presented stimulus objects (here, the investor profiles of CVC units), which are represented by a fixed number of predetermined attributes (here, the single attributes of CVC units) (Behrens & Patzelt, 2016). Each of these attributes has at least two specifications (e.g., 'high' and 'low'). Over the past decades, conjoint experiments have been applied in a wide range of research domains (Dawson, 2011; Warnick, Murnieks, McMullen, & Brooks, 2018),

including entrepreneurship research (Lohrke et al., 2010). Conjoint experiments give researchers the opportunity to study individuals' decision-making *at the very moment* the decisions are made, thus offering several advantages over post hoc methods, such as traditional surveys (Behrens & Patzelt, 2016; Dawson, 2011). These methods are especially prone to post hoc rationalization and self-reporting bias (e.g., Brundin, Patzelt, & Shepherd, 2008), which are less likely to occur in conjoint experiments. Various entrepreneurship scholars have identified conjoint experiments as an effective method to study entrepreneurs' decision-making (Lohrke et al., 2010), including their investor choices (e.g., Drover et al., 2014).

In the conjoint experiment conducted in this essay, the participants were asked to imagine a scenario where the start-up company, for which they were working for when they participated in the experiment, received financing offers from CVC units with different investor profiles. The entire scenario description that was presented to the entrepreneurs can be found in Appendix A. The profiles of the CVC units were represented by six attributes, which corresponded to the main research variables of this study, namely CVC units' operational autonomy (H1a), strategic autonomy (H1b), and VC experience (H1c), as well as the market-related support (H2a), R&D-related support (H2b), and exit opportunity (H2c) provided by corporate investors.

Each attribute had two specifications, namely 'high' and 'low' for VC experience and 'yes' and 'no' for the other attributes. This resulted in $2^6 = 64$ possible investor profiles of CVC units. Following prior studies (e.g., Brundin et al., 2008), I used a fractional factorial orthogonal design to arrive at a reduced number of 16 investor profiles that were presented to the participants. Like Warnick et al. (2018), I added two practice profiles to the experiment to familiarize the participants with the conjoint tasks. Furthermore, the conjoint experiment encompassed four replication profiles to assess the reliability of respondents' assessments, resulting in a total of 22 presented investor profiles. Two versions of the conjoint experiment were created in which the investor profiles were given in a different order to prevent potential biases in the results that arise from order effects. For the same reason, the order of the six attributes that represented the single investor profiles was randomized. The conjoint experiment was carried out online (e.g., Behrens & Patzelt, 2016) and took place from May 28, 2018 until December 15, 2018.

3.4.2 Sample

The participants of the conjoint experiment were recruited from the private and business networks of entrepreneurs who were, or had formerly been, affiliated with the Technical University of Munich, Germany (e.g., through university start-up programs).

Specifically, I asked these entrepreneurs to send an e-mail, which contained a link to the website of the conjoint experiment, to entrepreneurs in their networks, inviting them to participate in the experiment. These entrepreneurs, again, were asked to forward the e-mail to their respective networks, and so forth. This procedure is commonly referred to as ‘snowball sampling’ (e.g., Landström, 1993). To complement this sampling method and potentially reduce the selection bias, I additionally collaborated with a start-up magazine, which is distributed throughout Germany. The managing directors agreed to sending the e-mail with the link to the conjoint experiment to entrepreneurs on their mailing lists. Although the exact number of entrepreneurs on the mailing lists was not disclosed by the managing directors for reasons of business secrecy, this procedure resulted in a considerable number of additionally contacted entrepreneurs.

Overall, $N = 300$ entrepreneurs opened the link to the online website that contained the conjoint experiment and $N = 62$ completed all conjoint tasks as well as the post-experiment survey. The $N = 62$ participants with no missing data represented the sample of this study. Measured in terms of entrepreneurs who opened the link, the response rate was 20.7%, which is similar to the response rates reported in other studies (e.g., DeTienne, Shepherd, & De Castro, 2008). Moreover, the size of the sample was in accordance with prior conjoint experiments (e.g., Drover et al., 2014; Murnieks, Cardon, Sudek, White, & Brooks, 2016; Wood et al., 2014).

Among the participants, $n = 55$ (88.7%) participants were male and the average age was 34.4 ($SD = 11.1$) years. The relatively low share of female participants is consistent with other studies that recruited their participants in Germany (e.g., Domurath & Patzelt, 2016). The majority of the participants held a master’s degree or a higher degree (67.7%) and the participants have spent on average 2.8 years ($SD = 1.9$) in the start-up business. Almost all participants were the founders and managing directors of the start-up companies they were working for when they participated in the experiment. Hence, they were likely to get involved in the selection of outside investors for their start-up companies and, therefore, represented an appropriate sample for this study. Their start-up companies were operating in a broad range of sectors, with many of them being active in the software (37.1%) or hardware (12.9%) business.

3.4.3 Hierarchical linear modeling

The $N = 992$ investor assessments in the conjoint experiment were nested within the $N = 62$ participants (i.e., 16 assessments per participant) and were thus, not independent of each other due to the idiosyncrasy of humans’ cognitive models (Behrens & Patzelt, 2016; Wood et al., 2014). In accordance with prior studies (e.g., Drover et

al., 2014), I used hierarchical linear modeling (HLM) to analyze the data, because this technique takes account of the potential autocorrelation arising from the nested data structure (Aguinis et al., 2013). In particular, I applied a two-level HLM analysis. The level 1 variables comprised the attribute variables, i.e., the attributes of the CVC units that were manipulated in the experiment (within-subject effects). The level 2 variables captured the characteristics of the participants and their start-up companies (between-subject effects). The variables are described in detail in the following section.

3.4.4 Variables

Dependent variable

The dependent variable measured entrepreneurs' willingness to partner with the CVC units presented in the conjoint experiment. For each investor profile, the respondents were asked to assess, on a two-item Likert-type scale, how likely they were to partner with the respective CVC unit (1–'very unlikely'; 7–'very likely') and as how favorable they perceived a financing contract with the CVC unit for their start-up company (1–'unfavorable'; 7–'highly favorable'). This scale was adapted from prior conjoint experiments and has shown high reliability values (Drover et al., 2014; Murnieks, Haynie, Wiltbank, & Harting, 2011). The average Cronbach's alpha in this study was $\alpha = .93$, implying a high degree of internal consistency.

Level 1 main variables

The level 1 main variables were the six attribute variables derived in the Hypotheses section, namely *operational autonomy* (H1a), *strategic autonomy* (H1b), *VC experience* (H1c), *market-related support* (H2a), *R&D-related support* (H2b), and *exit opportunity* (H2c). Since each attribute variable had two specifications as described before, they represented dichotomous variables (1 = 'high' or 'yes'; 0 = 'low' or 'no'). A description of the attributes was provided before *and* after the practice profiles to ensure that participants were well-acquainted with them. Prior to the experiment, two entrepreneurs confirmed that the attribute descriptions were objective, understandable, and targeted the intended characteristics of CVC units, supporting face validity of the attribute variables. The attribute descriptions that were presented to the participants can be found in Appendix B.

Level 2 main variables

The level 2 variable capturing entrepreneurs' level of ESE was measured using the scale developed by McGee et al. (2009). The scale comprised 19 items on five sub-dimensions of ESE (searching, planning, marshaling, implementing-people, implementing-financials). The scale included items such as "how much confidence do you have in your ability to estimate customer demand for a new product or service?" (McGee et al., 2009, p. 978) and was operationalized using 7-point Likert-type items (1-'no confidence'; 7-'high confidence'). The entire scale can be found in Appendix C. In order to arrive at the total ESE score for each participant, the single item scores were added up. The overall Cronbach's alpha of the scale, i.e., including all 19 items, was $\alpha = .84$ and the average Cronbach's alpha of the five sub-dimensions was $\alpha = .71$. This points towards internal consistency of the scale. The level 2 variable depicting entrepreneurs' risk propensity was measured by the single-item Likert-type scale developed and validated by Beierlein et al. (2014). The wording of the scale was "how do you see yourself—how willing are you in general to take risks? (1—not at all willing to take risks; 7—very willing to take risks)" (Beierlein et al., 2014, p. 26).

Level 2 control variables

The HLM analysis included multiple level 2 control variables that captured the properties of the participants and their start-up companies. In compliance with past conjoint studies examining entrepreneurs' decision-making, I controlled for their age as well as their education (1 = 'master's degree' or higher degrees; 0 otherwise) (Douglas, 2013). At the firm level, I added a control variable that computed whether the participants' firms had conducted a financing round during the last twelve months prior to their participation in the conjoint experiment (1 = 'yes'; 0 = 'no') as well as whether they pursued a business-to-business model or not (1 = 'yes'; 0 = 'no'). I also controlled for whether they already had an existing cooperation with an incumbent firm or not (1 = 'yes'; 0 = 'no'). In order to ensure sufficient statistical power, I incorporated these control variables in the main HLM analysis presented in the subsequent section. Note that I controlled for many other aspects in later robustness checks.

3.5 Results

3.5.1 Descriptive statistics

To begin with, I used the four replication profiles to evaluate the reliability of the assessments made by the entrepreneurs (Warnick et al., 2018). The mean test-retest correlation for the dependent variable was .69 across entrepreneurs, which exceeds the critical value of .50 (Hauswald, Hack, Kellermanns, & Patzelt, 2016) and is comparable to the values reported in similar studies (e.g., Holland & Shepherd, 2013). This value is especially satisfactory, because only four replication profiles were used, making the test-retest reliability sensitive to single assessments. Moreover, the mean R^2 between the assessments made in the regular conjoint task and those on the replication profiles was .68 ($p \leq .01$). Hence, it can be concluded that the respondents answered in a reliable manner during the experiment. Table 3.1 reports the correlations between the main level 2 variables. Correlations between the level 1 variables are not reported, because an orthogonal experimental design was used, which determined correlations between the attribute variables to be zero (Patzelt, Shepherd, Deeds, & Bradley, 2008). The variance inflation factors (VIFs) of all level 2 variables were far below the critical threshold of 10 (Hair, Black, Babin, Anderson, & Tatham, 2006), which implied that multicollinearity was not an issue in the regression analysis presented in the next section.

3.5.2 Hierarchical linear modeling results

In accordance with prior research using data from conjoint experiments (Moser, Tumasjan, & Welp, 2017), I followed the stepwise procedure of analyzing hierarchical data proposed by Aguinis et al. (2013). I first estimated the null model (intercept only) to test if the data structure was really nested. The null model showed an intra-class correlation (ICC) of 0.13, which was slightly higher than that reported in related studies using conjoint experiments (Hauswald et al., 2016; Moser et al., 2017) and lied within the typical ICC ranges reported in Aguinis et al. (2013). This ICC value implied that a significant part of the variance was explained by differences among entrepreneurs as well as by differences between their start-up companies. Hence, the inclusion of higher-level variables that captured these differences was appropriate.

Next, I tested both a random intercept fixed slope (RIFS) and a random intercept random slope (RIRS) model, leaving out cross-level interactions at this point to evaluate the effect sizes of the main variables first (Aguinis et al., 2013). In both models, the effects of the six level 1 main variables described in Section 3.4.4 were highly significant ($p \leq .01$). Moreover, the level 2 main variables *ESE* and *risk propensity* introduced in

Table 3.1: Descriptive statistics.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) ESE	1.00						
(2) Risk propensity	0.12	1.00					
(3) Age	0.17	-0.10	1.00				
(4) Education	0.05	0.00	-0.03	1.00			
(5) Business-to-business	-0.01	0.21	0.12	0.25	1.00		
(6) Recent funding round	0.06	0.30	-0.07	0.23	0.21	1.00	
(7) Existing cooperation	0.04	0.06	-0.25	-0.01	-0.09	-0.05	1.00
Mean	106.43	5.50	34.39	0.68	0.48	0.24	0.65
SD	10.87	1.20	11.13	0.47	0.50	0.43	0.48
VIF	1.06	1.18	1.15	1.13	1.18	1.19	1.09

SD: standard deviation; VIF: variance inflation factor.

$N = 62$ at the individual level (level 2).

Correlations with an absolute value $\geq .25$ are significant at $p \leq .05$.

Section 3.4.4 showed significant, negative effects ($p \leq .01$ and $p \leq .05$) on the dependent variable *willingness to partner*. I then proceeded with a cross-level interaction model to test for the moderating effects of *ESE*. Because the parameter estimates in the cross-level interaction model did not differ from those estimated in the RIFS and the RIRS model, I only present the results of the cross-level interaction model in Table 3.2 (e.g., Moser et al., 2017).

The cross-level interaction model yields several interesting results. I found strong statistical support for the effects of the level 1 main variables. The variables *market-related support* (H2a, $\beta = 1.44, p \leq .01$) and *R&D-related support* (H2b, $\beta = 0.95, p \leq .01$) showed the largest effects on the independent variable *willingness to partner*, followed by the variables *operational autonomy* (H1a, $\beta = 0.72, p \leq .01$) and *strategic autonomy* (H1b, $\beta = 0.67, p \leq .01$). As compared to the other level 1 main variables, the effect of the variable *exit opportunity* was moderate (H2c, $\beta = 0.58, p \leq .01$). The variable *VC experience* had the lowest effect on the dependent variable *willingness to partner*, though the effect was still highly significant (H1c, $\beta = 0.40, p \leq .01$).

The level 2 main variable *ESE* had a significantly negative effect on entrepreneurs' willingness to partner with CVC units ($\beta = -0.02, p \leq .01$), thus supporting H3a. Furthermore, the results revealed that entrepreneurs with a higher risk propensity were generally less willing to partner with CVC units (H3d, $\beta = -0.14, p \leq .05$). With regard

Table 3.2: Hierarchical linear modeling results.

Model	Estimate	Significance	Hypothesis
<i>Level 1 main variables</i>			
Operational autonomy	0.72	***	H1a
Strategic autonomy	0.67	***	H1b
VC experience	0.40	***	H1c
Market-related support	1.44	***	H2a
R&D-related support	0.95	***	H2b
Exit opportunity	0.58	***	H2c
<i>Level 2 main variables</i>			
ESE	-0.02	***	H3a
Risk propensity	-0.14	**	H3d
<i>Cross-level interactions</i>			
ESE × Operational autonomy	0.01	†	H3b
ESE × Strategic autonomy	0.02	**	H3b
ESE × VC experience	-0.00		H3c
ESE × Market-related support	0.00		H3c
ESE × R&D-related support	0.00		H3c
ESE × Exit opportunity	-0.00		H3c
<i>Level 2 control variables</i>	included		
<i>Constant</i>	3.62	***	

Method: HLM with two levels. Dependent variable: *willingness to partner*.

* $p \leq .10$, ** $p \leq .05$, *** $p \leq .01$ (two-sided test). † $p \leq .10$ (one-sided test).

$N = 992$ at the assessment level (level 1); $N = 62$ at the individual level (level 2).

Level 1 variables were group-mean centered; level 2 variables were grand-mean centered.

Level 2 control variables are not displayed to improve clarity.

to the moderating effect of *ESE*, I found a significant, positive cross-level interaction with the variable *strategic autonomy* (H3b, $\beta = 0.02, p \leq .05$). This result suggests that entrepreneurs with a high level of *ESE* place, as hypothesized, more emphasis on the independence of *CVC* units from the strategic interests of their parent corporations. The moderating effect of *ESE* on *operational autonomy* became significant only when a one-sided test was computed (H3b, $\beta = 0.01, p \leq .10$, one-sided test). No moderating effects of *ESE* were observed on the variables *VC experience*, *market-related support*, *R&D-related support*, and *exit opportunity*. This led to the rejection of H3c.

Although the parameter estimates and significance levels of the level 2 control variables were not displayed in Table 3.2 for reasons of space and clarity, some results are worth noticing. Older entrepreneurs were more willing to partner with CVC units ($\beta = 0.01, p \leq .10$). The same held true for entrepreneurs whose start-up companies pursued a business-to-business model ($\beta = 0.39, p \leq .05$). Moreover, I also tested for moderating effects of *risk propensity* on the level 1 variables and found no significant results. To ensure robustness of the results, I additionally tested the effects of various other variables, including the gender of the participants as well as the number of ventures they founded to capture their entrepreneurial experience (Domurath & Patzelt, 2016). I also controlled for the overall time they were employed at established corporations, the sectors in which their start-up companies were operating, and for whether they received financing from IVC investors and angel investors or not (Hellmann, Schure, & Vo, 2017). I examined the potential effect of the stage of their start-up companies as well as for whether the innovations of their start-up companies were technology-based or not. All of the HLM analyses were additionally performed using robust standard errors. These supplemental analyses yielded almost identical parameter estimates and significance levels, leaving the qualitative discussion of the results unchanged.

3.5.3 Additional analyses of the effects of ESE and risk propensity

To further validate the effects of ESE and risk propensity on the willingness to partner with CVC units, I added a 5-item Likert-type scale (1-‘strongly disagree’; 7-‘strongly agree’) to the post-experiment survey that measured the general attractiveness of CVC units as perceived by the participating entrepreneurs. The items of the scale were (1) ‘Generally, CVC units are attractive investors’, (2) ‘I see CVC units skeptically’ (reverse worded), (3) ‘I prefer IVC investors over CVC units as investors’ (reverse worded), (4) ‘I would appreciate CVC units as investors for my start-up company’, (5) ‘I am generally willing to enter into collaborations with CVC units’. I used principal component analysis (PCA) to explore the dimensionality of the scale. In the PCA, I found the scale to be one-dimensional, as only one factor emerged that had an eigenvalue greater than one (e.g., Covin, Garrett, Gupta, Kuratko, & Shepherd, 2016). All items loaded sufficiently on the identified factor ($\geq .50$) and Cronbach’s alpha was $\alpha = .79$, which pointed towards internal consistency of this exploratory scale (e.g., Marion, Dunlap, & Friar, 2012).

I used this scale as the dependent variable in an additional ordinary least squares (OLS) regression analysis of the effects of ESE and risk propensity (see Model (1) in Table 3.3). I included the same control variables as in the main HLM analysis

presented in the preceding subsection. The variable *ESE* showed a significant, negative effect on the dependent variable *perceived attractiveness* ($\beta = -0.32, p \leq .05$), which further supported H3a. I found no significant effect of the variable *risk propensity* (H3d, $\beta = 0.07, p > .10$). In Model (2), I included only the third item ('I prefer IVC investors over CVC units as investors') as the dependent variable to test whether entrepreneurs with a higher level of ESE and a greater risk propensity prefer IVC investors over CVC units. Again, the variable *ESE* had a significant effect on the dependent variable *perceived attractiveness* (H3a, $\beta = 0.58, p \leq .01$) and the variable *risk propensity* did not show a significant effect (H3d, $\beta = -0.09, p > .10$). These additional, non-experimental analyses hence corroborated the effect of ESE on entrepreneurs' willingness to partner with CVC units. However, these analyses did not confirm the effect of risk propensity.

Table 3.3: Additional regression analyses.

Model	(1)	(2)	Hypothesis
<i>Independent variables</i>			
ESE	-0.32**	0.58***	H3a
Risk propensity	0.07	-0.09	H3d
<i>Control variables</i>	included	included	
<i>N</i>	62	62	
<i>R</i> ²	0.22	0.17	

Method: OLS regression. Dependent variable: *perceived attractiveness*.

** $p \leq .05$, *** $p \leq .01$ (two-sided test).

Control variables are not displayed to improve clarity.

3.6 Discussion

3.6.1 Discussion of results

The primary research question in this essay sought to determine if and how the configuration of CVC units affects entrepreneurs' willingness to partner with them. I drew from the dynamic capabilities view and explained why firms' 'higher-order' capabilities (e.g., Winter, 2003), namely their ability to change their operational routines and resources (Zahra et al., 2006), are required when configuring CVC units. In particular, I explained how their dynamic capabilities enable them to adjust parts of their organizations to the entrepreneurial ecosystem (e.g., Teece, 2012) and, thus, build appropriate organizational conditions for CVC units (H1a-H1c). Moreover, I described how their

dynamic capabilities influence their ability to leverage complementary resources as well as organizational capabilities, such as their M&A capability, in the start-up financing context (H2a-H2c).

Whether CVC units provide their start-up companies with market-related (H2a) and R&D-related (H2b) resources or not has the strongest effect on entrepreneurs' willingness to partner. The fact that entrepreneurs are highly attracted by the resources they gain access to through CVC units suggests that entrepreneurs and their ventures do not solely rely on 'building' their resources on their own (e.g., Arthurs & Busenitz, 2006), but also seek to access external resources, for example, by collaborating with incumbent firms. In this vein, Park and Steensma (2012) argued that start-up companies' access to complementary resources of established corporations "may render their technology commercialization process more efficient and ultimately enhance their performance" (p. 4) and their results demonstrate positive firm-level effects for start-up companies that access complementary assets through CVC financing. My findings are also consistent with the results of previous work in the field of strategic alliances. For example, Eisenhardt and Schoonhoven (1996) demonstrated that entrepreneurial firms seek to form alliances to access their partners' resources, especially when they are in vulnerable strategic positions, e.g., when they face high uncertainty and high costs at the same time. The results reported in the present essay add to the literature by highlighting the important role of such complementary assets in *concrete* decision-making scenarios.

The operational (H1a) and strategic (H1b) autonomy of CVC units showed the second highest effect sizes on entrepreneurs' willingness to partner. The result that the strategic autonomy of CVC units has a relatively small effect, especially when compared to the strong effects of the market-related and R&D-related support provided by CVC units, was unexpected. The issue of strategic conflicts between CVC units' portfolio companies and parent corporations has been the subject of intense discussion in the literature (e.g., Basu, Phelps, & Kotha, 2016; Ivanov & Xie, 2010; Park & Steensma, 2012). Therefore, it was anticipated that the strategic autonomy of CVC units would have a strong effect on entrepreneurs' decision-making regarding this investor group. A possible explanation for this result might be that entrepreneurs are not aware of all the drawbacks that strategic conflicts could have for their entrepreneurial firms. Another explanation for this finding might be that entrepreneurs do not only expect disadvantages from the strategic interests of CVC units' parent corporations. Specifically, when the innovative technologies and business models of start-up companies are complementary to those of the parent corporations, corporate executives might want to promote these entrepreneurial firms rather than jeopardize their businesses (e.g.,

Hellmann, 2002). Intel's investments in entrepreneurial firms whose products use its Pentium processor is one example of such a scenario (Chesbrough, 2002).

The effect of the exit opportunity (H2c) that CVC units may offer to entrepreneurs has a moderate effect on entrepreneurs' willingness to partner. Entrepreneurs seem to value this option, as the participants of the conjoint experiment were significantly more willing to partner with CVC units whose parent corporations provided them with a prospect of a later acquisition. Hence, my results demonstrate that entrepreneurs' exit intentions, i.e., their intentions to leave their firms, cash out, and build a new venture or to reduce their responsibilities in the existing venture (e.g., Wennberg & DeTienne, 2014), influence their decision-making when they consider to receive CVC financing.

One unanticipated finding is the only moderate effect of the VC-related experience (H1c) of the investment managers of CVC units, especially when compared to the effect sizes of market-related and R&D-related support. As mentioned earlier, many scholars argue that CVC units are probably not able to recruit experienced investment managers (Block & Ornati, 1987; Gompers & Lerner, 2000), some scholars even regard this inability as the key issue faced by CVC units (Dushnitsky & Shaver, 2009). More recent research shows that CVC units are better able to attract skilled personnel with relevant experience in the VC industry (Battistini et al., 2013). Although this essay found VC-related experience to have a significant influence on entrepreneurs' willingness to partner, the effect was expected to be higher due to the significant amount of attention this topic has gained in the literature. The question remains as to *why* this effect was only moderate. In discussions with entrepreneurs on this result, it has been argued that some participants might have expected investment managers with a corporate background, as opposed to a VC background, to have a higher social capital *inside* their respective firms (Simsek et al., 2003); that is, these investment managers may be better connected within the parent corporations and, thus, have better access to information and resources within these organizations (Bleicher & Paul, 1987; Ernst et al., 2005; Rind, 1981).

While much of the previous literature on CVC has concentrated on industry- and firm-level effects (e.g., Drover et al., 2017; Narayanan et al., 2009), this essay focused on individual entrepreneurs by assessing effects arising from differences in their personal characteristics on their willingness to partner with corporate investors. I found significant, negative effects of both entrepreneurs' level of ESE (H3a) and their risk propensity (H3d) on the willingness to partner with CVC units. These results are interesting, because only little knowledge exists on the effects of such latent factors in entrepreneurs' decisions in the context of CVC. Note that I could confirm the effect of ESE in additional, non-experimental analyses, while the effect of risk propensity did

not show significant results in these additional analyses.

This essay also contributes to the growing stream of literature on the moderating role of ESE on the antecedents and outcomes of entrepreneurial behavior (e.g., Ahlin et al., 2014; Newman et al., 2019). For example, prior research has found a moderating effect of ESE on the relationship between entrepreneurs' level of creativity and firm innovation (Ahlin et al., 2014). In this essay, ESE was found to moderate the relationship between the strategic and operational autonomy of CVC units (H3b) and entrepreneurs' willingness to partner with them; that is, entrepreneurs with a high level of ESE place higher emphasis on the strategic and operational autonomy of CVC units. While the positive link between the desire for independence and the pursuit of entrepreneurial activities is well-established in the literature (Douglas & Shepherd, 2002), this research unveiled that ESE moderates the importance entrepreneurs attach to the independence of *investors* when considering to partner with them.

I did not detect any evidence for moderating effects of ESE on the effects of CVC units' VC experience, market- and R&D-related support, and exit opportunity (H3c). Hence, whether entrepreneurs show high or low levels of ESE does not affect their assessments regarding these attributes of CVC units. An explanation for this result could be that entrepreneurs with a high level of ESE do not perceive these support functions of CVC units as substitutes for their own capabilities, but rather view them as opportunities, like entrepreneurs with a low level of ESE. It is reasonable to infer that other psychological constructs, such as entrepreneurial opportunity recognition (Mccline, Bhat, & Baj, 2000), are more appropriate to test for moderating effects in this context.

3.6.2 Theoretical implications

This essay explained why and how established corporations have to employ their dynamic capabilities (Teece et al., 1997) in order to configure viable CVC units. Although some scholars have criticized the dynamic capabilities view for being an abstract, vague, and elusive concept (e.g., Danneels, 2008; Kraatz & Zajac, 2001), it has proved to be a highly appropriate framework when applied to the specific organizational issues faced by established corporations in the context of CVC. The dynamic capabilities view has long been recognized as a framework that takes an isolated view of the firm and disregards relational aspects with other players (e.g., Dyer & Singh, 1998). Lately, it has increasingly been applied to settings in which firms undergo organizational transformations that aim to improve their relations with *external* players; examples recently treated in the literature include open innovation programs (Teece et al., 2016) and

customer-centric business models (Teece, 2018).

The present essay contributes to this emerging stream of literature by providing a synthesis of the literatures on dynamic capabilities, CVC, and entrepreneurial behavior. The results of this essay showed that established corporations' dynamic capabilities have important implications for external partners (here, entrepreneurs and their ventures) and that these capabilities indirectly influence the willingness of external partners to collaborate with them (here, in the form of CVC financing). Furthermore, there is a substantial debate in the literature on how the outcomes of dynamic capabilities should be measured (Barreto, 2010): Some scholars argue that dynamic capabilities are directly linked to firm performance (Teece et al., 1997), whereas other scholars are more skeptical about this direct relationship (Eisenhardt & Martin, 2000). This essay took a different perspective and concentrated on determining the outcomes of dynamic capabilities when they are most salient, namely when routines and resource configurations are altered to address changing environments (Teece, 2012; Zahra et al., 2006), for example, when established corporations configure CVC programs. As a result, this essay emphasizes *organizational* outcomes (e.g., the configuration of CVC units), rather than direct performance outcomes, of firms' dynamic capabilities.

3.6.3 Managerial implications

The findings of this essay have direct implications for corporate executives and may, therefore, guide future managerial practice. In particular, four recommendations for practice can be inferred from the results and discussion above, which are as follows:

1. *Build appropriate organizational conditions for CVC units.* Entrepreneurs prefer CVC units that operate outside of their parent corporations' organizational structures and operational procedures (H1a). It is ultimately a managerial task to provide CVC units with the necessary operational independence. Management tools for achieving operational independence include the establishment of separate legal entities for CVC activities and spatial separation from corporate units, among other means (e.g., Weiblen & Chesbrough, 2015). Entrepreneurs are also more willing to partner when CVC units are not subject to strategic intervention by their parent corporations (H1b). Operational independence appears to be a promising first step to achieve the strategic autonomy of CVC units (e.g., Souitaris & Zerbinati, 2014). However, a careful selection of individuals who get involved in such CVC units is necessary to prevent spill-over effects from the core business. It is crucial to note that CVC programs may still have a *general* strategic mission. For example, Microsoft's mission to invest in entrepreneurial

firms that support its ‘Net’ internet service architecture (Chesbrough, 2002) is probably acceptable from the point of view of entrepreneurs. Problems are more likely to arise when corporate executives interfere in *concrete* investment relationships between CVC units and start-up companies. In the conjoint experiment, entrepreneurs were more attracted by CVC units that employed experienced investment managers (H1c). This attribute has the lowest effect on entrepreneurs’ willingness to partner and corporate executives are, therefore, best advised to install commingled investment teams, i.e., CVC units with both corporate personnel and externally recruited investment managers. Investment managers with a corporate background might be better able to connect start-ups to the right people within their parent corporations, making their presence a crucial factor (Bleicher & Paul, 1987; Ernst et al., 2005; Keil, 2004; Rind, 1981).

2. *Make complementary resources available to start-up companies through CVC units.* Entrepreneurs’ willingness to partner is highly dependent on whether CVC units give them access to complementary market- and R&D-related resources or not (H2a-H2b). While the general idea that incumbent firms grant start-up companies access to their resources appears plausible in theory, it is most likely difficult to implement in practice (Ernst et al., 2005). As described earlier, corporate personnel narrowly focuses on core operations and has neither the time nor incentives to additionally support entrepreneurial firms. Hence, managerial action is required to change these deeply rooted routines and reward collaborations with portfolio firms, e.g., by linking the annual bonus to the number of collaborations with portfolio companies (e.g., Bassen et al., 2006; Battistini et al., 2013). This potentially enables the mutually beneficial exchange of resources, which is the main goal of most CVC programs (e.g., Weber, Bauke, & Raibulet, 2016; Weber & Weber, 2010; Yang, 2012).
3. *Provide entrepreneurs with a viable exit path.* The results in this essay show that entrepreneurs are more willing to partner when the respective CVC unit is associated with an exit opportunity through a later acquisition by its parent corporation (H2c). The question if established corporations should use CVC investments as an instrument to identify acquisition targets is beyond the scope of this essay (e.g., Benson & Ziedonis, 2010). However, it can be inferred from the results that entrepreneurs value the prospect of a later exit opportunity. Corporate executives should be aware that CVC units, which are involved in their parent corporations’ M&A activities, may be better able to attract prospective investment targets.
4. *Accept that not all influential factors are actually influenceable.* Entrepreneurs, who took part in the conjoint experiment, showed differences in their propensity

to partner with CVC units, independently of the exact configuration of CVC units. These differences were partly explained by two personal characteristics: ESE and risk propensity (H3a-H3d). Although these personal characteristics represent latent constructs that cannot be easily observed in reality, these results may nevertheless help investment managers in financing discussions. The results suggest that CVC units may be best advised to stress their independence from their parent corporations when dealing with entrepreneurs that seem to have an extraordinarily high confidence in their own abilities. However, such inferences must be viewed with caution as I drew from a sample of $N = 62$ entrepreneurs. What can be generally learned from these results is that some entrepreneurs may show a higher propensity to partner with CVC units than others and this essay shed light on the question of *who* these entrepreneurs are.

This research enhances the understanding of the necessary measures established corporations must take to effectively attract entrepreneurs, and the implications of this essay may further contribute to what Porter (1996) describes as “rapid diffusion of best practices” (p. 5) in the field of CVC. This essay also has implications for other forms of collaboration with start-up companies, such as corporate accelerators and incubators (Weiblen & Chesbrough, 2015), as well as for other institutions that face similar challenges like established corporations, such as governmental institutions. In discussions with government officials, it has been reported that organizational problems, similar to those discussed in Section 3.3.1, impede the ability of certain government units to pursue innovative projects like, for example, the implementation of the ‘e-government’ (e.g., Wirtz & Daiser, 2018). Hence, the results of this essay also suggest several courses of action for executives in related domains.

3.6.4 Limitations, future research, and conclusion

A number of limitations need to be considered. Although conjoint experiments offer the important advantages mentioned above, this research method is not without constraints (e.g., Patzelt et al., 2008). In the conjoint experiment that was carried out in this study, I broke down a complex business decision, namely the choice of outside investors, into six attributes. Although the attributes were carefully selected based on a thorough review of the literature, a preliminary survey, and insights gained from various field reports (e.g., KPMG, 2017), some entrepreneurs may pay more attention to additional aspects that were not included in the experiment, like the political influence of CVC units’ parent corporations. Therefore, additional discussions were performed, in which entrepreneurs and researchers alike confirmed that the most relevant attributes were

included. This supports the external validity of the results.

Like prior research that focused on non-financial aspects in entrepreneurs' investor selection, I omitted effects arising from the valuation and distribution of equity stakes (Drover et al., 2014); i.e., these effects were held constant as can be seen in the scenario description (see Appendix A). Moreover, following prior studies (e.g., Brundin et al., 2008), I used an orthogonal experimental design, which implied zero correlation between the attribute variables (e.g., Patzelt et al., 2008). These variables are likely to be correlated in real-world scenarios (e.g., the operational autonomy is most likely positively correlated with the strategic autonomy of CVC units). However, ensuring zero correlation is an important measure to make inferences about the influence of single attribute variables on the dependent variable (Behrens & Patzelt, 2016) and, hence, was a necessary step in designing the conjoint experiment.

I encourage future research to further validate these results, e.g., by using qualitative research methods or conventional survey research designs. Moreover, future studies could investigate if the results of the conjoint experiment remain the same when teams of entrepreneurs rather than individual entrepreneurs are the research object. It would also be interesting to examine if the results change when a similar conjoint experiment on CVC units is conducted with other investor groups as participants, such as investment managers of IVC funds or angel investors. For example, investment managers of IVC funds may be more concerned about the organizational issues and less attracted by the resource-related support from CVC units, because IVC funds may themselves have access to complementary resources (Alexy et al., 2012; Hsu, 2006).

Another natural progression of this work is to include further psychological constructs in the analysis. Both psychological constructs analyzed in this essay influenced entrepreneurs' willingness to partner with CVC units. It is reasonable to assume that other personal characteristics of entrepreneurs influence their decision-making behavior regarding this investor group. One possible extension in this context may be to investigate moderating effects of entrepreneurial opportunity recognition (e.g., Mccline et al., 2000) as mentioned earlier. In this essay, I used a single-item measure to assess entrepreneurs' risk propensity. Although the measure has been validated in psychological tests (Beierlein et al., 2014), further research might investigate if other risk propensity measures produce similar results. Another interesting question that researchers may examine is why the effect of risk propensity was significant in the conjoint experiment but not significant in the additional, non-experimental analysis.

To conclude, the purpose of this essay was to determine if and how the specific attributes of CVC units affect entrepreneurs' decision-making regarding this investor group. The results demonstrate that entrepreneurs place high emphasis on whether

CVC units are able to provide them with access to complementary market- and R&D-related resources or not. Also, the operational and strategic autonomy of CVC units, the prospect of a later exit opportunity through an acquisition by their parent corporations, as well as their VC-related experience significantly alter entrepreneurs' propensity to partner with them. Moreover, my findings add to a rich body of literature on the role of personal characteristics in entrepreneurial decision-making by showing that entrepreneurs' with a high level of ESE or a high risk propensity are less willing to partner with corporate investors. In addition, my results unveil moderating effects of ESE on the perceived importance of single attributes of CVC units.

Chapter 4

The Attitude of Angel Investors Towards Corporate Venture Capital Units: Pouring Money Into the Market Is Not Enough¹

Abstract

Existing research on corporate venture capital (CVC) takes a narrow view of the subject as it mostly concentrates on the perspectives of the directly involved established corporations and start-up companies. This study widens the scope of CVC research by examining the yet unexplored perspective of angel investors, the most important investor group for early-stage investments. Recent empirical evidence demonstrates that CVC units invest at earlier stages than previously assumed, rendering direct interactions between angel investors and corporate investors probable. Particularly, deal referrals from angel investors may enable CVC units to learn about new technologies and innovations early on, thus giving them a competitive edge. Due to the resulting potential interest of corporate investors to collaborate with angel investors, I ask which factors influence the attitude of angel investors towards the group of CVC units as potential (co-)investors. Drawing from a unique data set gained through an online questionnaire with $N = 111$ participating angel investors in Germany, I found that the attitude of angel investors towards corporate investors is strongly influenced by the level of social capital, imitation concerns, and the presumably high funding requirements associated with this investor group, among other factors. I encourage future research to deepen the understanding of suitable measures for corporate investors to attract external parties in the entrepreneurial ecosystem.

Keywords: corporate venture capital, angel investors, social capital

JEL: G24, L26, M13, O33, O34

Author: Julian Ludat

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4.1 Introduction

In today's Schumpeterian market environment, where innovation is key to economic prosperity, established corporations have opened up for newly emerging technologies and innovations developed by young, small start-up companies (Dushnitsky & Lenox, 2005a; Weiblen & Chesbrough, 2015). As one way to access and capitalize on start-up companies' technologies and innovations, established corporations around the world engage in corporate venture capital (CVC) investments (Anokhin et al., 2016; Dushnitsky & Lenox, 2005a), i.e., they conduct minority equity investments in independent, external start-up companies via dedicated CVC units (Gompers & Lerner, 2000). With an overall share of about 20.0% of the global venture capital (VC) investment volume, CVC units have become a significant player in the market for start-up funding (CB Insights, 2017).

There is a lively and ongoing debate among scholars on the topic of CVC (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). Despite widespread concerns about corporate investors, most often relating to their organizational setup and the ulterior motives they may have (Dushnitsky & Lenox, 2005a; Hardyman et al., 1983), prior research has also emphasized possible advantages for start-up companies in receiving CVC funding (Ivanov & Xie, 2010; Maula et al., 2005). In particular, CVC units may leverage their parent corporations' resources and provide their investees with technological support, industry knowledge, access to distribution and marketing channels, etc. (Ivanov & Xie, 2010). Empirical evidence shows that CVC investments indeed accelerate innovation rates (Chemmanur et al., 2014; Dushnitsky & Lenox, 2005a) and increase firm values (Dushnitsky & Lenox, 2006; Ivanov & Xie, 2010; Park & Steensma, 2012) of both established corporations and start-up companies.

Yet, the existent body of CVC research is characterized by a narrow view of the subject as it mostly focuses on the perspectives of established corporations and start-up companies (Basu, Wadhwa, & Kotha, 2016; Drover et al., 2017; Dushnitsky, 2012). What has largely remained unexplored is how other major players in the entrepreneurial ecosystem perceive the group of CVC units (e.g., Dushnitsky, 2012). Restricting CVC research to the two directly involved parties may lead to an incomplete picture of the subject. The importance of a change of perspective is corroborated by social network theory, which regards entrepreneurship as a dynamic process that requires relations between all key parties involved (Aldrich & Zimmer, 1986). This essay therefore sets out to explore the relationship of CVC units with other actors involved in the promotion of young, innovative firms.

Other players that commonly play a crucial role in the entrepreneurial process are an-

gel investors (Madill, Haines, & Riding, 2005) and independent venture capital (IVC) investors (Hsu, 2006). Angel investors are wealthy individuals who invest parts of their private fortune in start-up companies, in which they have no family ties, at an early stage (Freear, Sohl, & Wetzel, 1994; Mason & Harrison, 2008). IVC investors are traditional VC firms whose sole objective is to achieve a superior financial return and who are commonly organized as limited partnerships (Chemmanur et al., 2014; Park & Steensma, 2012). While some studies address the relationship between CVC units and IVC investors by mainly looking at investment syndicates between them (Dushnitsky & Shapira, 2010; Hill et al., 2009; Keil et al., 2010), little is known about the linkage between CVC units and angel investors.

This study emphasizes the complementary roles of CVC units and angel investors in financing and promoting start-up companies. Angel investors typically grant start-up companies access to their networks (Mason & Harrison, 2000; Sørheim, 2003) and support them in obtaining follow-up financing (Madill et al., 2005), e.g., by passing deal referrals to institutional VC investors (Harrison & Mason, 2000). I argue that CVC units have a vital interest in receiving deal referrals from angel investors at an early stage due to their primary objective of acting as “their parent corporations’ eyes and ears for promising technologies and innovations” (Ivanov & Xie, 2010, p. 132). Direct deal referrals from angel investors may give CVC units the opportunity to learn about potential investment targets early on (Aernoudt & José, 2003; Mason & Harrison, 2000; Maula, Keil, & Zahra, 2013), which could be useful in gaining a competitive advantage over IVC investors and rival corporate investors. Specifically, deal referrals from angel investors may allow CVC units to become lead investors and choose additional investment partners based on their own preferences, rather than entering already existing investment syndicates that potentially include other strategic investors with diverging interests (Anokhin et al., 2011; Baierl et al., 2016; Dushnitsky & Shapira, 2010; Hardyman et al., 1983).

Recent empirical evidence indeed indicates that CVC units tend to invest earlier (CB Insights, 2016; Chemmanur et al., 2014) than assumed by prior research (De Clercq et al., 2006), making direct interactions between angel investors and CVC units likely. The tendency of CVC units to invest at an early stage and their presumable interest in collaborating with angel investors leave us with the question of how angel investors evaluate CVC units as potential (co-)investors. In this study, I ask which factors drive the attitude of individual angel investors—the unit of analysis—towards the group of CVC units, and, thereby, accomplish the necessary change of perspective in CVC research. Conceptually, I build on the relationship-building theory of Dwyer et al. (1987) and look for factors that substantially increase or decrease the expected net

benefits of cooperating with CVC units from the perspective of angel investors.

Drawing from an extensive review of the literature as well as preliminary discussions with angel investors, CVC investment managers, and entrepreneurs, I identified multiple factors that potentially influence the attitude of individual angel investors towards CVC units and constructed a survey instrument to test the resulting hypotheses. Drawing upon a sample of $N = 111$ angel investors in Germany, I deliver evidence that the attitude of angel investors towards CVC units strongly depends on the social capital that they attribute to them. My results suggest that imitation concerns as well as misgivings about CVC units' organizational setup negatively influence the attitude of angel investors towards them. Furthermore, I found support for the hypothesis that angel investors targeting a wide range of sectors are more attracted by CVC units. Angel investors are less attracted by CVC units when they perceive the funding requirements of CVC units as particularly high. Lastly, the results show that the increased market presence of CVC units and their seemingly growing role in start-up funding have no lasting effect on the preference formation among angel investors. The essay yields multiple valuable contributions to the literature on CVC. It provides researchers with a better understanding of the specific factors that drive the attitude of other investor groups towards CVC units and, hence, addresses an important research gap in this field (e.g., Dushnitsky, 2012). The results demonstrate that CVC units may have to overcome general concerns that other players in the entrepreneurial ecosystem may have towards them.

This study is structured as follows. Section 4.2 entails a review of the relevant literature on angel investors and institutional VC investors. In Section 4.3, I propose factors that potentially drive the attitude of angel investors towards CVC units and develop multiple testable hypotheses. Section 4.4 presents the sample and introduces the different measures that I used in the empirical investigation. Section 4.5 contains the empirical results, which are discussed and summarized in Section 4.6.

4.2 Angel investors and CVC units: bridging the conceptual gap

Entrepreneurship research and related research areas commonly draw a clear line between the informal and the formal VC market (Elitzur & Gaviols, 2003; Fairchild, 2011; Hellmann & Thiele, 2015; Morrissette, 2007). In the informal VC market, the arguably most important source of funding is the group of angel investors (Van Osnabrugge, 2000). Angel investors invest their private fortune and serve their entrepreneurial ecosystems by filling the so-called 'equity gap' (Brettel, 2003). They cover the financial shortage that typically arises when the entrepreneurs' own resources, as well as the

funds provided by their families and friends, are exhausted, and their companies lack the necessary track record to receive funding from institutional investors (Avdeitchikova et al., 2008; Farrell, Howorth, & Wright, 2008; Riding, 2008; Van Osnabrugge, 2000).

Prior research portrays angel investors as predominantly male, middle-aged, well-educated, and wealthy individuals with prior entrepreneurial and/or managerial experience (Avdeitchikova et al., 2008; Morrissette, 2007). Angel investors have also been referred to as providers of ‘smart money’ (e.g., Aernoudt & José, 2003), because they typically do not only bring financial resources to their investees, but also support them with their sector-specific skills and knowledge. Moreover, angel investors usually act as entrepreneurs’ personal mentors and grant them access to their networks (Madill et al., 2005; Morrissette, 2007). Their involvement may function as a quality signal for institutional VC investors at a later point in time (Madill et al., 2005). The large majority of angel investors are not solely driven by financial objectives, as they also appreciate working with entrepreneurial teams and contributing to a flourishing entrepreneurial ecosystem (Brettel, 2003; Morrissette, 2007; Riding, 2008).

In the formal VC market, the predominant actors are IVC investors (Alexy et al., 2012; Hsu, 2006). The most obvious property that distinguishes IVC investors from angel investors is their funding source: They invest funds collected from their sponsors, such as pension funds, instead of their private fortune (Morrissette, 2007). As compared to angel investors, IVC investors typically invest larger amounts of money in the later stages, have higher formal requirements for funding, and place distinctly more emphasis on exiting their investments successfully (Morrissette, 2007). Like angel investors, IVC investors get involved in their investees’ businesses, but usually by means of strategic and planning support as opposed to the hands-on assistance provided by angel investors (Alexy et al., 2012; Madill et al., 2005; Morrissette, 2007; Riding, 2008).

Next to IVC investors, CVC units represent another major component of the formal VC market, accounting for about 20.0% of the global VC investment volume in the past few years (CB Insights, 2017). Although CVC units share several of the above mentioned characteristics with their independent counterparts (Dushnitsky & Shaver, 2009; Ivanov & Xie, 2010), they differ from them in some key dimensions, such as their funding source and their primary objectives. Being fully-owned and controlled by an established corporation, CVC units predominantly also pursue strategic, rather than only financial, objectives (e.g., Chesbrough, 2002). These include obtaining a “window on new technologies”, “support[ing] existing businesses” and “seek[ing] new directions” on behalf of their parent corporations (MacMillan et al., 2008, p. 9).

The presence of CVC units in the formal VC market has been discussed with some controversy. Scholars argued that CVC investments and the resulting ties with start-

up companies could tempt incumbent firms to imitate their investees' innovations and, thereby, possibly cause their ruin (Basu et al., 2011; Dushnitsky & Shaver, 2009). Acting in the interest of their parent corporations, CVC units may also hinder start-up companies from collaborating with other established corporations (Ivanov & Xie, 2010; Park & Steensma, 2012; zu Knyphausen-Aufseß, 2005). Despite these and other concerns, prior research has also underlined that, by drawing upon their parent corporations' resources, CVC units may provide start-up companies with unique opportunities. Among other things, CVC units may grant start-up companies access to technological support and industry knowledge, as well as to distribution and marketing channels (Ivanov & Xie, 2010). Empirical evidence indicates that CVC-backed start-up companies may indeed perform better in terms of increased innovation rates (Chemmanur et al., 2014) and firm values (Ivanov & Xie, 2010), as well as have a higher likelihood of going public (Gompers & Lerner, 2000) when compared to non-CVC-backed start-up companies.

In this study, I place special emphasis on the linkage between the introduced key investor groups acting in the informal and the formal VC market. Prior research has recognized that institutional VC investors generally benefit from the existence of angel investors (Harrison & Mason, 2000; Hellmann & Thiele, 2015). Indirect benefits arise from the early involvement of angel investors, which allows VC investors to concentrate on large-scale investments in more mature start-up companies that have reached the expansion stage (Aernoudt, 1999; Harrison & Mason, 2000; Hellmann & Thiele, 2015). Specifically, angel investors conduct a first screening of viable start-up companies at an early stage, thereby reducing VC investors' risk of choosing failing investment targets at a later point in time (Brettel, 2003; Dutta & Folta, 2016; Elitzur & Gaviols, 2003; Madill et al., 2005). Direct benefits emerge from deal referrals passed from angel investors to VC investors as well as from co-investments of angel investors and VC investors (Harrison & Mason, 2000).

Deal referrals from angel investors may give VC investors the possibility to obtain information about attractive investment opportunities that, especially due to their early stage, small scale, or unrelated sector, they would not have been able to retrieve from their networks of institutional VC investors (Harrison & Mason, 2000). Conversely, angel investors also gain from cooperating with VC investors: As start-up companies mature and their financial needs grow beyond what angel investors can afford, they benefit from follow-up financing provided by VC investors (Aernoudt, 1999; Harrison & Mason, 2000; Hellmann & Thiele, 2015). When co-investing with VC investors, angel investors may also profit from their formal due diligence and investment procedures (Morrissette, 2007), potentially resulting in lower risk and high-quality investments (Aernoudt, 1999; Harrison & Mason, 2000).

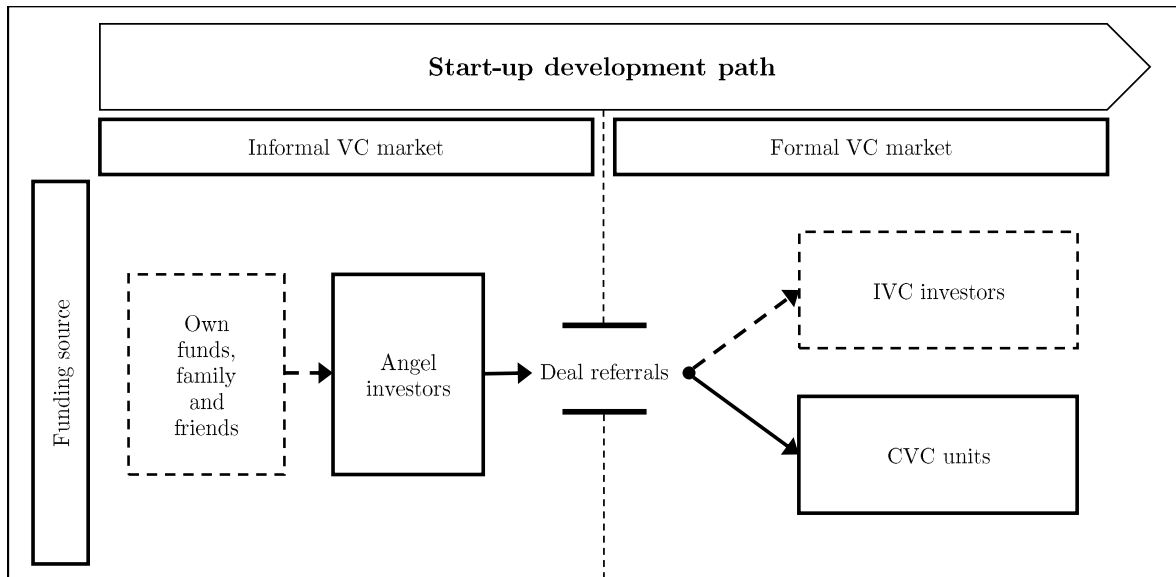


Figure 4.1: Angel investors as a source of deal referrals for institutional VC investors.

This study focuses on the interconnection between CVC units and angel investors. In light of their overarching objective of looking for newly arising technologies and innovative business models on behalf of their parent corporations (Dushnitsky & Lenox, 2005a), I argue that CVC units are especially interested in receiving deal referrals from angel investors (Aernoudt & José, 2003; Harrison & Mason, 2000). As pointed out before, deal referrals from angel investors may help CVC units to be the first to learn about potential investment targets in the formal VC market (Harrison & Mason, 2000), thereby gaining a competitive advantage over potentially rival players, such as IVC investors and other corporate investors. Receiving deal referrals from angel investors may allow CVC units to become lead investors and select additional investment partners autonomously, rather than being dependent on already existing investment syndicates that comprise other strategic investors with different interests (Anokhin et al., 2011; Baierl et al., 2016; Dushnitsky & Shapira, 2010; Hardyman et al., 1983). These fundamental relationships are illustrated in Figure 4.1.

The theoretical work of Norbäck and Persson (2009) supports the view that CVC units are potentially interested in receiving deal referrals from angel investors at an early stage. They showed that competitive dynamics may induce established corporations to make early-stage CVC investments in start-up companies that own basic innovations in order to preempt IVC investors. According to their model, IVC-backed start-up companies could otherwise exploit their bargaining position at a later stage, when their fully-developed innovations are offered to multiple, competing incumbent firms. Drawing upon the model of Riyanto and Schwienbacher (2006), I also reason that early-stage investments give CVC units more scope for shaping start-up companies'

businesses in order to increase the complementarity with their parent corporations' product offerings. Furthermore, referring to the study of Basu et al. (2011), I argue that the benefits of small-scale, early-stage investments are likely to outweigh those of large-scale, later-stage investments when the rate of technological change is high and fast commitment to specific innovations may turn out to be unfavorable (see also Folta, 1998). Indeed, recent empirical evidence indicates that CVC units tend to invest at earlier stages than previously expected (CB Insights, 2017; Chemmanur et al., 2014). In 2017, early-stage investments accounted for around 50.0% of the total global CVC investment volume (CB Insights, 2017).

Their theoretically predicted and empirically attested aspirations towards early-stage investments as well as their potential interest in cooperating with angel investors leave us with the question of how CVC units are perceived by angel investors. Particularly, I investigate which factors affect the general attractiveness of CVC units—as potential (co-)investors—from the perspective of individual angel investors. Drawing from an extensive literature review as well as on preliminary discussions with angel investors, CVC investment managers, and entrepreneurs, I propose several factors that potentially influence the attitude of angel investors towards CVC units. The derived factors represent the main research variables of the present essay and inform the hypotheses development presented in the subsequent section.

I use the relationship-building theory developed by Dwyer et al. (1987) as a theoretical foundation for the hypotheses development. In their their seminal article, which has received more than 12,000 citations on Google Scholar to date (January 22, 2019), Dwyer et al. (1987) divide the relationship-building process between potential business partners into four phases: awareness, exploration, expansion, and commitment. I concentrate on the awareness phase and the exploration phase, which I discuss in-depth in the section that follows. Originally, the relationship-building theory of Dwyer et al. (1987) was developed to understand the dynamics in dyadic relationship-building processes. In this essay, I apply this theory to a research setting in which individual angel investors generally evaluate the population of CVC units as potential collaboration partners. The section that follows presents the hypotheses of this essay.

4.3 Hypotheses development

4.3.1 Increased awareness

Corporate executives, researchers, and the popular business press have strongly underlined the increasing financial resources that are currently being poured into CVC

initiatives around the globe (Chemmanur et al., 2014; Da Gbadji et al., 2015; Weiblen & Chesbrough, 2015). In Germany, the geographic focus of this study, 15 of the 30 major corporations listed in the German share index (DAX) already run dedicated CVC initiatives.² Standing out from this group, the technology giant Siemens has recently equipped its CVC unit ‘Next47’ with an overall investment budget of 1.0 billion EUR, ready to be invested in promising entrepreneurial ventures within a period of five years (Siemens, 2016). This and other CVC initiatives have received extensive media coverage in Germany in the last few years, which, among other factors, may have contributed to an increased overall awareness of the presence of CVC units and their seemingly growing role in start-up funding. Dwyer et al. (1987) established the unilateral awareness of potential transaction partners only as a first phase in relationship building, followed by a bilateral exploration phase during which the costs and benefits associated with an eventual transaction are evaluated. The question I seek to answer is whether an increased awareness for corporate investment activities automatically renders CVC units more attractive (co-)investors for other key investor groups, such as angel investors.

I reason that the increased awareness for CVC units may positively affect angel investors’ attitude towards them. First, the ‘mere-exposure effect’ suggests that individuals become familiar with stimulus objects, and build a positive attitude towards them, by merely being repeatedly exposed to them (Zajonc, 1968). Hence, the ongoing and publicly communicated start-up funding efforts of CVC units may result in a more positive attitude towards CVC units among those angel investors who are more aware of their increasing role in the financing of young, entrepreneurial firms. Second, angel investors may take the growing market penetration of corporate investors as a positive signal about their track record, a crucial criterion in the decision-making of angel investors when choosing investment partners (Sørheim, 2003). Against this background, I examine the effect of the increased awareness on the preference formation among angel investors. The resulting hypothesis is the following:

H1: The higher the awareness of the presence of CVC units and their increasing role in start-up funding, the more attractive CVC units are for individual angel investors.

4.3.2 Social capital

It has been largely acknowledged by prior research that financial capital is not the only form of capital that investors require in order to thrive within the entrepreneurial ecosystem (De Clercq et al., 2006; Dimov & Shepherd, 2005; Pratch, 2005). In particular, social capital has been identified as another important prerequisite for success

²This number is based on an internet search that I conducted as part of this essay.

(Alexy et al., 2012; Hsu, 2006; Pratch, 2005). Social capital refers to the benefits that individuals or groups derive from their social networks (Adler & Kwon, 2002; Nahapiet & Ghoshal, 1998). Although social capital can neither be traded nor be exclusively owned by single actors (Nahapiet & Ghoshal, 1998; Sørheim, 2003), it nevertheless exhibits fundamental properties associated with the general term of capital (Adler & Kwon, 2002). Similar to other forms of capital, social capital is built by initial and ongoing investments in social relationships, most likely by means of time and money, in order to achieve desired, though uncertain, benefits at a later point in time (Adler & Kwon, 2002). Social capital encompasses both a structural and a relational dimension (Granovetter, 1992; Nahapiet & Ghoshal, 1998). The former dimension depicts the number and strength of connections the actors maintain, whereas the latter dimension concentrates on relational aspects, such as the level of trustworthiness and reputation attributed to them (Granovetter, 1992; Nahapiet & Ghoshal, 1998).

Ever since Aldrich and Zimmer (1986) established entrepreneurship as being inextricably linked to and affected by networks of social relationships, the notion of social capital has informed a growing number of studies in entrepreneurship research (Alexy et al., 2012). Previous research indicates that a high level of social capital attributed to individual entrepreneurs positively influences the formation and funding, as well as the chances of success of the start-up companies they are involved in (Brüderl & Preisendörfer, 1998; Hallen, 2008; Shane & Stuart, 2002). However, entrepreneurs do not usually rely solely on their direct network ties, but also aim to access their investors' social capital (Alexy et al., 2012; De Clercq et al., 2006; Hsu, 2004; Madill et al., 2005). Investors in the informal and the formal VC market are embedded in social networks, often emerging from former investment syndicates (Sorenson & Stuart, 2001; Sørheim, 2003), through which they pass vital, non-public information and share resources (Stam, Arzlanian, & Elfring, 2014). Against this background, it has been reasoned that high-social capital investors may provide their investees with superior access to strategic information about current trends, threats and opportunities and facilitate the attraction of additional investors (Alexy et al., 2012; Hsu, 2006; Madill et al., 2005).

In accordance with the existing literature, I argue that angel investors select their investment partners based on the social capital that they attribute to them (Sørheim, 2003). First, angel investors typically add value to start-up companies by granting them access to their social networks (Madill et al., 2005). The total utility that can be extracted from these networks depends on the social capital of the involved parties. Given the scarcity of resources available to build and maintain social relationships (Adler & Kwon, 2002), I argue that angel investors allocate their efforts and pass

deal referrals to those network ties associated with a high level of social capital. In doing so, they maximize the value of their networking function. Second, as opposed to institutional VC investors, angel investors usually pursue less formal due diligence and investment procedures (Ding, Au, & Chiang, 2015). Instead, they rely strongly on the level of trustworthiness and reputation attributed to their business partners (Ding et al., 2015; Fairchild, 2011; Sørheim, 2003), both being crucial components of social capital (Granovetter, 1992; Nahapiet & Ghoshal, 1998).

As introduced in Section 4.3.1, Dwyer et al. (1987) considered the bilateral exploration of potential transaction partners as the second phase in relationship building. During this phase, the involved parties evaluate the expected net benefits that may result from a business relationship. Due to the reasons described above, I argue that the net benefits, which angel investors generally expect from collaborating with CVC units, increase with the level of social capital they attribute to them. I put forward the following hypothesis:

H2: The higher the level of social capital individual angel investors attribute to CVC units, the more attractive CVC units are for them.

4.3.3 Imitation concerns

Start-up companies develop and market innovations that commonly interact with the product offerings of established corporations by either complementing or substituting them (Hellmann, 2002). In both cases, established corporations often aim to internalize these external innovations in order to gain administrative control over them (Folta, 1998). If the innovations complement their existing offerings, they may aim to safeguard, or further increase, the complementary effect in order to promote their core business activities (Chesbrough, 2002; Folta, 1998; Riyanto & Schwiendbacher, 2006). If the substituting effect dominates, established corporations usually seek to protect their market position and incorporate the economic rents accompanied by these disruptive innovations (Hellmann, 2002; Norbäck & Persson, 2009).

When considering the internalization of external innovations, established corporations often consider two alternative strategies, commonly referred to as the make-or-buy decision (Bartel et al., 2012). The *buy* strategy often implies the outright acquisition of start-up companies (Folta, 1998). The *make* strategy entails the internal reproduction of innovations, which may in turn necessitate the procurement of external knowledge resources prevailing in start-up companies (Basu et al., 2011; Dushnitsky & Lenox, 2005b). In this light, it has been argued that CVC investments may serve as an instrument for established corporations to access and absorb critical knowledge from start-up

companies in order to imitate their innovations and potentially cause their ruin (Dushnitsky & Lenox, 2006; Dushnitsky & Shaver, 2009; Hardyman et al., 1983; Ivanov & Xie, 2010; Katila et al., 2008). As a consequence of these imitation concerns, angel investors may refrain from collaborating with CVC units. In particular, they may expect a disturbed relationship between start-up companies and CVC units (Hardyman et al., 1983) and see their investments of time and money at risk.

However, there are several reasons that render this view too simplistic. First, any involved party could extract critical knowledge from a start-up company and walk away with the innovation, including founding team members, other angel investors, and IVC investors (Fairchild, 2011; Hsu, 2006). Moreover, angel investors and IVC investors often invest in other start-up companies operating in the same industry and could, just like CVC units, transfer critical knowledge to the detriment of the original inventor (Dushnitsky & Shaver, 2009). Second, the extent to which established corporations can imitate start-up companies' innovations is regulated by the intellectual property (IP) protection prevailing within their industries (Basu et al., 2011; Dushnitsky & Shaver, 2009). With regard to the geographical focus of this study, the German IP regime exhibits strong overall as well as industry-specific IP protection (Lesser, 2011), which may reduce imitation concerns associated with CVC units in Germany.

Third, prior research indicates that the imitation concerns associated with CVC units are especially pronounced when their parent corporations and their investees compete in the same industry (Dushnitsky & Shaver, 2009; Hellmann, 2002). Hence, these concerns appear to be company- and situation-specific and do not necessarily affect the general attitude of angel investors towards CVC units. Lastly, just like IVC investors, CVC units have a reputation to maintain in order to attract prospective investment opportunities (see also Dushnitsky & Shaver, 2009). Copying the innovations of their investees is likely to damage their reputation, which may cause serious harm to their social capital as pointed out in Section 4.3.2.

Despite these arguments against the view that imitation concerns substantially affect the general attractiveness of CVC units, angel investors may nevertheless be influenced by them. Prior research characterizes angel investors as being especially sensitive to trust issues (Fairchild, 2011; Sørheim, 2003), rendering imitation concerns associated with CVC units a probably decisive factor for preference formation. In order to examine this issue, I build on the work of Dwyer et al. (1987) and propose that the expected net benefits of cooperating with CVC units decrease with increasing imitation concerns of individual angel investors. The resulting hypothesis is:

H3: The stronger the imitation concerns individual angel investors associate with CVC units, the less attractive CVC units are for them.

4.3.4 Organizational obstacles

CVC units are, by definition, tied to large, established corporations, which some researchers regard as being per se non-entrepreneurial (Siegel et al., 1988). This view is based on many aspects, such as the high level of bureaucracy, strict hierarchies, lengthy processes, and strong risk aversion associated with large, established corporations (Benner & Tushman, 2002; Hannan & Freeman, 1984; Hill & Rothaermel, 2003; Teece, 2007). As a consequence of receiving funding from CVC units, start-up companies may become dependent on and get involved in this corporate environment, which supposedly interferes with their creativity and flexibility, i.e., crucial factors for achieving entrepreneurial momentum and success (Arthurs & Busenitz, 2006). For example, when a start-up company is dependent on corporate approval processes (e.g., Chesbrough, 2000), it may not be able to flexibly react to market changes and adjust its strategy (Rode & Vallaster, 2005).

Due to these characteristics of established corporations and their CVC units, and because angel investors themselves are characterized by an entrepreneurial mindset (Aernoudt, 1999; Morrissette, 2007; Van Osnabrugge, 2000), I argue that the described organizational obstacles negatively influence the attitude of angel investors towards CVC units. According to the work of Dwyer et al. (1987), the expected net benefits of cooperating with CVC units may be negatively affected by this factor. To further examine this issue, I propose the following hypothesis:

H4: The more severe the organizational obstacles of CVC units are perceived by individual angel investors, the less attractive CVC units are for them.

4.3.5 Sector focus

Angel investors often prefer to conduct their investments in sectors they are acquainted with (De Clercq et al., 2006; Morrissette, 2007). This behavior is based on their sector-specific experience gained from former entrepreneurial or managerial activities (Morrissette, 2007). As a consequence, angel investors themselves have sector-specific knowledge and skills, as well as access to crucial resources and exchange partners, such as potential suppliers and customers, within these sectors (Aernoudt, 1999; Madill et al., 2005; Morrissette, 2007). These capabilities of angel investors may, especially in case of co-investments, substitute the value-adding activities of CVC units as outlined in Section 4.2 (Hellmann et al., 2017; Hellmann & Thiele, 2015).

Based on this argument, I expect that the substituting effect between individual angel investors and CVC units is more pronounced when angel investors have a narrower

sector focus, i.e., when they target fewer sectors. These angel investors act exclusively within their particular domains, making them experts in their fields and less attracted by the complementary capabilities of CVC units. Similarly, I suppose that angel investors with a wider sector focus, i.e., more targeted sectors, are more attracted by the value-adding activities that CVC units may provide in sectors they are less familiar with. This does not imply that angel investors with a wider sector focus are automatically non-specialized, but that they are more open to step into other domains and invest in start-up companies acting outside their key area of expertise. Drawing upon the conceptual framework of Dwyer et al. (1987), I thus reason that the net benefits associated with CVC units are higher for angel investors with a higher number of targeted sectors. I therefore test the following hypothesis:

H5: The wider the range of sectors targeted by individual angel investors, the more attractive CVC units are for them.

4.3.6 Funding requirements

Lastly, the relationship-building theory of Dwyer et al. (1987) suggests that, after having considered the costs and benefits associated with a transaction, potential exchange partners will ultimately consider whether to approach each other and communicate their willingness to collaborate or not. Even if individual angel investors are attracted by CVC units in the first instance, they may perceive their funding requirements as too high and, thus, refrain from contacting them a priori (Basu, Phelps, & Kotha, 2016). First, although recent empirical evidence points in a different direction (CB Insights, 2016; Chemmanur et al., 2014), it is often assumed that CVC units conduct their investments in more mature start-up companies (De Clercq et al., 2006), which makes early-stage deal referrals from angel investors appear ineligible.

Second, CVC units usually seek start-up companies exhibiting a high ‘strategic fit’ with their parent corporations, which is difficult to interpret from an external point of view (De Clercq et al., 2006; Dushnitsky & Lenox, 2006; Gompers & Lerner, 2000). This may further reduce the prospects of receiving funding from them. Lastly, angel investors may also expect corporate investors to have high requirements with regard to contractual terms (board seats, reporting requirements, etc.) due to their strategic objectives (De Clercq et al., 2006), which may displease other parties involved in the start-up company and, thus, lead to time-consuming negotiations. Following the relationship-building theory of Dwyer et al. (1987), I expect that angel investors, who perceive the funding requirements of CVC units as particularly high, perceive this investor group as less attractive. I put forward the following hypothesis:

H6: The higher the funding requirements individual angel investors associate with CVC units, the less attractive CVC units are for them.

4.4 Data and method

4.4.1 Survey design and sample

Survey design

Drawing from insights gained from an extensive literature review and preliminary discussions with angel investors, CVC investment managers, and entrepreneurs, I constructed a survey instrument in order to collect the required data. The online questionnaire consisted of a general section and a CVC-specific section. In the general section, I gathered information on the characteristics of the surveyed angel investors, including their gender, age, investment experience, targeted sectors, and investment motives. The succeeding CVC-specific section was divided into eight subsections. The first subsection aimed to determine how acquainted the respondents were with the topic of CVC by asking them for their contact frequency and former investment experience with CVC units. The following six subsections were designed to investigate how angel investors perceived the activities, patterns, and properties of CVC units in Germany. The subsequent eighth and final subsection was intended to learn about the general attitude of the surveyed angel investors towards CVC units.

I primarily employed 5-point Likert-type scales (1–‘strongly disagree’; 5–‘strongly agree’) and the survey included multiple reverse worded items to prevent pattern answering. As I expected a significant number of the surveyed angel investors to be unfamiliar with CVC units, I had to carefully trade off leaving the items precise enough to extract the desired information against keeping them broad and simple enough to avoid overloading the respondents and, thus, triggering increased fatigue and drop-out rates. After having revised and tested the questionnaire, jointly with two angel investors and two entrepreneurs, it was sent out as an online questionnaire to the sub-population of angel investors described hereafter. The questionnaire was administered in German.

Sample

Generating samples of angel investors is a non-trivial task, as most of them prefer remaining anonymous and operating in the background (Avdeitchikova et al., 2008; Landström, 1993). Researchers have described them as being an ‘invisible’ or ‘unknowable’ population and, thus, difficult to identify on an individual basis (Avdeitchikova

et al., 2008; Harrison & Mason, 2000). In order to arrive at a satisfactory sample size, I combined two conventional sampling methods described in the literature. The first method I applied was the so-called ‘snowball method’ (Landström, 1993). In particular, about 40 angel investors were contacted from the direct network of an early-stage start-up company, which was affiliated to the Technical University of Munich in Germany and had conducted a financing round at that time, resulting in direct communications with a significant number of angel investors. I asked this initial set of respondents to fill out the survey and distribute it to additional angel investors in their environments. Although this sampling method exhibits several advantages, such as a reduced effort, it may have the drawback of leading to a biased sample as participating angel investors may pass the survey primarily to peers with similar characteristics, e.g., similar age, sector focus, and regional focus (Avdeitchikova et al., 2008).

To circumvent this issue, I additionally cooperated with eleven angel investor networks (AINs) located in Eastern, Western and Southern Germany, comprising around 700 contacted angel investors. AINs are formal networks of angel investors, which aim to match their members with suitable start-up companies as well as facilitating information flow and investment syndicates between individual angel investors (Mason & Harrison, 2000, 2008; Sohl, 2006). The participating AINs agreed on sending out the online questionnaire to their respective members via their mailing lists and, in one case, additionally promoting it in a monthly online newsletter. Albeit this sampling method allows researchers to reach a high number of angel investors, it does mainly include angel investors that self-select into and rely on formal, already existing networks. These angel investors may exhibit different characteristics than those who do not enter formal AINs, such as a lower level of experience and activity (Avdeitchikova et al., 2008). However, since I drew from a diverse set of AINs of largely distinct sizes and from different regions (Sohl, 2006), as well as supplemented this sampling method with the initially described ‘snowball method’, I am less concerned about this issue (Avdeitchikova et al., 2008). Additionally, the collected data indicated that the surveyed angel investors widely differed in most characteristics (e.g., age, sector focus, investment volume), demonstrating a sound diversity among them.

The survey took place from June 12, 2017 until July 9, 2017. Overall, $N = 111$ angel investors have fully completed the survey, making up 15.0% of the approximately 740 contacted angel investors.³ Among the respondents, only $n = 5$ (4.5%) were women, which is consistent with the finding of prior studies that the vast majority of angel

³This rate must be viewed with caution, as the individually contacted respondents may, in parts, be also members of participating AINs, leading to a double count. Furthermore, the ‘snowball method’ entails an unforeseeable number of additionally contacted angel investors, rendering the total number of contacted angel investors difficult to estimate.

Table 4.1: Number of investments carried out.

Number of investments	<i>n</i>	%
5 or more	51	45.9
3-4	29	26.1
1-2	25	22.5
0	6	5.4

investors are male (e.g., Morrissette, 2007). Moreover, the respondents were on average 51.6 ($SD = 10.4$) years old, which again complies with previous research (Brettel, 2003; Morrissette, 2007). As reported in Table 4.1, the respondents showed different numbers of investments carried out to date, ranging from so-called ‘virgin angels’ with no past or current investments (Mason & Harrison, 2000) to experienced angel investors with five or more investments. In order to learn about the respondents’ financial capabilities as well as their devotion to start-up funding, I asked them to state the overall investment amount they were willing to commit to this activity at that time, comprising all past and future investments. For this purpose, I used thresholds similar to those employed by Brettel (2003), who investigated the household income of angel investors in Germany. Table 4.2 shows the broad distribution of the stated overall investment amounts among the surveyed angel investors.

Table 4.2: Overall investment volume.

Investment volume (in thousand EUR)	<i>n</i>	%
More than 2,500	13	11.7
1,000 - 2,500	14	12.6
500 - 1,000	18	16.2
250 - 500	25	22.5
100 - 250	23	20.7
Less than 100	12	10.8
Prefer not to say	6	5.4

Furthermore, the respondents were asked to indicate on which of the business sectors listed in Table 4.3 they focus on. The proposed sectors were derived from recent field studies showing in which sectors German start-up companies mainly operate and where the largest amounts of funding are currently being allocated to (Ernst & Young, 2017; KPMG, 2017). Thereby, the category ‘other’ comprised all business sectors of minor sizes. In addition, I examined what motives the surveyed angel investors typically

pursue when investing in start-up companies and, drawing from the study of Brettel (2003), offered the objectives exhibited in Table 4.4. I found that a vast majority (78.4%) of the respondents were looking for fun when cooperating with entrepreneurs, which again corresponds to the findings of previous studies (Brettel, 2003; Morrissette, 2007). The option ‘other’ was selected by merely $n = 16$ (14.4%) angel investors, which may serve as an indicator that I captured the most important motives in the sample.

Table 4.3: Targeted business sectors.

Business sector	n	%
Software	47	42.3
E-commerce	42	37.8
Health	38	34.2
Mobility	31	27.9
Food and beverages	25	22.5
FinTech	24	21.6
Hardware	24	21.6
Energy	21	18.9
Media and entertainment	15	13.5
Other	41	36.9

Table 4.4: Motives for investing.

Motive	n	%
For having fun	87	78.4
Making a high return	62	55.9
Mentoring entrepreneurs	60	54.1
Portfolio diversification	57	51.3
Other	16	14.4

Concerning the CVC-specific information, $n = 20$ (18.0%) of the respondents stated to be currently in frequent or very frequent contact with CVC units. A considerably higher number of $n = 49$ (44.1%) of the surveyed angel investors indicated to have gained experience with CVC units through former (co-)investments. I also asked the angel investors to name other situations in which they got in touch with CVC units and grouped their responses into two categories. Particularly, I found that $n = 58$ (52.2%) have met CVC units on the occasion of events (fairs, social events, etc.) and

$n = 23$ (20.7%) reported to have network ties with them. Overall, I am confident that the respondents were well-informed about the subject of CVC and, thus, able to cope with the questionnaire.

4.4.2 Dependent variable

In the following, I present the measures that were used to empirically test the predictions outlined in Section 4.3. Although the rich literature on angel investors and CVC allowed me to build the hypotheses by means of non-exploratory, deductive reasoning, this research is exploratory with regard to the applied measures. In order to quantify the dependent variable, I constructed a three-item Likert-type scale measuring the general attractiveness of CVC units as perceived by individual angel investors. The single items of the scale were (1) ‘I would appreciate having a CVC unit as an investor or co-investor of a start-up company I invested in’, (2) ‘I am skeptical towards CVC units’ (reverse worded), and (3) ‘I would prefer an IVC investor over a CVC unit as an investor or co-investor of a start-up company I invested in’ (reverse worded). As recommended by prior research, I employed principal component analysis (PCA) in order to explore the dimensionality of the scale, i.e., the number of underlying factors (Sieger et al., 2016). Applying the Kaiser rule (‘drop all factors with an eigenvalue smaller than one’), I found that the scale was one-dimensional with only one factor exhibiting an eigenvalue greater than one (2.02). The minimum factor loading among the items was 0.81, which points to convergent validity of the scale (Covin et al., 2016). Furthermore, Cronbach’s alpha of the scale was $\alpha = 0.76$, indicating a very satisfactory internal consistency for a short, non-redundant scale in exploratory research (Davis, 1964; Marion et al., 2012; Nunnally, 1967).

4.4.3 Independent variables

Increased awareness. In order to approximate the awareness of individual angel investors of the presence of CVC units and their arguably increasing role in start-up funding, I again used three Likert-type items, asking them to assess whether (1) ‘CVC units play an increasingly important role in start-up funding in Germany’, (2) ‘Investments from CVC units have increased over the past five years in Germany’, and (3) ‘CVC units are an integral part of the entrepreneurial ecosystem in Germany today’. PCA unveiled the one-dimensionality of the scale with only one factor showing an eigenvalue greater than one (2.00). The lowest factor loading among the items was 0.78, which supports convergent validity. The scale displayed a Cronbach’s alpha of $\alpha = 0.75$, again showing a satisfactory level of internal consistency.

Social capital. After having reviewed existing scales in the field of social capital (Batjargal & Liu, 2004; Davidsson & Honig, 2003; Shane & Cable, 2002), I deemed them impracticable to assess the social capital at the highly aggregated level of the group of CVC units. As a consequence, I constructed a more general scale that comprised five Likert-type items derived from the literature on social capital. The items were (1) ‘CVC units are well networked within the entrepreneurial ecosystem in Germany’, (2) ‘CVC units attain information about investment opportunities early on’, (3) ‘Inside the entrepreneurial ecosystem in Germany, the general attitude towards CVC units is positive’, (4) ‘CVC units are seen sceptically by other investors’ (reverse worded), and (5) ‘The investment managers of CVC units are experienced experts’. The first two items addressed structural properties of CVC units’ social capital, i.e., their network position and access to information, whereas the next two items encompassed relational properties (Granovetter, 1992; Nahapiet & Ghoshal, 1998). In accordance with Adler and Kwon (2002), who regarded abilities or, more generally, human capital as an enabling dimension of social capital, I added the last item measuring the level of expertise and experience that individual angel investors attribute to CVC investment managers. PCA unveiled that the scale was one-dimensional with one factor exhibiting an eigenvalue greater than one (2.41). All items loaded sufficiently ($\geq .60$) on the identified factor, which indicated convergent validity. Cronbach’s alpha was $\alpha = 0.73$, which is, given the broadness of the concept of social capital as well as the non-redundancy of the presented items, a highly satisfactory result in exploratory research (Dai, Maksimov, Gilbert, & Fernhaber, 2014). In order to investigate if the scale measuring the increased awareness for CVC units and the scale measuring their social capital actually approximate two distinct factors, I examined these two scales in a joint PCA. I identified two factors with eigenvalues greater than one (3.20 and 1.32). Applying oblimin factor rotation, I found all items to be strongly loading on their respective factor. Additionally, I did not identify any cross-loading items, which suggests discriminant validity of the scales (Covin et al., 2016).

Imitation concerns. In order to measure the imitation concerns that angel investors associate with CVC units, I employed the following single-item Likert-type scale: ‘Many start-up companies in Germany fear that CVC units’ parent corporations may imitate their innovative idea or technology’. Single-item scales are appropriate in management research if they measure concrete, one-dimensional constructs (Fuchs & Diamantopoulos, 2009). The preliminary discussions underscored that the item was understandable and targeted the relevant factor.

Organizational obstacles. For the purpose of approximating the perceived organizational obstacles of CVC units, I constructed a six-item Likert-type scale that addressed key

organizational issues of CVC units that are being discussed by scholars (Chemmanur et al., 2014; Dushnitsky & Lenox, 2005b; Weiblen & Chesbrough, 2015). The applied scale targeted CVC units' processes and agility, embeddedness in their parent corporations' structures, risk-taking propensity, and organizational culture. In particular, I asked the respondents to evaluate whether (1) 'The processes of CVC units are fast and efficient' (reverse worded), (2) 'CVC units are inflexible due to their strong embeddedness in their parent corporations' structures', (3) 'The organizational structures of the CVC units' parent corporations do not fit well with those of start-up companies', (4) 'CVC units are driven by the strategic objectives of their parent corporations', (5) 'CVC units avoid investing in risky start-up companies', and (6) 'Start-up companies and CVC units do not match culturally'. I again used PCA and identified one underlying factor showing an eigenvalue greater than one (2.45) with all factor loadings being above .50. Cronbach's alpha of the scale was acceptable ($\alpha = 0.70$).

Sector focus. In order to quantify the sector focus of individual angel investors, I constructed a ten-point scale with one being the minimum and ten the maximum. For each checked sector presented in Table 4.3 the respondents obtained one point. Hence, respondents who scored higher on this scale were supposed to have a wider sector focus.

Funding requirements. To assess if individual angel investors perceive the funding requirements of CVC units as particularly high, a reference point was needed as they may perceive receiving funding from institutional VC investors as per se challenging (Madill et al., 2005). Therefore, the funding requirements of CVC units were benchmarked against those of IVC investors by asking the respondents 'Which investor type has higher funding requirements?' and offering them three possible answer categories: 'CVC units', 'IVC investors', 'no difference/no indication'. Subsequently, I created the dummy variable *high requirements* which was one if the respondents opted for 'CVC units' and zero otherwise.

4.4.4 Control variables

I included a number of additional variables in the analysis, such as *age* as well as *no. of investments*, i.e., the number of investments the respondents had carried out at that time. I additionally controlled for whether the respondents had experience with CVC units emerging from former (co-)investments or not by adding the dummy variable *CVC experience*, which was one if they exhibited investment experience with them and zero otherwise. Furthermore, I included the variable *CVC higher price*, which was one when the respondents stated that CVC units pay higher prices for equity shares in start-up companies and zero if they stated 'IVC investors' or 'no difference/no indication'. This

variable was added to ultimately control for the financial objectives of angel investors that may influence their attitude towards CVC units.

4.5 Results

4.5.1 Descriptive statistics

I present the descriptive statistics in Table 4.5. Some of these preliminary results are noteworthy. With regard to the variable *increased awareness*, the respondents scored significantly higher than the scale mid-point ('Neutral'), $t(110) = 9.22, p \leq .01$, indicating that they were on average well aware of the presence of CVC units and their increasing start-up funding efforts. The same held true for the variables *imitation concerns*, $t(110) = 4.85, p \leq .01$ and *organizational obstacles*, $t(110) = 12.83, p \leq .01$. Hence, these concerns associated with CVC units were indeed prevalent in the sample. The variables *perceived attractiveness* and *social capital* did not show a clear tendency towards agreement or disagreement.

Interestingly, a considerable number of $n = 45$ (40.5%) angel investors indicated that CVC units pay higher prices for equity shares in start-up companies rather than stating 'IVC investors', or 'no difference/no indication'. Moreover, the subsample of angel investors who had experience with CVC units as (co-)investors scored significantly higher on the *increased awareness* scale than the remainder of the sample, $t(109) = 2.91, p \leq .01$. As mentioned before, Dwyer et al. (1987) regarded the awareness of potential exchange partners as a precursor for a later transaction. Hence, my results support this view in the sense that angel investors showing investment experience with CVC units were indeed more aware of their presence and increased efforts in the VC market. The variable *imitation concerns* averaged significantly lower in this subsample, $t(110) = 2.05, p \leq .05$, showing that angel investors, who had prior investment experience with CVC units, were less concerned about this issue. With regard to the variance inflation factors (VIFs), the independent variables were far below the critical threshold of 10 (Hair et al., 2006), which showed that multicollinearity was not an issue in the regression analysis presented hereafter.

4.5.2 Regression analysis

In order to test the hypotheses, I specified the four ordinary least squares (OLS) regression models presented in Table 4.6. Looking at Model (1), which includes all main variables, I found large support for my hypotheses. I found no support for H1, which stated

Table 4.5: Descriptive statistics.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Perceived attractiveness	1.00										
(2) Increased awareness	0.32	1.00									
(3) Social capital	0.48	0.42	1.00								
(4) Imitation concerns	-0.24	-0.13	-0.10	1.00							
(5) Organizational obstacles	-0.37	-0.21	-0.41	0.19	1.00						
(6) Sector focus	0.17	0.07	-0.05	0.10	-0.01	1.00					
(7) Funding requirements	-0.20	-0.07	0.07	-0.08	0.00	0.08	1.00				
(8) Age	0.11	-0.02	0.11	0.03	0.10	0.12	0.11	1.00			
(9) No. of investments	0.09	0.18	-0.10	-0.02	0.08	0.25	-0.19	0.12	1.00		
(10) CVC experience	0.07	0.27	0.01	-0.19	-0.04	0.04	0.13	0.05	0.48	1.00	
(11) CVC higher price	0.15	0.25	0.09	0.02	-0.10	0.00	0.08	-0.03	0.05	0.01	1.00
Mean	3.01	3.63	3.03	3.42	3.64	2.77	0.29	51.62	3.13	0.44	0.41
SD	0.70	0.72	0.58	0.92	0.52	1.89	0.46	10.39	0.95	0.50	0.49
VIF	n/a	1.47	1.51	1.12	1.29	1.11	1.09	1.10	1.47	1.43	1.09

SD: standard deviation; VIF: variance inflation factor.

$N = 111$; correlations with an absolute value $\geq .19$ are significant at $p \leq .05$.

that the variable *increased awareness* positively affects the attitude of angel investors towards CVC units ($\beta = 0.06, p > .10$). I deliver strong evidence for H2, which claimed that a higher level of social capital attributed to CVC units leads to a higher perceived attractiveness of this investor group ($\beta = 0.47, p \leq .01$). The results strongly support my prediction that the variables *imitation concerns* (H3, $\beta = -0.16, p \leq .05$) and *funding requirements* (H6, $\beta = -0.34, p \leq .01$) negatively affect the perceived attractiveness of CVC units among angel investors. Somewhat lower, though still statistically significant, was the effect of the variables *organizational obstacles* (H4, $\beta = -0.21, p \leq .10$) and *sector focus* (H5, $\beta = 0.07, p \leq .05$). In Model (2), I complemented the analysis by adding the control variables *age*, *no. of investments*, *CVC experience*, and *CVC higher price*. First, I found only marginal changes in the effects of the main variables and, second, no significant effect arising from these additional variables. Solely the effect of the variable *imitation concerns* slightly increased and, thereby, passed the 1%-significance level (H3, $\beta = -0.17, p \leq .01$).

Next, I divided the sample into two groups based on whether the respondents had prior investment experience with CVC units or not. Due to the reduced sample sizes ($n = 62$ and $n = 49$), I concentrated on the main variables in these analyses. Model (3), which presents the results for the subsample of angel investors exhibiting no investment experience with CVC units, delivers several interesting insights. First, although being only statistically significant at the 10%-level, the variable *increased awareness* seemed to have a positive impact on the preference formation among these angel investors ($\beta = 0.18, p \leq .10$). Second, the effect arising from the variable *imitation concerns* appeared to be strongly pronounced within this subsample ($\beta = -0.24, p \leq .01$). Lastly and contrary to my expectations, Model (3) indicates that the variable *organizational*

Table 4.6: Regression results.

Model	(1)	(2)	(3)	(4)
<i>Independent variables</i>				
Increased awareness	0.06	0.04	0.18*	-0.12
Social capital	0.47***	0.46***	0.55***	0.46***
Imitation concerns	-0.16**	-0.17***	-0.24***	-0.08
Organizational obstacles	-0.21*	-0.22*	-0.11	-0.42**
Sector focus	0.07**	0.06**	0.10***	0.00
Funding requirements	-0.34***	-0.38***	-0.43***	-0.08
<i>Control variables</i>				
Age		0.01		
No. of investments		0.03		
CVC experience		-0.06		
CVC higher price		0.17		
<i>Constant</i>	2.54***	2.28***	1.80**	3.92***
<i>N/n</i>	111	111	62	49
<i>F</i>	11.08***	7.09***	9.04***	4.41***
<i>R</i> ²	0.39	0.42	0.50	0.39

Method: OLS regression. Dependent variable: *perceived attractiveness*.

* $p \leq .10$, ** $p \leq .05$, *** $p \leq .01$.

obstacles did not have a significant effect on the perceived attractiveness of CVC units among these respondents ($\beta = -0.11, p > .10$). Moreover, the variable *funding requirements* was associated with a strong decline in the dependent variable *perceived attractiveness* ($\beta = -0.43, p \leq .01$).

Model (4), which comprises the subsample of angel investors who had investment experience with CVC units emerging from former (co-)investments, shows a different picture. As for the other subsample of angel investors, the attitude of these angel investors was significantly influenced by the variable *social capital* ($\beta = 0.46, p \leq .01$), which meets the general expectation (H2). I found that the variable *imitation concerns* has a comparatively low, statistically insignificant impact on the perceived attractiveness of CVC units in this subsample ($\beta = -0.08, p > .10$). Surprisingly, the variable *organizational obstacles* influenced their attitude towards CVC units ($\beta = -0.42, p \leq .05$). My expectation was that angel investors, who had investment experience with CVC units, would actually be less influenced by organizational aspects. The effect of the variable

funding requirements was not significant in this analysis ($\beta = -0.08, p > .10$).

4.6 Discussion

4.6.1 Discussion of results

In this study, I explored multiple factors that influence the attitude of individual angel investors towards the group of CVC units. The empirical results presented in the previous section largely support my hypotheses. An increased awareness of the presence and growing role of CVC units seems to be insufficient to make them generally more attractive from the viewpoint of individual angel investors, which complies with the relationship-building theory of Dwyer et al. (1987). Only in the subsample of angel investors, who had no investment experience with CVC units, the effect of this factor turned significantly positive at the 10%-level. A potential explanation for this finding is the ‘mere-exposure effect’ on preference formation (Zajonc, 1968), which appears to be more pronounced in this subsample. I conclude that this factor has no lasting effect on the preference formation of angel investors, because it becomes less decisive as the investment experience with CVC units increases.

I argued that angel investors optimize their function as ‘network brokers’ (Madill et al., 2005) by collaborating with those institutional VC investors associated with a high level of social capital. I reasoned that the relational dimension of VC investors’ social capital, i.e., their reputation and trustworthiness (Granovetter, 1992; Nahapiet & Ghoshal, 1998), influence the expected net benefits of collaborating with them. The results demonstrate that the attitude of angel investors towards CVC units crucially depends on the social capital that they attribute to this investor group. Overall, I can thus support prior research that emphasized the vital role of social capital in the decision-making of angel investors (Ding et al., 2015; Fairchild, 2011; Sørheim, 2003).

In accordance with prior research, I established CVC investments as a possible instrument of established corporations to access and absorb critical knowledge from start-up companies in order to imitate their innovations (Basu et al., 2011; Dushnitsky & Lenox, 2005b). As a result of these imitation concerns, and because angel investors attach particular importance to their partners’ trustworthiness (Fairchild, 2011; Sørheim, 2003), I argued that their attitude may be influenced by this factor and delivered empirical evidence for this prediction. I found those angel investors, who showed no investment experience with CVC units, to be especially driven by these concerns. This result is interesting due to the arguments brought forward in Section 4.3.3 against the view that imitation concerns are an issue that particularly arises with CVC units. Hence,

my results show that imitation concerns may constitute an obstacle for CVC units when trying to build relationships with angel investors.

The much-discussed organizational obstacles of CVC units that arise from their affiliation with a large, established corporation, indeed influence the perceived attractiveness of CVC units from the viewpoint of angel investors. Although these issues have already been identified and described in the early stages of CVC research (Siegel et al., 1988), and many established corporations have separated their CVC units from corporate structures and processes (Weiblen & Chesbrough, 2015) to grant them the necessary autonomy and flexibility to fit into the entrepreneurial ecosystem, this factor still seems to play an important role when considering to cooperate with CVC units. Interestingly, and contrary to my expectations, the effect arising from this factor is even more pronounced for angel investors showing investment experience with CVC units. This leads to the conclusion that these angel investors may have made differing experiences with CVC units regarding this issue, resulting in distinct effects on their attitude towards this investor type.

I discussed that the value-adding activities of angel investors and CVC units may, at least partly, substitute each other, resulting in a lower perceived attractiveness of CVC units from the perspective of angel investors. In particular, I argued that the substituting effect is more pronounced for angel investors acting in a limited number of sectors. Similarly, I assumed that angel investors who invest in a broad range of sectors, including those that lie outside their fields of expertise, are more attracted by CVC units due to the complementary capabilities CVC units may provide in unfamiliar sectors. The results suggest that a wider sector focus is indeed associated with a higher perceived attractiveness of CVC units. Interestingly, this factor had no effect on preference formation in the subsample of angel investors having investment experience with CVC units. This factor is, hence, more important from an *ex ante* point of view when angel investors initially assess the expected net benefits of collaborating with CVC units.

I found large support for the hypothesis that the higher the funding requirements of CVC units are perceived by angel investors, the more negative is their attitude towards them. I reasoned that high funding requirements reduce the prospects of receiving CVC funding and, hence, diminish the net benefits of approaching them *a priori*. To further examine if the perceived high requirements of CVC units are related to the start-up companies' development stage, I added an item to the survey asking the respondents to state whether they believe that CVC units invest earlier than IVC investors or vice versa. I found that angel investors who perceived the funding requirements of CVC units as especially high also tended to believe that CVC units invest at later stages than IVC investors, $r(109) = .37, p \leq .01$. As a consequence, the perceived high funding

requirements of CVC units seem to be related to the development phase of potential investment targets, i.e., their product development stage, number of employees, sales volume, etc. (MacMillan et al., 2008).

In order to check my results for robustness, I controlled for the respondents' targeted sectors, overall investment volumes, contact frequency with CVC units, as well as their motives for investing. I found neither remarkable changes in the described main effects nor significant effects arising from these additional variables. Next, in all of the analyses above, I did not include *single* complementary capabilities of CVC units and their parent corporations, such as their access to pilot customers as well as marketing and distribution channels. I regarded these capabilities as company- and situation-specific factors which do not affect the general attitude towards the group of CVC units (Park & Steensma, 2012). In order to test if this assumption was correct, I included two additional items in the survey: The respondents were asked to assess whether (1) start-up companies benefit from the technological support provided through CVC units (Wang & Wan, 2013), and (2) start-up companies profit from the brand name of CVC units' parent corporations (Chemmanur et al., 2014). As expected, both factors showed insignificant effects on the dependent variable *perceived attractiveness*, regardless of the regression specification.

Lastly, I conducted Ramsey's omitted variable regression specification error test (RESET) for all regression specifications presented in Section 4.5.2 (Ramsey, 1969). For all models, I was able to maintain the null hypothesis that "the model has no omitted variables" (Uy, Foo, & Song, 2013). Taken together, I see no reason to believe that the results are significantly biased due to omitted variables. Moreover, I conducted Harman's single factor test (Harman, 1967) to address the issue of common method variance. When reviewing the unrotated factor solution in a joint PCA, i.e., including all items presented in Section 4.4, no single factor emerged that explained the majority of the variance in the data (Uy et al., 2013). Hence, common method variance was no substantial threat to this study.

4.6.2 Theoretical implications

This study widens the scope of CVC research by examining this topic through the lens of angel investors, a yet unexplored perspective. I motivated this change of perspective by building on social network theory, which regards entrepreneurship as being dependent on interconnections between all participating parties (Aldrich & Zimmer, 1986). For the purpose of linking angel investors and CVC units, this study bridged the conceptual gap between these actors by emphasizing the complementary roles they

may play in the market for start-up funding. Because CVC units aim to obtain technological insights at an early point in time to preempt competing actors in the formal VC market, I established angel investors as a valuable source of deal referrals for CVC units. Based on these initial considerations, I proposed multiple factors that potentially influence the general attitude of angel investors towards the group of CVC units.

My work improves our theoretical understanding of how angel investors select potential investment partners. While prior research qualitatively examined the role of social capital in angel investors' decision-making (e.g., Sørheim, 2003), I used a quantitative research approach to investigate, and confirm, the influence of this central construct on their preference formation. Furthermore, the fact that angel investors' attitude towards CVC units crucially depends on the imitation concerns associated with investor group strengthens our knowledge of the importance of trust issues in angel investors' decision-making (Fairchild, 2011). This essay also adds to the research that regards institutional VC investors and angel investors as substitute sources of capital (Hellmann et al., 2017), particularly by showing that angel investors with a narrow sector focus are generally less attracted by CVC units.

The relationship-building theory of Dwyer et al. (1987) served as the theoretical foundation of this essay. Although this theory was originally intended to picture the dynamics in concrete relationship-building situations between individual actors, I found its theoretical implications to be also applicable to a more general context in which individual angel investors consider the population of CVC units as potential transaction partners. My results confirm main insights gained from this theory, e.g., by delivering empirical evidence that the mere awareness of potential transaction partners appears to have no effect on the perceived attractiveness of CVC units. The idea of Dwyer et al. (1987) that potential business partners undergo an exploration phase, during which they evaluate the costs and benefits of an eventual transaction, proved helpful in disentangling the different factors that drive the attitude of angel investors towards CVC units.

In order to develop the measures that have been used in the exploratory regression analysis, I applied PCA as described in Section 4.4. The results of these exploratory analyses yield several interesting implications for theory and thus merit a brief discussion. First, when constructing the social capital scale, I included items that addressed the structural as well as the relational dimension of social capital as described in 4.3.2, and indeed found them to be two aspects of the same factor (Granovetter, 1992; Nahapiet & Ghoshal, 1998). Moreover, I identified the perceived level of ability attributed to CVC investment managers as a further attribute of their social capital. This is in accord with previous research emphasizing human capital as an enabling dimension of social capital (Adler & Kwon, 2002; Sørheim, 2003). Furthermore, while existing

research in this field applied the concept of social capital mostly at the individual level (Brüderl & Preisendörfer, 1998; Hallen, 2008) or at the firm level (Alexy et al., 2012), this study demonstrates that it is also applicable at the population level. Second, the exploratory analyses indicated that organizational concerns about CVC units regarding their processes and agility, embeddedness in their parent corporations' structures, risk propensity, and organizational culture, could be condensed into a single scale. All of these organizational issues associated with CVC units appeared to be related to each other and were, therefore, included into a single scale.

4.6.3 Managerial implications

This study yields multiple practical implications, in particular by helping CVC investment managers recognize angel investors as a valuable partner in the entrepreneurial ecosystem. The mere awareness of the presence and growing efforts of CVC units in the VC market appears to be insufficient to make them more attractive from the viewpoint of individual angel investors. Hence, established corporations are ill-advised to rely solely on their financial resources and the public awareness raised by their initiatives to position themselves in the entrepreneurial ecosystem. I demonstrated that CVC units may have to overcome general concerns that other major investor groups, like angel investors in this study, may have towards them. I derive five important practical recommendations from this essay that may help corporate investors to build relationships with angel investors and thus, to access the early-stage entrepreneurial ecosystem:

1. *Build social capital.* Entrepreneurship is a process in which social relationships between the various key players (entrepreneurs, investors, universities, etc.) play a crucial role (Aldrich & Zimmer, 1986). I encourage CVC investment managers to invest time and money in relationships with other players in order to build the necessary social capital and thus, to attract potential investment partners, such as angel investors (Sørheim, 2003). Managerial actions to build social capital may comprise visiting or hosting start-up competitions, participating in social events with founders and other investors, or recruiting experienced investment managers with large professional networks.
2. *Clearly communicate the investment objectives.* The attitude of angel investors towards CVC units depends on whether they believe that corporate investors misappropriate crucial knowledge or not. CVC investment managers may overcome these concerns by clearly communicating the objectives behind their investment

activities as well as by always acting in the best interest of their portfolio firms, thus building credibility over time.

3. *Provide CVC units with organizational autonomy.* Angel investors that perceive CVC units as being strongly dependent from their parent corporations are less attracted by this investor group. One way to deal with this is to grant CVC units the necessary autonomy from their parent corporations (e.g., through a separate legal structure, geographic distance, etc.) (Weiblen & Chesbrough, 2015). This could give CVC units the ability to signal independence from the corporate environment.
4. *Clearly communicate the funding requirements.* The perceived high funding requirements of CVC units may discourage angel investors to offer deal referrals to them. CVC units must, hence, find ways to articulate their willingness to invest in young start-up companies. CVC investment managers may consider collaborating with accelerators, angel investor networks, and similar institutions, to build a reputation as favorable early-stage investors.
5. *Angel investors' experience with CVC units matters.* The results indicate that the concerns about CVC units differ among angel investors, depending on whether they have prior investment experience with them or not. The attitude of 'inexperienced' angel investors seems to be more driven by imitation concerns and the perceived high funding requirements of CVC units. In contrast, the attitude of 'experienced' angel investors appears to be more affected by concerns about the organizational setup of CVC units. Hence, organizational concerns become obviously more decisive as investment experience with CVC units increases. This may be due to the heterogeneity among CVC units and the resulting disparity in the experiences made with them. With regard to imitation concerns, the empirical evidence demonstrates that 'experienced' angel investors are less concerned about this issue.

4.6.4 Limitations, future research, and conclusion

This study is subject to several limitations, which may serve as anchor points for future research examining the attitude towards the group of CVC units in the entrepreneurial ecosystem. The goal of this study was to set up an exploratory empirical model. In order to develop the measures of interest, I applied PCA as described above. The next step for further ensuring construct validity and reliability would be to conduct a confirmatory factor analysis, ideally with a larger set of items, on a different sample (Sieger et al., 2016). From the perspective of scale development theory, this study delivers a

valuable initial set of items that may serve as a foundation for future research. Due to the exploratory nature of the regression analysis and the absence of instrumental variables, endogeneity concerns cannot be fully eliminated. Future studies may address these concerns by including instrumental variables.

With respect to the measures of the perceived social capital of CVC units and their organizational obstacles, I encourage future research to further unfold these factors and disentangle the effects of their different constituents. For example, it would be interesting to examine whether the relational characteristics (i.e., reputation and trustworthiness) of CVC units' social capital are more important to angel investors than the structural characteristics (i.e., number and strength of connections) (e.g., Weber & Weber, 2007). The same holds true for the organizational obstacles of CVC units: Is the perceived lack of agility of CVC units more important to angel investors than the risk aversion associated with this investor group? Conjoint experiments may be a suitable research method to answer these questions in future studies. Furthermore, I conducted sampling methods leading to a so-called 'convenience sample', i.e., a sample that is not truly randomly generated (Avdeitchikova et al., 2008). Because I drew from a diverse sample of angel investors, generated through different sampling methods, I believe that this circumstance was no significant threat to this study. I motivate future research to further examine the interconnection of angel investors and CVC units using international samples.

To conclude, this study investigated multiple factors that affect the overall attitude of individual angel investors towards the group of CVC units. In doing so, it accomplished the necessary and overdue change of perspective in CVC research (Dushnitsky, 2012). The results indicate that angel investors may have several concerns regarding the group of CVC units. These relate to their social capital, misappropriation of innovative ideas, organizational obstacles, complementary capabilities, and funding requirements. It is important to note that the purpose of this study was not to drive IVC investors and CVC units apart by emphasizing CVC units' potential interest to collaborate with angel investors and to preempt IVC investors. I demonstrate that there are other players in the entrepreneurial ecosystem, such as angel investors, that may serve CVC units in fulfilling their overarching mission of being their parent corporations' window on new technologies. Overall, I encourage future research to deepen the understanding of suitable measures of CVC units to attract external parties in the entrepreneurial ecosystem and establish prosperous relationships with them.

Chapter 5

Conclusion

5.1 Summary of research findings

In this dissertation, I addressed three important gaps in the literature on CVC. In Essay I, I enhanced the understanding of the link between CVC and the real options theory. Prior research connecting these domains is mainly empirical and based on general insights drawn from the real options theory when predicting the investment behavior of corporate investors (e.g., Basu et al., 2011; Tong & Li, 2011). I complemented the existing literature by providing a formal, real options-based model framework that is tailored to the specific features of CVC, as it includes central strategic considerations of corporate investors (Chesbrough, 2002; Hellmann, 2002). I found that my model framework has substantial explanatory power. In particular, it is capable to explain (1) why corporations often acquire equity shares in start-up companies at a premium (Gompers & Lerner, 2000), (2) why CVC-backed start-up companies are riskier (Chemanur et al., 2014), and (3) why CVC-backed start-up companies are more likely to go public and less likely to be liquidated than IVC-backed start-up companies (Gompers & Lerner, 2000; Ivanov & Xie, 2010).

In Essay II, I investigated the decision-making behavior of entrepreneurs when considering to collaborate with corporate investors. Prior research on CVC strongly focuses on firm-level parameters and does not explicitly analyze the individuals that operate the start-up companies under consideration (Basu, Wadhwa, & Kotha, 2016). Using data gathered in a metric conjoint experiment and applying hierarchical linear modeling, I found that the capacity of corporate investors to give their investees access to market-related resources (e.g., marketing channels and customers) has the strongest effect on entrepreneurs' propensity to partner with them. Surprisingly, whether CVC units employ experienced investment managers or not is of considerably lower importance to entrepreneurs. My results also suggest that two personal characteristics of entrepreneurs, namely entrepreneurial self-efficacy (ESE) and risk propensity, af-

fect their willingness to partner with CVC units. In particular, entrepreneurs showing higher levels of ESE or a higher risk propensity are substantially less willing to partner with CVC units. Moreover, I found that entrepreneurs with a higher degree of ESE place markedly more emphasis on the autonomy of CVC units from their parent corporations' operations and strategic interests, thus demonstrating moderating effects of ESE. This essay gives us an improved understanding of the dynamics involved in the decision-making of entrepreneurs when they consider CVC units as potential investors. My work helps corporate executives to successfully install and operate CVC activities within their organizations.

In Essay III, I examined the relationship between CVC units and angel investors. In particular, I drew from survey data and identified factors that influence the general attitude of individual angel investors towards corporate investors. I found that the level of social capital that angel investors assign to CVC units strongly affects their attitude towards this investor group. In addition, imitation concerns and certain organizational issues that angel investors associate with corporate investors substantially influence the attractiveness of CVC units as perceived by angel investors. I also found that angel investors targeting a wide range of sectors are more attracted by CVC units. Angel investors are less attracted by CVC units when they perceive the funding requirements of CVC units as particularly high. The essay gives scholars and corporate executives a better understanding of the specific factors that drive the attitude of other investor groups towards CVC units (e.g., Dushnitsky, 2012). The results show that CVC units have to overcome general concerns associated with them when interacting with other key players in the entrepreneurial ecosystem.

5.2 Avenues for future research

This dissertation makes important contributions to the field of CVC research. Yet, there are questions in need of further investigation. To begin with, the model framework presented in Essay I suggests that CVC units that pursue strategic objectives may be willing to sponsor different start-up companies (e.g., start-up companies that bear higher technological risk) and to invest under different contractual terms (e.g., a smaller equity stake) than IVC investors. Future empirical studies might explore if these and other model predictions prove to be true when analyzing large, international samples. Future formal work connecting CVC and the real options theory could include additional features that I did not consider to keep the complexity of the model manageable. These additional features could comprise investor syndicates and portfolios of firms rather than single investment targets, as well as competition among different

investors across all financing rounds. Furthermore, I encourage scholars to develop metrics that better capture the monetary value of the strategic benefits that established corporations derive from CVC investments, such as the value of learning benefits (e.g., Bassen et al., 2006).

Another possible area of future research is to further validate and extend the analysis presented in Essay II. It would be interesting to investigate how pecuniary aspects, i.e., the valuation of start-up companies, affect entrepreneurs' decision-making in a similar conjoint experiment. Furthermore, as I found direct and moderating effects of both personal characteristics under consideration, namely ESE and risk propensity, it would be very interesting to examine the effect of other personality constructs, such as entrepreneurial opportunity recognition (e.g., Mccline et al., 2000). While the direct effect of risk propensity was significant in the conjoint experiment, I found no significant effect of this personal characteristic in an additional analysis in which I used a self-developed scale that measured the perceived attractiveness of CVC units as the dependent variable. Future studies may further validate the effect of entrepreneurs' risk propensity on their willingness to partner with CVC units.

Essay III unveils several pathways for future scholarly work on CVC. In the empirical analysis, I applied scales that were based on insights derived from exploratory data analyses. Researchers may further validate these exploratory scales using confirmatory factor analysis. Furthermore, my results may be biased due to several issues that often arise with survey data, such as post hoc rationalization (e.g., Brundin et al., 2008). Future studies may address these concerns by using different methodologies that do not show these biases, such as conjoint experiments. Also, it would be very interesting to investigate which dimension of social capital, i.e., the structural or the relational dimension, is more important to angel investors. Again, conjoint experiments may be useful in answering such questions, as they allow researchers to divide broad theoretical constructs into their different components. Lastly, as I drew from data collected in Germany, I motivate researchers to use international samples in future studies.

5.3 Concluding remarks

This dissertation offers important contributions to the literature on CVC. It provides researchers with new knowledge on (1) the link between CVC and the real options theory, (2) the subtle factors that drive entrepreneurs' willingness to partner with CVC units, and (3) the crucial determinants that influence the attitude of angel investors towards CVC units. I showed why CVC units differ from IVC investors with regard to their investment decisions and, thereby, delivered new explanations for former

empirical results. I demonstrated that entrepreneurs consider the availability of complementary resources most important when partnering with corporate investors, and that certain personal characteristics of entrepreneurs influence their decision-making. Lastly, I widened the scope of CVC research by examining the perspective of angel investors and delivered empirical evidence that they place considerable emphasis on the level of social capital of CVC units. In this dissertation, I give researchers and corporate executives an enhanced understanding of the topic of CVC by discussing the various theoretical and managerial implications of the different essays in-depth. I encourage researchers to address the theoretical implications and limitations of my work in future studies on the subject of CVC. Finally, I strongly recommend corporate executives to consider the various managerial implications when setting up and operating CVC investment programs.

Appendix

A. Scenario description (as presented to the respondents prior to the conjoint tasks)

Note: The German version is available on request.

Please consider the following scenario for the start-up company **that you are currently mainly working for**. In order to realize your growth potential, you receive financing offers from different CVC units. CVC units are the venture capital arms of established corporations ('parent corporations'). Assume that ...

- the parent corporation of the respective CVC unit is active in the same, or in a closely related sector, like your start-up company,
- all financing offers represent minority interests,
- all financing offers meet your requirements regarding the investment size, assigned equity shares, and (control) rights of the respective CVC unit.

B. Explanation of CVC investor attributes (as presented to the respondents prior to the conjoint tasks)

Note: The German version is available on request.

Operational autonomy of the CVC unit from the parent corporation

- **Yes:** The CVC unit is independent of the organizational structures and processes of the parent corporation.
- **No:** The CVC unit is integrated in the organizational structures and processes of the parent corporation.

Strategic autonomy of the CVC unit from the parent corporation

- **Yes:** The parent corporation does not interfere in the actions of the CVC unit due to strategic interests.
- **No:** Next to the interests of your start-up company, the CVC unit also considers the strategic interests of the parent corporation.

Venture capital experience of the CVC investment managers

- **High:** The majority of the CVC unit's investment managers have formerly been employed at IVC investors. Furthermore, the CVC unit has already made syndicated investments with IVC investors in its current team structure.
- **Low:** The majority of the CVC unit's investment managers have a corporate background. Furthermore, the CVC unit has only made a few syndicated investments with IVC investors in its current team structure.

Access to marketing and distribution channels

- **Yes:** You have access to the marketing and distribution channels of the parent corporation. If your start-up company pursues a business-to-business model, your start-up company also has access to internal sales markets.
- **No:** You have no access to the marketing and distribution channels of the parent corporation. If your start-up company pursues a business-to-business model, your start-up company does not have access to internal sales markets.

Access to functional and technological support

- **Yes:** The parent corporation supports you functionally and technologically in further developing your product and service offerings.
- **No:** The parent corporation does not support you functionally and technologically in further developing your product and service offerings.

Exit opportunity through acquisition by the parent corporation

- **Yes:** A later acquisition of your start-up by the parent corporation at a fair price is likely, if you accept the offer.
- **No:** A later acquisition by the parent company is unlikely, even if you want to sell your company.

C. Entrepreneurial self-efficacy (ESE) scale developed by McGee et al. (2009), measured with 7-point Likert-type items (1-'no confidence'; 7-'high confidence') (p. 978)

Note: The German version is available on request.

"Searching-(How much confidence do you have in your ability to ... ?)

... Brainstorm (come up with) a new idea for a product or service

... Identify the need for a new product or service

... Design a product or service that will satisfy customer needs and wants

Planning–(How much confidence do you have in your ability to ... ?)

- ... Estimate customer demand for a new product or service
- ... Determine a competitive price for a new product or service
- ... Estimate the amount of start-up funds and working capital necessary to start my business
- ... Design an effective marketing/advertising campaign for a new product or service

Marshaling–(How much confidence do you have in your ability to ... ?)

- ... Get others to identify with and believe in my vision and plans for a new business
- ... Network–i.e., make contact with and exchange information with others
- ... Clearly and concisely explain verbally/in writing my business idea in everyday terms

Implementing-people–(How much confidence do you have in your ability to ... ?)

- ... Supervise employees
- ... Recruit and hire employees
- ... Delegate tasks and responsibilities to employees in my business
- ... Deal effectively with day-to-day problems and crises
- ... Inspire, encourage, and motivate my employees
- ... Train employees

Implementing-financial–(How much confidence do you have in your ability to ... ?)

- ... Organize and maintain the financial records of my business
- ... Manage the financial assets of my business
- ... Read and interpret financial statements”

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